The ENVIRONMENT

Questions for Learning

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Illustrated by Merlin A. Currie

This book has been ten years in the making.

It started from small seeds – little ideas that were shared with practitioners to improve their approaches to interdisciplinary learning. From those scattered seeds, a mighty tree has grown – as depicted by the beautiful illustration on the front cover.

The author has generously shared this book so that as many people in Scotland, and around the world, can benefit.

The only ask of those who engage with the book is that they, in turn, create ideas of their own to share with others.

The journey of the seeds must continue, for they must become a forest if we are to build a more sustainable and equitable world for all.

With thanks to Karen for her inspiration and generosity of spirit.

Revised by Dilys Rose.

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The Environment: Questions for Learning

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PREFACE

I was born and raised in a small town in the South of Scotland where my Dad's family had lived for several generations. Nevertheless my background is not entirely rural since my Mum was born in Edinburgh and our family frequently visited the big city to stay with relatives. After qualifying as a lawyer, she was undecided as to which area of the law she wanted to specialize in and asked her father's advice (he was also a lawyer, in the civil service). He suggested that she should start work in a small rural practice, because if she had to deal with everything, she would be able to work out which area interested her more. However, after moving to a rural community to practice law, my Mum met my Dad, so she did end up having to deal with everything, plus three children, for the rest of her life.

We travelled to Edinburgh fairly regularly to visit family and I also lived in Edinburgh for 8 years while I studied at University, then worked there as a research assistant when I met my husband, a Brazilian teacher of English who was studying for his Master's degree. We moved to Brazil in 1979 and have lived there ever since. I home-schooled my two children for several years and became involved in multiple projects related to in-service training for public school teachers. Then, when my children were 12 and 14 respectively, all three of us decided to enter the education system. A year later, I found myself temporarily in charge of approximately 75 public schools in the rural municipality of Domingos Martins in the state of Espírito Santo, Brazil (1995-1997). A tremendous challenge and a fascinating experience – I have never learned so much in such a short space of time.

When I first met with the teachers in regional meetings throughout the municipality, I asked them what their main problems were (apart from their tiny salaries and long working hours with very little infrastructure) and the majority wanted to understand more about the practical aspects of interdisciplinary teaching since they had only read a few theoretical articles, but had learned nothing about possible practical applications. So after long discussions and much hard thinking, I decided to work with a few colleagues, who helped me out with some of the research, in order to put together some teaching ideas for the whole year using environmental studies as the main theme. Every month I would write down suggestions for interdisciplinary teaching. We would Xerox copies

for all the primary teachers teaching the first 4 years of school, and at the end of the month I would meet up with all of the teachers, organized into different regional groups, so that we could discuss what had been tried out, what had worked, and what had caused problems. And of course these discussions would affect the writing of suggestions for the following month. However, in my opinion, it was not simply the written proposals which were responsible for the success of this process. Teachers brought samples of the work their students had produced to each of the regional meetings – and as each one shared their classroom experiences, everyone present was able to appreciate the possibilities which were being explored by their colleagues. The visual evidence of the work students had produced, together with the personal explanations of the teaching strategies, were much more convincing than the written word which simply offered initial ideas.

At the end of the year, when my good friend, Euzi Moraes, Secretary of Education for the State of Espírito Santo at that time, asked to see the collection of ideas, she suggested that I should publish what I had written in book form. The result was the book *'Meio Ambiente: interdisciplinaridade na prática'*[1], published by *Papirus* in 1998, reaching its 12th edition in 2012 and appearing as an e-book in 2013.

Throughout the years, many friends and relatives asked me to translate this book into English, but other priorities always seemed to nudge this particular project to the end of the line. However, when I finally sat down to start the 'translation' process, I decided that the book was very strongly contextually constrained. It was written for a specific audience and most of the examples focused on familiar topics for this audience. Consequently, I decided to use the basic structure of the original book but wrote a new book for a different audience, using my personal knowledge of the rural South of Scotland and the city of Edinburgh as sources for some of the exemplification, as well as my accumulated experience and reading related to more global topics.

Faced with an uncertain future for our species and innumerous proposals for the necessary measures to be taken, it is vitally important that collaborative teaching and learning for wellbeing and sustainability should be promoted across the curriculum at all stages of teaching and learning so that appropriate educational decisions can be taken to suit the particular aspects of specific groups and circumstances.

[1] 'Environmental Studies: Interdisciplinarity in practice'

I hope that the initial dialogue between reader and writer does not finish here. I would like to imagine that readers of this book will try out some of these ideas in practice, or, even better, will be stimulated by some of the proposed ideas to come up with unique possibilities of their own. As we share our own thoughts and experiences, I hope we begin to perceive how difficult it is to limit our teaching, or our sustainable practices, to the restricted domain of a single discipline, since life in the real world is essentially inter-, multi- or transdisciplinary. In this way, interdisciplinary or transdisciplinary teaching and learning may become more widely accepted as the major component of formal education so that students can be prepared more effectively for an ever more interdisciplinary or transdisciplinary world.

INTRODUCTION

There are several important strands which permeate this book. One of them is related to theoretical aspects involved in the teaching-learning process. For example, to what extent are we focusing our teaching on the learning of content? How relevant is the content we are teaching? What should we be teaching and how should we be teaching it? What does it mean to teach for change? How has the recent pandemic COVID19 transformed our thinking and forced us to reconsider what we need to know and how we may be able to learn? How much do we know about the learning process? How are we applying this knowledge in diverse learning situations? What are the most effective options which stimulate our inner motivation to drive us towards successful learning?

A second strand comes from my passion for the natural environment and my growing concern about the possible future of human life on Earth. How much do we know about our local environment and how does it connect to the planet as a whole? How can we best preserve existing animal, vegetable and human life on Earth? And the final strand asks what each one of us can do to improve the current situation of the global environment? How can individuals join forces effectively to work towards a more sustainable planet? The main aim of this book, therefore, is to promote strong personal connections to global environmental problems through interactive dialogue and collaborative investigation. For this reason many of the references and explicit examples are based on the author's personal knowledge of Scotland.

The book has 7 chapters and starts off with fairly simple themes to stimulate readers to make meaningful connections between themselves and their immediate environment, exploring topics such as 'my body', 'my food', 'my water' and 'my rubbish' (Chapter 1). These themes are developed further in subsequent chapters as they involve teaching and learning ideas related to the family (Chapter 2) and the school environment (Chapter 3), while Chapter 4 asks readers to consider the history, geography and ecosystems of their local community. Chapter 5 investigates connections between cultural aspects of the municipality and its natural environment while considering possibilities for a more circular economy, then chapter 6 relates environmental studies of 'my country' to the themes 'critical thinking and adaptation', 'collaboration and

taking action', 'communication and creativity', adopting a holistic approach to education with a Scottish focus[2].

The seventh and final chapter makes clear personal connections to the global environment using the basic themes 'soil', 'water', 'air' and 'people'. This is the longest chapter in the book, and is the culmination of a deliberate movement from more straightforward suggestions for teaching and learning at the beginning of the book, to more complex collaborative proposals as the text develops. Nevertheless, most of the suggestions and illustrations throughout the book make robust connections between the topics in question and the learner's personal knowledge, experience, and interest areas, in an attempt to inspire the necessary intrinsic motivation to invest in long-term actions which are indispensable for the continuation and wellbeing of the environment where we live.

I have distributed several theoretical elements of my discussion throughout the various chapters, but there is a more detailed examination of specific concepts in each chapter. Thus, in the first Chapter, I include explicit information related to storytelling and also make connections between environmental studies and the different content areas proposed in 'A Curriculum for Excellence – building the curriculum 3-18 (1)' published by Education Scotland in 2006 and applied in schools as from 2010. At the end of this chapter I discuss possible objectives which teachers may choose to develop as they investigate various topics suggested throughout the book.

In Chapter 2, I start off by presenting Sugata Mitra's investigations related to Self-Organizing Learning Environments (2010, 2018) since I believe that many of the principles which seem to be operating in his experiments, such as collaboration and communication in small groups, can also be applied to the majority of the suggestions proposed throughout this book. For this reason, in Chapter 3, I expand the discussion of the four key elements Collaboration, Communication, Creativity and Critical Thinking, which the 'Partnership for 21st Century Learning' believes to form the basis of innovative teaching and learning (PLUCKER, 2015a, 2015b). These concepts can be developed explicitly within the school environment but are also easily applicable to all areas and levels of teaching and learning.

[2] Thanks for this phrase Dilys!

Chapter 4 offers more explicit suggestions related to possible inter- or transdisciplinary investigations[3] as the historical, cultural, geographical, geological, hydrological, and environmental aspects of the local community are explored. Interdisciplinary teaching or learning refers to the connections which can be made between various disciplines through integration and cooperation, whereas a transdisciplinary approach transcends the disciplinary structure of knowledge, challenges the fragmentation of knowledge and often involves context-specific negotiation and application of knowledge (LAWRENCE, 2010).

In Chapter 5 I explore local government and social organization, as well as the ways that our ancestors interacted with the environment to produce our cultural heritage. Students are encouraged to investigate the multicultural aspects of the region where they live, as I explore both biological and cultural diversity in 2 different municipalities of Scotland which I know well, one rural and one urban. I also include suggestions related to a more circular economy as applied to the development of tourism and to the treatment of e-waste, textile waste, as well as waste in general, in an attempt to help reduce current pressure on existing resources.

In Chapter 6, I revisit the four 'Cs', Creativity, Critical Thinking, Collaboration and Communication, presented initially in Chapter 3, but they are now linked to the importance of adaptation and taking action, as applied to the sustainable preservation and conservation of the environment of my native country, Scotland. More details about the critical thinking process include a 6-step problem-solving technique which can be applied to many topics, such as climate-change adaptation strategies related to energy efficiency, or taking action in areas such as food choices, health and wellbeing. I also emphasize effective communication as being essential for the creative, collaborative planning which forms the basis for effective innovative actions.

Finally, in chapter 7, I use information culled from several documents published by the United Nations as references, and relate a selection of Sustainable Development Goals (SDGs) to the main topics 'soil', 'water', 'air' and 'people'. The topic 'soil' includes an investigation of the relationships between poverty, hunger and the production and consumption of food, and also mentions the importance of indigenous peoples in

[3] I will use the term 'interdisciplinary' more frequently, although I will also be implying the addition of the term 'transdisciplinary' most of the time.

connection with these issues. The topic ‘water’ discusses basic water services; water-use efficiency; water pollution; the conservation of marine resources; and refers to the 2019 SDG Action Awards to illustrate several pivotal concerns. The third topic, ‘air’ concentrates on the air quality in cities while discussing air pollution and the ecosystem services provided by trees. Whereas the final topic ‘people’ emphasizes the promotion of inclusive societies and participatory decision-making, and I use children’s parliaments to exemplify this theme. These topics are all explored as I attempt to promote a dialogue between the concepts contained in the SDGs; information obtained from my reading; and my reader’s knowledge, ideas and opinions; as I suggest ways and means for further investigation in teaching-learning environments.

Conscious of the ever-expanding growth of digital access, I have included many direct quotes from other authors and official online documents from around the world to provide an easily accessible online library which readers can explore further to expand their knowledge in numerous directions of their choice. The book has been written in the first person using a conversational tone, and frequently uses open-ended direct questions to stimulate the reader to analyse possible avenues of independent and collaborative investigation. It is not an in-depth book on a specific subject area. The fundamental aim is to invite readers to make numerous connections between diverse subject areas as they explore environmental issues related to a wide range of topics in directions which are meaningful for them.

Given the growing interest in self-organized learning environments, there is also an increasing need for teaching proposals which focus on personal motivation and learning which may lead to beneficent collaborative actions. For this reason I have tried to instigate my dialogue with readers by asking innumerable questions which can be used to stimulate interest, and motivate students to become actively involved in their pursuit of knowledge. Effective questioning will often encourage learners to develop higher-order or in-depth thinking through asking them open questions related to content (*who, what, when, where*) and process (*how, why*), where a variety of answers are expected which usually lead to discussion, the sharing of divergent ideas, and inquiry-based learning. Thus, open questions are related to critical thinking and creative problem-solving (*What will happen in the future if the world population keeps growing?)*, whereas closed questions, which typically expect one ‘correct’ answer, are often used to

simply check students' content knowledge or memory (*When did the world population reach 7 billion?)*.

The book has been written for teachers, as well as readers in general, who are curious about the possibilities of interdisciplinary teaching and who may enjoy exploring innovative teaching and learning strategies related to sustainability practices in the classroom, in their own homes or in their local communities. Although the book makes many explicit references to Scotland, the reader is constantly invited to apply the author's explicit references to the reader's personal knowledge and interest areas. For this reason, I believe that the book should have general appeal.

CHAPTER 1

MY ENVIRONMENT

To guarantee the sustainable continuity of the human race, each one of us must become more fully aware of the environment which surrounds us and the effects of our individual choices and actions upon this environment. How does our daily life affect environmental issues? Are we handing out leaflets to promote a national campaign against wasting water – while brushing our teeth with the tap running? Are we complaining about the rising cost of food while buying excess amounts of ready-made meals and throwing away a considerable percentage of the food we buy? If we learn more about the immediate and long-term effects of our individual everyday actions and decisions we will be able to collaborate with our families, neighbours and local communities as we work towards a more sustainable future for human life on earth.

We can start by observing our own habits, choices and preferences, which will then be contextualized as part of the theme *'Family'*, which will in turn be considered as part of the *'Community'*, then as part of the *'Municipality',* until eventually we consider the environment of *'the Planet Earth',* conscious of the importance of the individual actions of each human being on the planet. Hopefully, by the end of the book, students, teachers and local communities will understand more about *"thinking globally while acting locally".*

Each theme forms a reference for teaching ideas which can be developed inside the classroom, in the home, in the local community or beyond. For instance, during the theme *'Me and the environment'*, teachers should always try to emphasize the role of each individual in the projects which students are pursuing. The suggestions which follow will be grouped into different topics in order to organize the proposed activities. Some of these topics will continue to be developed throughout the book.

Topics: ❁ *My name* ❁ *My body* ❁ *My food* ❁ *My plants* ❁ *My animals* ❁ *My rubbish* ❁ *My water*

How do we start?

There are various ways of starting up activities related to a specific theme. For example the teacher can read a story to the class, play some music, show them a piece of art,

introduce them to a game, ask the students to bring in something from home, get them to mime something and so on. There are many possibilities and I have decided to start off this journey of exploration by telling a story.

In 2013, storyteller Claire Hewitt was asked to create a monthly 'Tree Story' by the Forestry Commission for a Forest Education Initiative website as an Outdoor Education resource. Each story is related to the month with which its tree is connected in folklore. Hewitt (2013, p. 2) gives some tips for storytelling:

> If you wish to retell in the traditional way, 'Eye to Eye, Mind to Mind and Heart to Heart', then here's how. […] Tell yourself about the story – just the main points. […] You only need to remember the characters and the sequence of events – the skeleton / bare bones of the story. Now tell the skeleton of the story out loud without referring to the text. Just the simple basic plot. Relax and tell the story again. Flesh out the bones of the story and take time to make it your own. You will find your own natural way of telling this story in your own words […] a story has its own journey and its own rhythm. You are now ready to bring the story to life, for without people to hear the story it does not live. Put expression into the telling – use your face, hands and body language as you retell. It will shape and change as you get to know it and also change according to who is listening to you. Weave into it your own life's experiences. And as you share these stories, watch as they create wee seeds of inspiration in creating together new tales that are just waiting to grow.

The oral tradition of storytelling has been part of every known culture as a way to entertain, educate, instill moral values and preserve the culture, so it makes sense to incorporate storytelling as one of the strategies to explore any topic. I have selected the Oak Story, associated with the month of July in Clair Hewitt's collection, for various reasons. First of all, the oak tree is one of my favourite trees, strongly linked to my childhood. I vividly remember walking through local forests near my home town, glorying in the first signs of the fresh, green, early leafing, signaling that spring had arrived. Then later on, during the summer months, the majestic oaks seem to evoke such a vigorous sense of strength and permanence. And in the autumn they announce their hibernation in a blaze of colour (deep reds, fiery orange, golden yellow, amber, bronze, copper) as they cover the ground with their acorns. There was also a special oak tree fairly near my home, not a very big one, but with perfect, splayed branches for playing in and hiding in the foliage to read. I spent many happy hours in those branches.

Another personal connection to oak trees is the fact that my godmother, lifelong friend and dearest unsung hero, moved to the United States when she was a young woman and spent most of her life living in a small town called 'Thousand Oaks' near Los Angeles

where I visited her during several turning points in my life. Finally, as an adult, I married a Brazilian with the surname '*Carvalho'*, which means 'oak tree' in Portuguese, so my two children have the 'oak tree' surname.

There are therefore many strong family connections to the oak tree, many good reasons for choosing this particular tree. As teachers, it is always extremely important to make choices which are personally meaningful because we will then invest much more energy in our preparations, and our enthusiasm will shine through. Similarly, we need to guarantee choices for our students, so that they can also commit themselves to exploring topics which are significant in their lives. This helps guarantee their active involvement in the learning process.

So, having decided to start the topic *'the environment + me'* by telling a story about an oak tree, what is the next step? The story presents Little Acorn as being impatient to move on to the next phase in her life while Grandfather Oak keeps telling her to have patience and she will "see what she will see". So Little Acorn learns to observe her surroundings: "*The soft rays of the Spring Sun tickled her and she stretched her rooty toes down into the ground. And there she waited and she watched as the seasons passed and the world turned and the rain rained and the sun shone and wind whirled and burled all around.*" And as time passes, she eventually perceives that she has also become a strong adult tree. Can the students relate to this story? In what ways? Do they ever feel impatient to get ahead quickly? Is there someone in their family who tells them to 'wait', to 'take their time', 'everything will work out in the end'? How do they react to this advice?

Discussions about the students' thoughts, feelings and experiences could form the basis for sessions involving role-play, dramatic sketches, amongst other possibilities, since drama can help students to understand and express opinions, beliefs, and emotions which they may not have experienced in real life. Anthony Manna talks about *educational drama* as follows:

> When teachers harness drama's power with accurate learning outcomes, a precise structure, and appropriate drama techniques, drama activity can become a fertile method for integrating reading, writing, speaking, listening, researching, technology applications, and art experiences. Inside the imagined space that is drama's domain, students use their own lives and perceptions as a supply of ideas for taking on roles […] Drama inspires students to grapple with different – often opposing – points of view, beliefs and values, to play out alternate solutions to human problems and dilemmas

> […] *educational* drama is less a subject or special interest than it is an art that can serve as a viable learning medium. And like any thoughtfully planned classroom strategy, drama has the potential to maximize rather than limit instruction while it also supports students' emerging discoveries about content and concepts, the human condition, and themselves as creative makers of ideas in interaction with others. (MANNA, IN. DOWDY; KAPLAN, (eds.), 2011, p. 1-2).

Small groups could be formed to come up with different dramatic versions of selected themes. By investing in group work, students learn to express their own ideas, listen to different opinions, adapt and merge ideas from different sources to produce original 'group' ideas. These discussions can lead to a variety of products: written stories, poetry, plays; dramatic sketches with props, scene-painting and musical accompaniment; cartoons, picture stories or videos; an interpretation of the original story through dance; sculptures, collages or other expressive art forms using leaves, seeds, bark rubbings, etc. What other ideas pop into your mind as you are reading these suggestions? A great number, I'm sure.

Which ideas are more appropriate for the content areas being explored at this time? Which ideas appeal to specific groups of students? And which content areas or disciplines might be involved in the initial suggestion which started off by telling a simple story about an oak tree? I will use the eight different areas of learning proposed by Education Scotland in their publication 'A Curriculum for Excellence – building the curriculum 3-18 (1)' (2006) as a reference for suggestions. Students can be divided into groups according to their areas of interest, with each group choosing two or three curriculum areas to work on. As each group shares their work with the whole class, students will inevitably perceive a plethora of natural connections and relationships between the various content areas which will gradually lead to a more interdisciplinary perception of the learning process.

Content Areas

Expressive Arts: The Oak Story can be used to stimulate a variety of possibilities in the expressive arts. Students could write and perform a play or a musical based on their discussions about the story, using their ingenuity to set the scenes and producing the costumes using recycled materials. By stimulating students to create, present and evaluate their own work in art and design, drama, dance and music, they will learn to explore innovative opportunities for the expression of their innermost feelings and

concerns, and learn more about their colleagues and friends as they too express themselves through the arts.

Health and Wellbeing: How did Little Acorn transform herself into a tall, robust tree? What do acorns need in order to grow into strong healthy adults? How do we recognize whether trees are healthy or sick? Their roots push down deeply into the ground to draw up water and nutrients, how much water do trees consume and how much do they release into the atmosphere? How does this cycle compare with the human water cycle? How much do students know about the strong connection between humans and trees as we breathe in and out? Put very simply, when we breathe in, we use the oxygen from the air around us to fuel our bodies and when we breathe out we release carbon-dioxide into the atmosphere, whereas trees do the opposite. They use carbon-dioxide from the atmosphere and release oxygen into the atmosphere – a fascinating association between trees and humans. Clearly it's a good idea to have lots of trees nearby. How much strength do they need in order to delve down through the soil? Let's try to push a twig through the sand in a sandbox, then through the soil in the garden. Have students ever watched trees dancing in the wind? If they keep their feet anchored to the ground, how many 'tree' exercises can they do?

Languages: What is the etymology of the word 'oak'? Which modern languages have similar words for this species? Is the word 'oak' related to the word 'acorn'? What do the students know about the origin of their own names? How are their names related to their parents' names? Do any students in the class speak languages other than English? How would students' names be translated in these languages? Do they know anyone who speaks a different language? What is the translation for 'oak tree' and 'acorn' in these other languages? Which words seem to be related?

Apart from the historical investigation of language as students explore the etymology of specific words, they will also be investing in their understanding and effective use of language as they read about different topics, discuss their findings and write about their findings. Teachers will always guarantee oral and written communication in the classroom when they encourage students to investigate topics which interest them and share what they have learned.

Mathematics: Teachers could start exploring mathematical possibilities by asking students what <u>they</u> would like to know about oak trees. When students use their own

questions to initiate projects, they will invest much more effort and enthusiasm in their explorations and will be more committed to discovering the answers. Again, small groups could be formed round questions which interest specific students. For example: How many different species of oak trees are there? Where are they found? What is their growth rate? How long does it take to reach their maximum height and circumference? How do we measure the height, the circumference or the crown spread? How much water does an oak tree consume and release into the atmosphere at different times in their lives and at different seasons? How can we measure the perimeter or the area of the leaves? What's the difference between the measurements of a small leaf and a big leaf on the same tree? When an oak tree is cut down, what percentage of the tree is used for timber? How is this calculated? How much wood is wasted when trees are cut down to be converted into usable products? Has this percentage changed over the years? What are the students' mathematical questions that might prompt different lines of exploration?

Religious and Moral Education: Trees are important symbols in many religions, for example, in the Christian bible's Book of Genesis, there are two extremely important trees: the Tree of Life and the Tree of Knowledge. What is the difference between these two and how do they relate to the 'world trees' of other cultures and religions? The 'World Tree' symbolizes the four cardinal directions in many Mesoamerican cultures such as the Maya, Aztec Izapan, Mixtec, whereas in Indo-European, Siberian, Hebrew, Egyptian and native American religions it is said to connect the heavens, the terrestrial world and the underworld through its leaves, trunk and roots. In Buddhism, the Bhodi Tree, or the Tree of Enlightenment, is a central symbol in the life of Siddhartha Gautama since it provided shade throughout the long period of meditation which led to his enlightenment. The Bhodi tree is also known as the Peepul tree or Ashvattha in Hinduism and is said to be the most worshipped tree in India.

There are also many specific connections between the oak tree, the Druids and the Celts. Mara Freeman (online) presents some of the tree lore related to the oak tree:

> We first learn about the oak as sacred to the Druids in the well-known passage from the writings of Pliny, who lived in Gaul during the 1st century CE. He writes that the Druids performed all their religious rites in oak-groves, where they gathered mistletoe from the trees with a golden sickle. […] The 2nd century Maximus of Tyre, describes the Celts as worshipping Zeus […] as a tall oak tree. […] Many early Christian churches were situated in oak-groves, probably because they were once pagan places of worship.

> [There is also a famous] battle between the Oak King personifying the waxing year, and the Holly King, who ruled the waning year. At Midsummer, as the year began its turn towards the dark again, the Holly was victorious, but at Midwinter, the Oak King defeated the forces of darkness once again, revealing himself as a Vegetation God who must die each year so that Life can be renewed. It is not surprising, then, that images of the Green Man carved in wood and stone in mediaeval churches most frequently show oak leaves growing out of his ears and mouth.

What do students know about the Green Man? Are there any carvings of the Green Man in local churches? What do their parents, grandparents, elderly local inhabitants know about the Green Man? What other stories can they discover related to the oak tree? Which characteristics of the oak tree do they admire themselves? If they had to represent the world as they know it using an oak tree as part of their design, what would it look like? How many different cultures or belief systems are represented in the classroom? How far back can each student travel in their family tree? In what respect have beliefs, values, or traditions changed from one generation to the other?

By exploring questions such as these, students can delve into the folk lore and belief systems of different individuals, different generations and different cultures, setting in motion incursions into the fields of philosophy, cosmology, religion and myth. Through working in collaborative groups, students will hopefully learn to express their own opinions more clearly and listen respectfully to different opinions given by their peers, thus developing "the skills of reflection, discernment, critical thinking and deciding how to act when making moral decisions." (EDUCATION SCOTLAND, 2006, p. 22)

Science: What questions do students have related to the oak tree? How is an acorn born? What happens to it after it falls from the tree? How many acorns fall from one oak tree and what percentage grows into adult trees? How does the oak tree breathe? What does it eat? What happens to it after it dies? When an oak tree is cut down to use as timber, is the wood stronger than the wood of an oak tree that died naturally? How hard is the wood of an oak tree compared to other trees? Why do people plant more fir trees than oak trees? Let's plant some acorns and learn how to look after them until they grow strong enough to become independent.

If projects start off based on true questions which reflect topics that students really want to know more about, they are more likely to invest increased energy and concentration in their quest for answers. And, of course, as the investigation proceeds, teachers can easily raise questions of their own in order to include some of the main ideas of

contemporary science as students explore the diversity of living things, discuss concepts related to sustainability, alternative energy sources, etc.

Social Studies: In what ways can students compare the relationship between Little Acorn and Grandfather Oak to their own relationships with their grandparents or with elderly members of the community? How many students know their grandparents personally? How many generations are there in their immediate family? To what extent did their parents know their grandparents personally? Did any of their grandparents or elderly members of the community know their grandparents or great-grandparents in person? Has the relationship between grandchild and grandfather changed from one generation to another? In what ways?

How many oak trees are there in the local landscape at the present time? How many existed when the students' parents were at school? When their grandparents were at school? How has the local landscape changed over the different generations? What are the positive changes and the negative changes? What kind of landscape would the students like to see for their own grandchildren? What do they have to do now in order to guarantee positive changes in their future surroundings?

By encouraging students to invest in the exchange of ideas in order to carry out the plans they have proposed, students should gradually learn to make decisions and act on them for the common good.

Technologies: Clearly, different kinds of technology will be used to discover, organize and present information which students explore as they attempt to answer their own questions and develop their own solutions to the problems or challenges which they have identified. Nevertheless, since technology is literally advancing exponentially, it is probably the case that, as adults, teachers will often be at least one generation 'behind' their students. I am writing these words on the first day of 2017 using a four year-old Dell laptop – a machine which is already outdated. It will probably take me at least two or three years to write this book (since I have a day job as a teacher) and by the time the book is published, many topics I have written about will be 'different' in some sense from the general state of the world for my readers at the time of reading.

I will be 64 this year and will therefore be unable to sing the Beatles song using the future tense *"When I get old, and losing my hair, when I'm 64 ..."*. I was a teenager

when the Beatles released this song on their album *Sgt. Pepper's Lonely Hearts Club Band* in 1967, only available in vinyl. Paul McCartney is still alive and recording new songs, again available as vinyl records, but also in CD format and downloadable digital format. Access to music has changed drastically during his lifetime.

Edison invented the phonograph in 1877, flat 12-inch vinyl discs arrived in 1903, and radio was used to transmit music around 1912, then there was 8-track magnetic tape (1964), and in 1979 the original Walkman enabled individuals to carry music with them in the form of miniature cassette tapes. The first commercial compact discs (CDs) appeared in the early 1980s about the same time as the initial development of MP3 which eventually revolutionized access to music through peer-to-peer sharing, with the production of the first MP3 player (1996) followed by the first phone with MP3 capabilities launched in 2000. Then, in 2005 the first music streaming service became available and over the past few years, online streaming, that allows listeners to access music for free, has overtaken online digital music sales, seriously affecting the music industry. We await future developments. Nevertheless, I personally am very conscious of the fact that my students know much more than I do in terms of recent technological developments and positively encourage students to share their technological knowhow with their peers and their teachers so that everyone can benefit.

What kind of music do students associate with the oak tree? Do they know that the song 'Heart of Oak' is the official march of the British Royal Navy? Or are they perhaps more familiar with music performed by the American indie rock duo, *Wye Oak,* featured in the TV series 'The Walking Dead'? Have they ever heard Yoko Ono's song, 'Story of an Oak Tree', or do they remember their parents or grandparents reciting the nursery rhyme about *'the old wise owl who lived in an oak, the more he saw the less he spoke, the less he spoke the more he heard, now wasn't he a wise old bird'?* What kinds of technology would students enjoy using to make a game, a song, a play, a book, a work of art, a fashion design … based on the oak story? Let's explore and learn together.

Having investigated a few connections between the oak tree and the different content areas proposed by Education Scotland (2006), I will now explore the topics elected at the beginning of this chapter.

Topics + The Oak Tree: ❁ *My name* ❁ *My body* ❁ *My food* ❁ *My plants* ❁ *My animals* ❁ *My rubbish* ❁ *My water*

As teachers explore the different topics suggested in this chapter, the focus should always be on personal experiences, feelings, preferences, choices, ideas and connections. Students of all ages and levels of experience should be encouraged to observe living things in the environment over time and should become aware of how they depend on each other. They should also share their own experiences and feelings related to real or imaginary situations in such a way that they manage to successfully communicate what they want to say.

How can the topics we elected be related to the Oak Tree story?

❁ *My name*

The name of the tree is 'oak' and the story has two main characters: Grandfather Oak and Little Acorn, so one possible direction to follow is to discuss the names of the characters in the story in order to then explore the names of the students. Do students know the etymology of 'oak' and 'acorn'? How are these two names related? Do students know what their given names mean? Is there anyone else in the student's family who has the same first name as themselves? The class could come up with a short questionnaire to help them find out more about their names. They could find out who chose their name and why, and whether there was a special reason for the choice. Students could also make acrostics using their first names to make links to the story, for example:

SAM	LISA
Swinging from the oak tree	Looking at an oak tree
Acorns drop down to	I see lots of leaves
Make new trees.	Swaying in the wind.
	Acorns will fall and grow.

Morphological and etymological relationships between different names can be explored. For example, the 'oak' belongs to the genus *Quercus* which includes over 600 different species, just as 'Sam' is related to Samuel, Samantha, Samson, Sammy while 'Lisa' is related to Elizabeth, Betty, Elsa, Ella, Libby, etc. The number of letters in students' names can also be used to produce different kinds of graphs or groupings. Just as different trees move in different ways, the shape of the letters in students' names can be reproduced using the body to form individual dance routines … what other ideas can the students come up with?

❁ *My body*

What are the physical characteristics of an oak tree? How do students recognize an oak tree? Can they draw a recognisable oak leaf or a fully grown tree? How does the oak tree change its appearance during the year? Why? Can they describe these changes? How do we recognize each student? How does their appearance change during the year? Why? Can they draw themselves? How do their classmates recognize them?

How much do students know about how acorns develop into oak trees? How much do they know about how a human fetus or a new-born baby develops? How many students have younger siblings? What do they remember of their developmental process? What are they curious about? Students could put together a questionnaire and invite one or more of the mothers to visit the class or send short videos of their babies or young children so that students can observe their behavior. Later on, they could imitate the baby's physical movements as they develop from babies to young children. These observations can be used to mount a timeline which could then be linked to a seed's timeline as they observe its development in class or at home.

Many other possibilities related to the body can be explored, depending on the students' age, level of development, areas of interest, etc. Art work can be created using various parts of the body such as fingerprints, handprints, footprints. The senses can also be explored in different ways. Students can be asked to describe or identify objects by touch or smell. What is their favourite smell? What kind of smells do they dislike? Can they identify different plants or flowers just by smelling them? What do they enjoy touching and why? What do they avoid touching – and why?

How many parks or woodlands are there near the school? How many trees can students identify by feeling the bark? How many species of local trees produce nuts – acorns, chestnuts, beech nuts, walnuts, hazelnuts, pine nuts? How many nuts can students recognize just by feeling them? How would they describe the different sounds if they are shaken about in similar containers? How many can they recognize through taste? How would they describe the smell or the texture of a variety of nuts?

There are many ideas and games related to the senses online which can encourage students to investigate the world around them using all of their sensory organs. And as they explore the way their body moves, and the information they obtain through their senses, they may also become aware of the problems that some children face who do not have sight, or hearing, or who have limited physical abilities. Interestingly, these

children often develop one or more of the sensory organs they do have to compensate for areas which are lacking. Students could be encouraged to learn Braille and sign language in order to communicate more freely with any disabled classmates or members of the local community.

My food

The acorn is a nut, which is a fruit composed of a hard shell and a seed. However, all nuts are not fruits, so students might be interested in investigating this complicated relationship between nuts, fruit and seeds. What kind of nuts do students like to eat? Which of them are fruit and which are seeds? For example, cashews and walnuts are seeds, whereas hazelnuts and chestnuts are fruit. Let's find out more. Another area of confusion related to the definition of seeds arises when we try to distinguish between grains, beans and seeds. In fact, grains are the seeds of grasses and beans are the seeds of legumes and some nuts are the seeds of trees. What did students have for breakfast? Did it include any fruit, seeds or grains?

Lots of different art work can be produced using seeds, so students could explore 'seed art' images online for inspiration and ideas. They can also find instructions online for making musical instruments using seeds, or recipes from many different countries to try out. Students could also investigate the nutritional properties of different seeds and fruits and compare this information with a nutritional analysis of the food they eat normally. What are their favourite foods? How much do students know about the food pyramid or the food plate? How healthy are their eating habits? Which changes would make their food consumption healthier? To what extent does the school offer healthy food options? What are the implications for the environment when we compare healthy food options with options which lead to obesity, diabetes, heart problems and other health issues? Which food-related topics would students enjoy exploring and which topics might it be necessary to explore?

My plants

Nelson Mandela (1918-2013) has been quoted as saying: *"A garden was one of the few things in prison that one could control. To plant a seed, watch it grow, to tend it then harvest it, offered a simple but enduring satisfaction. The sense of being the custodian of this small patch of earth offered a taste of freedom."* The Scottish novelist Robert

Louis Stevenson (1850-1894) said: *"Don't judge each day by the harvest you reap but by the seeds that you plant."* So clearly we have many lessons to learn from the planting of seeds.

Since the acorn is a nut which contains a seed, there is of course a direct connection to all plant life. And if students are encouraged to plant a seed of their choice and take care of it until it grows to adulthood, they will begin to appreciate the general need to nurture all living things. Students who live in or near the countryside will be familiar with the life cycle of plants, but many urban students may not be aware of the plant sources of familiar packaged fruits, tinned goods and frozen vegetables which they see in the supermarkets. Do they know what a potato plant looks like? Do they realize that peanuts grow underground or that the cashew nut hangs outside the fruit? Perhaps each student could identify their favourite plant image and explain why they selected it. They could write a poem, a joke, or a song about it; produce their own images based on the original – using technology, plant-based dyes, organic materials, etc.; investigate the history of different uses for the plant, its geographical origin, chemical structure, herbal uses, amongst many other investigative possibilities.

❁ *Me + water*

Of course, if students are going to investigate the life cycle of plants they will inevitably become aware of the necessity of water for the plant to grow. However, as a plant grows, it also releases water vapor into the atmosphere as we do when we breathe. So students might be interested to discover how much water the oak tree consumes compared with the quantity of water it produces. Different plants require different amounts of water, and of course as they grow, they require more and more. How much water do human beings require in order to grow? Do students know that when a baby is born almost 80% of their body is water, an adult male has around 65% water and an elderly male around 55%, so we dehydrate as we grow older. Some of the water in our bodies comes from the food we eat, but we still need to drink a lot of water to maintain healthy bodies. Let's find out more.

How much water does each student drink while they are at school? How much should they drink each day, week, year? Where does our drinking water come from? How clean is it? Does it come directly from a natural water source or has it been recycled? How much does our water cost? How much water do we waste? How often do we leave the

tap running while we brush our teeth? How much water have we wasted in a day, in a week or in a year? How many dripping taps can we find at school or in our homes? How much water is lost each day through a dripping tap?

Do students know that access to water is becoming more and more limited all over the world and water supplies are also becoming more and more polluted? What can we do about this? Well, if we adopt the maxim to *'think globally and act locally'*, the first thing to do would be to reduce the amount of water that we each waste on a daily basis. If we only use the amount of water necessary to brush our teeth, have a shower instead of a bath, reduce the time we spend in a shower, etc., how much water would we save? What other ideas can the students come up with? If each student changed one personal habit during a whole month, how much water would be saved by the group as a whole? How would we calculate the amount of water saved?

It is always important to listen to students' ideas and proposals as a first step in any project. Teachers should then try to incorporate and build on the ideas produced by the students as well as encouraging them to explore alternative possibilities by themselves or in small groups. As knowledge becomes more readily available, it becomes more important to know what to do with the knowledge we are able to access and how to apply it in directions which will benefit the ecosystem or biosphere as a whole.

❁ *My animals*

It's very easy to make connections between food, water, plants and animals, and as students learn more about the life cycle and importance of plants in their lives, they can also be encouraged to perceive the interrelationships between animals and plants, as well as the relationship between man and nature in general. We cannot simply think about plants and animals as being potential sources of food for human beings. It is essential that all human beings become more aware of the fundamental importance of a well-balanced eco-system, and the oak tree is a prime example of an extremely rich habitat in terms of biodiversity. How many life forms can be found in and around an oak tree? What is the relationship between acorns, oak trees and the animals and plants which inhabit or visit the trees? For example, squirrels often build their homes in holes or branches of the adult tree and consume acorns as part of their diet. Foxes might dig around the roots or make their dens in hollowed oak trunks while badgers or deer will take advantage of fallen acorns as a food source. Many species of birds make their nests

in oak canopies and feed on insects such as ants, spiders, snails, moths and caterpillars which live in and around the bark. Caterpillars feed on leaf buds or flowers, the bark of the tree hosts a variety of lichens and mosses, while fungi and mushroom species can often be found around the roots in the rich leaf mould which forms under the tree in autumn, which also supports many invertebrates such as the stag beetle. The interdependent connections exemplified by the eco-system of the oak tree can be explored in more depth when students investigate aspects of the local community but they also serve as an illustration of the different connections and associations which each individual makes during their lives.

We have been comparing students with acorns and oak trees, therefore, just as the oak tree can be associated with a variety of different life forms, it is now time to build up an understanding of the complex interrelationships which exist between all living creatures, focusing more specifically on the connections between human beings and the animal kingdom. Bearing in mind that this section is focusing on each student and their own individual experience and thoughts, we could start off by discovering which animals students are familiar with. Which animals have they seen, touched, fed, looked after? How many students have pets? Who helps to look after any animals themselves? How often have they been to a zoo, or to an animal farm? Which animals do they see on their way to school? What do they look like, how can they describe them, can they create an image of their favourite animal?

Depending on the location of the school, the age of the students, the number of pets in the group, access to a zoo or a farm, a variety of projects could be suggested. For example, if several pets are identified in any group of students, small groups can be formed around each pet, trying to form groups according to easy access. Ideally each pet should be different, if not different species, then different breeds, so that when students find out information about each animal, they will be able to share their answers with each other. Diversity is always enriching. If there are very few pets in the group – perhaps the owners can be persuaded to bring their pets to the classroom or send videos showing their pets involved in regular activities. Alternatively, if the class has access to a zoo or to farm animals, perhaps a day trip could be planned, with small groups identifying specific animals or breeds as ‘their’ special animal which they want to find out more about.

Whichever project is decided on, students need to make preparations beforehand and register the information they discover after the event. They can prepare a questionnaire to discover what the animal eats, how much it eats (per day, week, month), how much water it drinks (per day, week, month), whether it was born in the wild or in captivity, what its life would be like in the wild compared to a domesticated environment, and so on. Then, after getting to know more about the animal they have selected, by seeing and observing animals with their own eyes, they can expand on their knowledge through reading, interviews, films, etc., in order to present what they have discovered to the group as a whole.

The sharing of information obtained by various groups using the same questions applied to diverse sources of data can be a remarkably powerful learning tool. When students are actively involved in obtaining their own information, based on hands-on experience, they will be more likely to draw comparisons with the information being presented by other groups, and will identify similarities and differences as more and more data is presented.

The information obtained about different animals can then be related to the students themselves. If they have investigated the food animals eat, the quantity of water consumed, they can compare their findings with the food and water they themselves consume during the same time period. What are the main dietary differences between the various animals that the group has studied and each student's food habits? If students have been studying the lifestyle of domesticated animals, they could also inquire about the history and development of these animals as they are linked to the history of Man and our relationships with them.

❁ *My rubbish*

Another essential theme for any environmental project is to raise students' awareness of the amount of rubbish (or waste) each individual human being produces on a daily basis. What is rubbish according to our students? How would they define it? The online British Dictionary defines 'rubbish' as: "worthless, useless or unwanted matter". What kind of rubbish does an oak tree produce? What do plants or animals living in their natural habitat produce which we might refer to as 'rubbish'? According to Paul Muggeridge (2015, p.1) writing for the World Economic Forum (WEF): "by 2025 there will be 1.4 billion more people living in cities worldwide, with each person producing

an average of 1.42kg of municipal solid waste (MSW) per day – more than double the current average of 0.64kg per day" [in 2015].

Students might be interested in exploring current online sites such as 'The World Counts' which uses numbers to give readers an overview of critical global challenges: "Every year we dump a massive 2.21 billion tons of waste. If all this waste was put on trucks they would go around the world 24 times." The authors, Larsen, Olsen and Emanouilov, present "the latest and most accurate live statistics on the state of the planet […] from the world's most reputable organizations", since they believe that "Awareness is the first step towards change". Data is presented using real time counters, and when I started this sentence, the number for the 'tons of waste dumped globally this year – on January 14th 2017 at 13:00 was 79,137,105 tons, and by the time I had finished typing this sentence, the number had already risen to 79,144,098 tons at 13:01. An increase of 6,993 tons of global waste produced in one minute. Of course, whenever students look for information online, they should always check their sources for reliability and compare data from a selection of appropriate books, online sites, authors or organizations.

What has each student thrown in the rubbish bin today? Have they eaten any biscuits, sweets, chewing gum, crisps and thrown away the packets? Have they drunk any fizzy drinks or commercial juices and thrown away plastic bottles or cans? Have they eaten any fruit and thrown the skins or seeds into the rubbish bin instead of a compost heap? Did they have cereal, bread, butter, yogurt or jam for breakfast which all come in containers or packets which are thrown away later? What are these containers or packets made from? What happens to them after they are thrown away?

What do students want to know about these topics? What can they do to reduce, reuse or recycle the waste they are producing personally? How can they gather information about any improvements they make over a specific time period? One format for evaluating performance over time is to use individual portfolios to register information which is being collected during a specific time interval. Students could register the amount of rubbish they produced in one day at the beginning of their project, describe the strategies they use to try to reduce their rubbish, take pictures or film theatrical representations of the ways and means they used to recycle some of the rubbish they produced originally, in order to chronicle the whole process. Students can work in

collaborative groups in order to overcome difficulties and work out solutions for problems or challenges encountered along the way. Groups can then compare their results and hopefully expand their individual efforts to include their families and friends.

Main Objectives

Every teacher should define the main objectives that they wish to develop as they work with their students. Some of the aims which are of fundamental importance to me whenever I am trying to promote learning in any area are the following:

Personal awareness: there has to be a personal connection to whatever is being studied in order for deep learning to take place. In this case students need to feel an individual responsibility for their immediate environment. Global issues will only be solved based on personal commitment to positive change.

Detailed personal observation: we need to be able to observe as many details, through as many senses, and from as many points of view as possible, in order to acquire information from primary sources and not be dependent on secondhand reports. As we develop our own powers of observation, we will become more capable of interpreting reports produced by others.

Data organization: once students have collected data, they need to be encouraged to ask questions about the information they have gathered in order to produce their own hypotheses and make predictions about the implications of their data. Students should always be encouraged to organize any information they have collected in their own way as a first step in learning how to organize anything. Then, as they compare their own attempts with alternative proposals produced by their classmates, they will perceive the positive, negative and interesting or innovative aspects of the diverse ideas produced by the group as a whole.

Analysis and self-evaluation: the ability to analyze is present at all times during the gathering, organizing and processing of data. In order to collect data, decisions have to be made about what kind of data is wanted or needed and how it should be collected. Then, after the information has been gathered, students need to analyze it during the process of organization. They will establish specific categories, lists, associations,

which will lead them to ever more complex levels of data analysis as they compare and contrast various categories in a variety of ways.

Communication: every worthwhile piece of research or investigation deserves to be publicised. Each student needs to believe that what they are doing is important in some sense so that they will want to communicate their results and will invest effort in the organization of what they want to say. However, the necessity for communication is not limited to research results. Students will also enjoy communicating their thoughts and feelings about life in general and about their individual areas of interest in particular. As teachers, we need to offer students multiple communication platforms and encourage them to express themselves through combinations of multi-media. Reading, writing and oral expression can be explored using innumerable formats and, given the present rate of technological development, let's ask the students for their ideas as starters.

Imagination and creativity: students should be encouraged to explore their imagination and creativity in all areas of the curriculum so that they come up with alternative solutions or ideas to any problem or task that has been set. Past attempts to train students to repeat and memorize the same answers to lists of pre-established questions is no longer a viable educational strategy since the world is changing at an ever-accelerating rate, and society will need more and more creative and imaginative solutions for problems which we cannot even envisage at this time. Students need to be inspired to take risks and to push known boundaries. They should enjoy challenges and feedback, instead of running from the former and resisting the latter.

Ability to think: education systems throughout the world seem to assume that everyone 'knows' how to think effectively. They seem to focus more on teaching specific kinds of knowledge. But, given the exponential amount of data being accumulated worldwide, how do we select the most 'useful', 'interesting', 'relevant' knowledge to teach our students? Arthur Costa edited a book entitled 'Developing Minds: a resource book for teaching thinking', with more than 590 pages, in which he, and many other authors, make an extremely strong case for the teaching of different thinking skills. They talk about thinking in context, the need for open-mindedness and critical understanding, effective thinking, creative thinking, the necessity for creating thought-full environments (in the home, schools and the workplace), amongst many other

fascinating topics. Perhaps it's time to consider developing the abilities that we already have in order to explore some of the possibilities that we are not even aware of?

Flexibility: there are always several ways to carry out any task or challenge, therefore students should be stimulated to try out a variety of options whenever possible. If students are always expected to come up with 'one correct answer', a strategy often used in the past, they will not learn to explore and analyze different possibilities in order to take context-based decisions where the most appropriate answer will depend on time, place and circumstances. If students are encouraged to believe that there is only one correct answer to every question, and there are two or three people in the class who always seem to come up with these answers very quickly, the majority of students will often stop trying to find any answers at all. It is much more effective to ask questions where multiple answers are expected so that all students can produce valid answers which can then be compared and discussed. According to Bransford et al. in *How People Learn* (2010, p. 101) they emphasize the fact that: "the development of a repertoire of flexible strategies has practical significance for learning."

Diversity: we live in an environment with diversity all around us. Each person in our family, our classroom, our town is unique compared to everyone else in the same group. We are surrounded by numerous cultures and languages. Our house, our street, our school, our country, is not the same as the house, street, town or country next to ours. We may think that when someone walks the same route to school every day, he / she will see or interact with the same animals and plants every time they walk along that route. But that is not the case. Depending on the season of the year, the weather, the time of day, the speed the person is walking, their preferences, their state of mind and many other factors, they will observe a variety of aspects of their immediate environment every time they walk through it. The diversity in our lives needs to be celebrated and very much present in our school work as well.

Autonomy and security: when babies learn to talk and to walk, they tackle two of the most complex challenges of their lives and demonstrate one hundred per cent autonomy and security throughout these highly sophisticated learning processes. They never give up. Why does this confidence and self-reliance seem to diminish as they grow older? Why do so many students lose their enthusiasm and determination later in life? According to Conor Williams (2014, online), "infants and toddlers display patience,

resilience and flexibility well beyond adults' capacities. Their first steps come literally on the heels of thousands of frustratingly weak failures." The author then tells a story about a famous Native American gold medalist at the 1912 Olympics, Jim Thorpe, who accepted a challenge to mimic a toddler's every movement for a whole day. The athlete collapsed after only a few hours.

Babies and toddlers invest overwhelming amounts of neural and physical energy in their learning processes. Bransford et al. (2010, p. 102-103) explain young children's tenacity when they say: "children are both problem solvers and problem generators; they not only attempt to solve problems presented to them, but they also seek and create novel challenges. […] Children persist, not because they have to, or are guided to, or even because they are responding to failure; they persist because success and understanding are motivating in their own right."

Clearly every teacher needs to discover the motivation which will fuel each individual's learning process most successfully: an extremely ambitious task, but at the same time, extraordinarily gratifying.

CHAPTER 2

THE ENVIRONMENT OF MY FAMILY

In the year 2020, I was revising this manuscript while many countries around the globe were suffering from the effects of the pandemic virus COVID 19. Schools, colleges and universities had been closed and many families were living in isolated quarantine with anxious parents worrying about what was happening to their children's education. Would children forget what they had been learning at school? How should they be studying at home? What could parents do to help motivate children to study?

Based on these fears, I decided to include a brief discussion of Sugata Mitra's Self-Organizing Learning Environments (SOLEs) to indicate educational possibilities which can easily be applied within the family environment.

At the time of writing this section, Sugata Mitra was a senior research investigator at Newcastle University, UK, working principally with self-organising systems as related to primary education. But earlier in his career, while working for the National Institute of Information Technology (NIIT) in India, he decided to install a computer in a hole in the wall overlooking a slum area in New Delhi near his work. He was curious to know whether the poor children of this area would be interested in the machine and whether they would be able to work out how to use it, since at that time, most of the materials and instructions were written in English, a language which these children did not understand. But within one month, the children had already acquired basic skills in English and maths, they were playing games, downloading media and searching for information. This initial study was expanded to include seventeen locations in various parts of India. Mitra and his colleagues worked with groups of children in isolated villages and slum areas where local inhabitants had no knowledge of computers – and the results were always the same: digital literacy seemed to occur spontaneously:

> We continued with several years of experiments until it was clear that children in groups do have an understanding that is much greater than that of each individual. It was this collective 'hive' mind that was working like an efficient teacher. I had seen nothing like this before and it took me years to realise that what we were witnessing at the 'holes in the walls' was an example of a self organising system – where spontaneous order appears out of nowhere (Frontline World, 2002, In. MITRA, 2018, online).

One of Mitra's early experiments asked the following questions: (1) Could Tamil-speaking children in a remote Indian village learn basic molecular biology in English on their own? (2) Could a friendly mediator with no knowledge of the subject improve the performance of these village children? (3) How would the learning and test scores of these children in a remote village compare with those of children who were fluent in English and taught by subject teachers in a local state government school, and those attending an affluent, private urban school?

According to Mitra and Dangwell (2010, p. 674):

> The purpose of this [third] question was to establish to what extent such self-organising learning could 'level the playing field'. In the authors' view, equalising educational opportunities is the most efficient and effective means of improving the quality of human life on the planet. Education provides the route to economic and social progress and to people taking greater control of their own destinies.

The authors selected a remote Indian village so that there was no possibility of teaching from any other sources, and molecular biology, because village community members would be unfamiliar with this topic. If they could demonstrate that friendly mediators, such as parents, grandparents or other adults, many of whom were illiterate, could help children improve the quality of their self-organized learning, then they would have "a replicable and sustainable solution [to the problem of] the non-availability of good teachers that was driving this study" (Ibid).

What were the results?

> […] the sample group performed well in a subject they knew nothing about and in a language with which they were unfamiliar. […] even without any help from other children or adults, the children working in unsupervised groups around a Hole-in-the-Wall computer were able to raise their test scores from 7% to about 30% in 75 days. A further period of 75 days with a mediator increased their scores to about 51%. These scores were comparable with those of children of the same age, taught by a trained and experienced teacher, in a privileged private school in the nation's capital. (Ibid., p. 683)

The mediator used in this experiment was a young woman from a local NGO who knew nothing about the subject involved. The children knew her and were very friendly towards her and she was simply asked to make positive, encouraging remarks about what the children were doing as they explored information and ideas. Mitra refers to this type of mediation as the 'grandmother's method', since the children are essentially being praised and admired for what they have already done, and are being encouraged

to continue with whatever it is they are doing by someone who is fascinated by the results, even though they may not even understand them.

> [...] while this research has implications for providing schooling in disadvantaged areas of India and elsewhere, it might also be hypothesised that the approach could be employed in conventional, well resourced and well-staffed schools to reinforce and enhance traditional teaching, [...] It may even be possible to develop a model for future schooling where children working in groups with access to the Internet and a friendly mediator, can complete large parts of the school curriculum through autonomous or semi-autonomous study. (Ibid, p. 685)

The success of this experiment stimulated the creation of a 'granny cloud' where volunteers, originally from England but subsequently from all over the world, act as remote mediators who give 1 hour or more a week to chat to children in various locations around the globe via peer-to-peer video communication such as Skype.

Mitra and his colleagues then went on to set up SOLEs within schools, believing that all students should be encouraged to learn more actively in more autonomous, collaborative ways which may initially seem chaotic:

> […] the children invariably worked in groups, interacting constantly with each other, in a somewhat chaotic way. Their approach scarcely resembled the orderly learning environment provided by a school classroom. Our observations led us to suspect that their learning was the outcome of a self-organising system, in much the same way it is understood in the physical sciences or mathematics: a set of interconnected parts, each unpredictable, producing spontaneous order in an apparently chaotic situation. (MITRA; KULKARNI; STANFIELD, 2016, p. 230)

Nevertheless, after many studies had been carried out in different parts of the world, Mitra concluded that in order for spontaneous order to appear from an apparently chaotic situation, several factors were necessary:

> A SOLE inside a school or any indoor environment attempts to simulate the environment of the outdoor *Hole in the Wall* design. This can be created by having computers with group seating arrangements so that a group of children can easily share a computer and by ensuring that the number of children in the space is four or five times that of the number of computers. For each session, the teacher, facilitator or mediator will provide the class with a big and challenging question. This would ideally be a question that the children would find extremely difficult or impossible to answer if they were sat by themselves in a traditional classroom with no access to the internet. The children are then invited to form their own groups around each computer. Given the ratio of children to computers, this happens naturally. Children are allowed to change groups, talk to one another, talk to other groups, and walk around looking at others' work. Towards the end of the session each group is then asked to present their findings to the rest of the class. Communication and collaboration are therefore key features of a SOLE. (Ibid., p. 231-232)

Clearly it should also be possible to apply the principles of these experiments within our own homes, especially in situations where access to schools is problematic. After all, these studies were set up initially to investigate the possibilities of autonomous learning which might help solve the problem of the lack of formal education in rural areas of India. However, it may be necessary to reconsider several of our pre-conceived notions about how the process of learning occurs. Instead of assuming that a qualified teacher is necessarily the only person responsible for passing on specific concepts and standardized packages of limited knowledge to distinct groups of children, usually organized according to age, then testing the children to check whether this information has been retained for a short period of time, we need to realize that we now have access to all the specific knowledge we may need through the internet. Nevertheless, we should also learn to analyse and compare a variety of sources and work out what we should do with the knowledge we acquire. Mitra and his associates are convinced that small, heterogeneous groups of children, who are motivated by a challenging question that cannot be explored without access to the internet, are perfectly capable of discovering relevant information through free communication and collaboration as they share ideas and experiment with flexible search strategies.

By the same token, families should also be able to function as small heterogeneous groups, not only when access to traditional schools is unavailable or limited, but also as a learning unit which can complement what children are learning at school. If the family group is very small, other members can be invited to participate online – and of course we must remember that encouragement, admiration and shared wisdom from 'grandparents' are also essential for the success of self-organizing learning environments. So hopefully, if any readers find themselves in situations where access to formal schooling is limited, some of the proposals from this book can be used to encourage the family to work together.

Various topics have been identified to provide focus for group work and projects related to the theme '*My Family'*.

Topics: ❁ *My family* ❁ *Our physical differences* ❁ *Our food* ❁ *Our home* ❁ *Our water* ❁ *Our rubbish*

❁ *My family*

The main aim of this topic is to inspire students to get to know their immediate environment in more detail, in other words their home and family. As they become more aware of the importance of individual and group responsibilities, learn to make an effort to work together as a team, and are able to enjoy the diversity within their own families, they should hopefully continue to apply these characteristics or abilities during adulthood as they participate in more disparate social circles.

In order to introduce this topic, the class could produce a questionnaire for each student to take home and fill out with their family members. However, since the family unit is becoming more and more diverse, the composition of possible family units must be taken into consideration when putting together the questionnaire. Since there are many possibilities, the sharing of these possibilities while constructing a questionnaire will already provide fascinating opportunities to investigate the meaning of 'family' and 'home' for everyone involved.

Since one of the topics used in the previous chapter was the student's name, this can now be extended to explore family names. Where do students' surnames or family names come from? Do students know the origin of their family names? Are there cultural naming differences within the family or in the classroom? For example, in Spain, a person's name is made up of a given name (or first name), followed by two family names or surnames where the first one is usually the father's paternal family name and the second is the mother's paternal family name. In China however, the surname or family name is given first and is followed by the given name, whereas Arab Muslims use the person's given name, followed by the father's given name, followed by the grandfather's given name. What would students be called if they followed Spanish, Chinese or Arabic naming customs? What happens to their names when women marry in the student's family? How many naming customs exist in the classroom? Do they know what their grandmothers' maiden names were? Do any of the students' grandparents or older family members know what *their* grandmothers' maiden names were?

As students explore their own family names and gradually expand their investigations to include more and more of their family tree, they are adding depth to their knowledge and understanding of naming customs. And as students share their findings, this knowledge base expands even more and is closely connected to the initial work

suggested in the previous chapter where students thought about their first names. After investigating a variety of topics related to naming customs, students can be encouraged to register what they have learned in different ways – using technologies, language, and the expressive arts.

If questionnaires were given to the students' families, many other content areas could be explored depending on the data collected. For example, if students registered the ages of their family members, several possibilities related to mathematics can be explored such as bar charts, histograms or pictographs. Similar data can be collated for the whole class and each student can compare their own family with the results obtained by the entire class. A variety of numeracy skills can be applied to the visual data as students interpret the information in appropriate ways in order to reach a range of valid conclusions.

If the data from the questionnaire included place of origin, students can map their origins geographically and historically as they research their roots. It may even be possible to trace their DNA in the very near future which could help reduce racial tension and hostilities between neighbouring cultures as we realize what a fascinating melting pot the human race has become. Students might want to film family members as they interview them and edit these recordings to present a family documentary. They might decide to represent their different geographical origins by selecting different songs, producing posters, 3D maps or dioramas using recycled materials. The possibilities for presenting data are endless. For example, Mark Cartwright explains how the Inca civilization, which flourished in South America during the 15th century, used pieces of string with knots tied in them to register a surprising array of information:

> A quipu, or knot-record (also called *khipu*), was a method used by the Incas and other ancient Andean cultures to keep records and communicate information. In the absence of an alphabetic writing system, this simple and highly portable device achieved a surprising degree of precision and flexibility. Using a wide variety of colours, strings, and sometimes several hundred knots all tied in various ways at various heights, quipu could record dates, statistics, accounts, and even represent, in abstract form, key episodes from traditional folk stories and poetry. (CARTWRIGHT, 2014, online)

Some students might decide to use poetry to record their conclusions. Would they be able to register the essence of a poem using colour-coded string with different kinds of knots? Compare the information about *quipus* in the paragraph above with the following

lines from a poem by Brian McCabe entitled *Chasqui*[4]. The *chasquis* were the messengers, who carried the *quipus* from village to village, often running up to 240km per day using a relay system. The following section describes this ancient recording system in a very different way from the factual presentation registered by Cartwright above:

> the green may be cattle the blue babies born the yellow those tried or waiting to be tried
> the tallow threads those punished or pardoned the orange those put to death I don't know
> the white may be peace the red war
> in any case it is not for me to understand
> what each thread each knot represents
> tens no doubt hundreds no doubt thousands
> in the end all things must count and be counted I was chosen because I am a good runner
> I have faith I will be rewarded if not in coins
> I will be sacrificed and my death recorded
> in any case it won't have been for nothing
>
> *ama suva, ama lulla, ama quella* (Inca moral dictate: 'Don't steal, don't lie, don't be lazy')

This extract contains several kinds of information presented in a very original style compared to the previous paragraph by Cartwright. What are the differences and where are the similarities? Which text style do students prefer and why? What would they like to investigate more fully after reading these different texts? How could they use the principles embedded in the Inca *quipus* to register the information they collected related to their families' names? How many groups would enjoy trying to produce a *quipu* to register the data they gathered from their questionnaires?

Which other aspects of the students' families could be explored as a motivating topic for investigation? Perhaps students would enjoy observing the physical movements of family members from different generations. Then they could reproduce some of the more interesting moves in the classroom to provide students with a deeper understanding of physical development and wellbeing within the family. Does the age and physical fitness of each family member affect the way they contribute towards the functioning of the family unit? If there is a baby or small child in the family, what does each family member do to help? If both parents work outside the home, how are family

[4] This poem is from Brian McCabe's book entitled 'Zero', published by Birlinn Ltd., in 2009. It is a collection of poems which express the writer's fascination with mathematics and mathematicians.

tasks distributed? Who helps with the cleaning, who helps with the laundry, with the food, with the shopping?

If one of the family members feels they are working more than other members, a simple table which sets out the different tasks performed by each member throughout the day may make any imbalance clearer. As teachers encourage students to analyze and discuss data in order to draw relevant conclusions, they will learn to achieve equilibrium between emotion and reason. Cooperation within the family is excellent preparation for future collaborative endeavors.

All of the above activities involve the use of language, mathematical or scientific reasoning, social studies and technologies. And of course there are many other possibilities to be explored – books, films, musicals and dance performances can be used to accompany the topics suggested so far. What kind of music does each of the family members prefer and why? What is their favourite dance style? Which dance styles do different age groups prefer? Let's invite some family members to teach us their favourite dances.

Our physical differences

The previous chapter offered various suggestions related to 'my body' therefore any work already carried out in relation to the student's body can now be compared to the physical structure of other family members. If the students produced artwork earlier using the hands or feet, they could now measure their hands from the wrist to the tip of the middle finger and compare these measurements with other members of their family. Or work out the area or circumference of their handprint or footprint and compare it with their parents' hands or feet. Which other body parts would they be interested in measuring – the circumference of the head, the waist, the wrist, the length of the nose, the big toe, the upper arm? Students could also investigate the proportion of the head to the body or explore concepts related to maximum, minimum, average, etc. After collecting, organizing and registering the measurements, students can be encouraged to analyze the data and discuss their conclusions, preferably in smaller units initially since each team member would have an opportunity to speak, before expanding the discussion to include the whole class.

If students have been measuring feet, they could explore the relationship between length and shoe size for selected family members. If they have measured the circumference of heads, they might be interested in discovering more about family headwear – and both of these connections could lead to future projects related to 'clothing' – who wears what and when? What do the females in the family wear on their heads, and the males? Which headwear is interchangeable? Can the students produce Venn diagrams to register the distribution of shoes or hats in the family? How does clothing differ from one generation to another generation? What does one generation think about the style of another generation? Can students identify each family member's favourite piece of clothing? Which family members know how to sew? Which articles of clothing are they able to make? Perhaps they could come to school or make a short video to teach students how to make a simple piece of clothing? How many pieces of clothing does each family member possess? What is done with clothing which is no longer in use – is it thrown in the bin, donated to charity, or recycled into a different format? Perhaps old newspapers and magazines could be used to make clothes for a theatrical presentation which showcases the clothing traditions of different generations or different cultures connected to the students' families. What other ideas can students suggest?

Differences in body structure and size are related to factors such as age, gender, genetic structure, etc. But another essential factor which also affects the size and shape of the body is the food we consume, which is our next topic.

Our food

Once again, suggestions which have already encouraged students to analyse their own food habits, can be extended to investigate the food habits of the whole family. For example, if students have already produced graphs related to their own favourite fruits, they can now find out more about their family's favourite fruits. If students have been working with their own favourite recipe, they now have a chance to put together a booklet of family favourites.

One strategy which many nutritionists adopt as a first step towards analyzing their client's eating habits is to get them to fill in a table listing the food they have eaten during a whole week – so this could be an initial starting point to discuss the family's eating habits. For example:

What did we eat this week?

Mealtime	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Cereal, toast, strawberry milk	Bacon roll, tea	Cereal, toast, chocolate milk	Egg, toast, tea	Cereal, bread roll, fruit juice	Bacon roll, chocolate milk	Bacon, sausage, egg, toast, tea
Snack	Crisps	Sweets	Biscuits, Soft drink	Crisps	Sweets	Banana	Fruit juice
Midday meal	Meat pie, chocolate	Cheese sandwich, Mars bar	Hamburger, crisps	Fish fingers, peas, chips	Sausage roll, chips	Cheese and tomato sandwich, soup	Roast chicken + potatoes, peas, carrots
Evening meal	Baked potato, cheese, apple pie, soft drink	Chicken curry, rice. soft drink	Shepherd's pie, beans, soft drink	Tuna fish, carrots, pasta, soft drink	Pork chops, peas, potatoes, soft drink	Fish and chips, soft drink	Chicken sandwich, Strawberry milk
Supper	Tea, biscuit	Hot chocolate	Tea, biscuit	Tea, cake	Hot chocolate, biscuit	Tea, cake	Tea, chocolate biscuit

Each student could gather information from their family to work out what everyone ate during a whole week. The information gathered by each student could be put up on the walls so that everyone can have a look. Then questions can be selected for investigation and discussion. For example: Which foods are eaten most frequently by your immediate family? How are meals prepared and eaten? Does everyone eat together or do some or all family members prepare and eat their food separately? How much does each plate of food weigh? How long does it take to prepare each meal? And how long does it take to consume each meal?

If we compare the family eating habits with recommended eating habits, what are the main differences which stand out for the students? What do students know about the nutritional facts of the food they are eating? Do they know how much sugar there is in soft drinks and commercial fruit juices compared to natural fruit juices produced at home? What are the positive components of natural fruit juices compared to soft drinks? How much do they know about how sugar affects their body? What happens to their bodies if they consume too much fat, or food with too many chemical additives? How much does the family spend on food in a week? Can students come up with healthier alternatives for the same amount of money? How often does the family prepare special meals for special occasions? Are there any food restrictions which affect the family's

food choices? To what extent is the family aware of the environmental impact of their food choices?

The objectives and outcomes for the 'Food Education Programme (2012-2015)' promoted by the Scottish Government were "to increase young people's knowledge and understanding regarding the social, cultural, economic, health and environmental aspects of the food we eat" (SCOTTISH GOVERNMENT, 2016, p. 7). And, according to the evaluation report of one of the projects involved in this programme, 'Eco Schools – Keep Scotland Beautiful': "The activities provided as part of the food topic were wide ranging. The most common activity was around growing food, although monitoring and reducing food waste, as well as learning about the environmental impacts of food choices, were key topic areas." (Ibid., p. 63)

Students could learn more about their family's ecological footprint as related to their food consumption by exploring sites such as 'the Global Footprint Network'[5]. How often are meals planned ahead of time? How much food is bought at local markets? How much wrapping is involved? How much food is wasted on the plate? And how much food goes bad in the fridge before it is eaten? We need to remember that any food we throw away means that all the resources used to produce that food have been wasted.

According to the 'Food for Thought Fund – Education Scotland': "Many schools used funding to create a growing garden to enhance knowledge around seasonality, outdoor learning, physical activity. Growing food, harvesting, using the food they had grown for practical cooking experiences, sharing food as a community, understanding issues around local food and sustainability." (Ibid., p. 82) How many students grow food in their gardens or allotments? How many recipes have they helped cook at home which have contained home-grown produce? What are some of the physical activities involved in producing your own food?

School projects such as the 'Food for Thought Fund' are extremely important, but it is also necessary to find out whether what has been learned in school is being put into practice in the home and in the community. Students may be able to answer questions and demonstrate their understanding of sustainability and food waste, but what happens

[5] GLOBAL FOOTPRINT NETWORK: advancing the science of sustainability, available at: <https://www.footprintnetwork.org/our-work/ecological-footprint/>. Accessed on: 04.06.2021. Or students can try the 'footprint' calculator provided by the World Wildlife Fund (WWF) at: <http://footprint.wwf.org.uk/>. Accessed on: 04.06.2021.

within their own homes? What are the students and their families doing to reduce and recycle their own food waste? Let's find out more, share everyone's ideas, adopt some of the positive experiences and work together to solve some of the problems which are brought to class for discussion. Let's apply what we are learning at school by putting our knowledge into practice in our homes.

❁ *Our home*

How do students differentiate between the phrases 'my home' and 'my house'? How would they prefer to express themselves? Using mime, visual images, poetry, cartoons, film, song? If we check the etymology for the word 'house' we find that it comes from the Old English *hus*, which in turn comes from Proto-Germanic **husan* which was the source for Dutch *huis* and German *Haus,* all meaning 'dwelling, shelter, building designed to be used as a residence. However, the word 'home' comes from Old English *ham,* Proto-Germanic **heimaz,* the source for Danish *hjem,* Middle Dutch *heem,* German *heim,* all of which come from Proto Indo European **(t)koimo* which means to settle, dwell, be home. So both words have different historical meanings. Are these historical differences maintained today? Let's examine what the students have come up with when they compared the two words 'house' and 'home' and enjoy the class discussion of the similarities and differences.

How do we construct a house? How do we build a home? Are these phrases synonymous? How would students describe the different nuances of meaning involved? Would they prefer to use Venn diagrams, comparison tables, drawings, lists, poetry, theatre? What is the most important aspect of a home, compared to the most important aspect of a house? What do students know about the structure of their house? Have they lived in different houses? Can they draw a plan of the house they live in now? Can they work out how much space each person living in the house has? Can they calculate their 'housing footprint' and what can they do to improve it? For example, they could check out online sites, such as 'Shrink That Footprint' (2012-18) where founder Lindsay Wilson offers suggestions as to how to shrink your housing footprint by reducing emissions from heating, cooling, electricity use, electricity supply, water and waste.

How often does the family switch lights off when a room is not being used? How frequently do family members have showers or baths? How much water is used each time? How often does the family use a dishwasher and / or washing machine and drier?

Are these appliances used only with full loads or with partial loads as well? Does the house have double glazing, use solar energy, or renewable electricity? How effective is the insulation system? Is the heating system set to the same temperature for all spaces in the house? Is the same temperature maintained during the day and during the night for all spaces? Are there any empty rooms which are being heated unnecessarily? According to Wilson (2018) if you try reducing your thermostat by 1ºC you can typically reduce your heating use by around 10%. How will this affect the family's heating bills? Which heating options are more efficient? How can this efficiency be calculated? As students discuss these ideas, they are investing in their comprehension of many different mathematical concepts. Have systems of temperature control changed within the family's memory? What do students imagine might happen in the future? Can students suggest other strategies to make their homes more ecologically friendly?

What are the topics which interest the students related to the places where they live? Would they enjoy designing their 'ideal home' while trying to make it as ecologically efficient as possible? Small teams could build models of their ideal 'green' homes and set up an exhibition in the school. What combination of shapes would they use and how would they decorate these new homes? When students are asked to include aspects of the expressive arts as they work with a more scientific project, they will become more aware of multiple connections between diverse areas of study.

Experts in a variety of areas can be invited to discuss students' questions via virtual platforms, or in person. In both cases, students need to prepare questionnaires before the meeting and produce reports based on their conclusions afterwards. As they invest in their use of language to acquire and register information about topics which interest them, they may also perceive that the technologies they are analyzing are directly related to social health and wellbeing as well as taking moral issues into consideration.

Studies related to the place where we live could also include an investigation of the external appearance of the family residence and its immediate surroundings. How many family homes have a garden? How many trees or bushes are there, what are their names and why were they chosen? Are there any fruit trees or a vegetable garden? Does the family have any plants inside the house or a hanging garden on any of the external walls with herbs or flowers? How many plants around the house have medicinal properties? Is there a communal garden or allotment area nearby shared with other families? Do the

students consume anything produced by the family? Would any members of the family be interested in joining with other families to create a common 'green' area near their homes?

Involvement in any project which requires caring for plants and caring for their immediate environment will help students understand concepts related to the life cycle of all growing things as well as the interdependence between different groups of living organisms and many other important concepts related to healthy growth and community wellbeing.

❁ *Our water*

We have already mentioned some of the family's use of water in the previous section – personal washing habits and the use of appliances for cleaning dishes and clothes. Lots of projects can be developed in these areas. For example, students could measure the quantity of water used to have a bath compared to having a shower. They could calculate the volume of water in a bath at a certain height, and the amount of water used per minute for a shower, to help work out how to reduce their water use in each case. They could also check their appliances to see if there are options for 'half-load' as well as 'full load' or measure the amount of water they take to wash dishes by hand compared to using a dishwasher. How do students normally wash their dishes? What are the different strategies used by different family members for washing dishes by hand? Which method uses less water without diminishing efficiency?

Another extremely important area to investigate is related to the quantity of drinking water being consumed by our families. In chapter 1 we asked how much water each student drinks during the day, now it would be interesting to find out more about the whole family's drinking habits since the majority of our nutritional practices start at home. Therefore in order to develop healthy eating and drinking habits for the rest of our lives, we need to examine the family eating and drinking customs as early in life as possible.

According to Vieux et al. (2017) who studied 845 children between 4-13 years old representing a cross-section for the National Diet and Nutrition Survey of 2008-2011, almost 89% of children did not meet the adequate intake standards for water defined by the European Food Safety Authority (EFSA). Do students know what the current

recommended water intake is? According to an EFSA publication in 2010[6], adequate intake of water for children is estimated to be 1300 mL/day for children 2-3 years of age; 1600 mL/day for children 4-8 years of age; 2100 mL/day for boys 9-13 years of age; and 1900 mL/day for girls 9-13 years of age. From 14 years on, the EFSA recommends a minimum of 2.0 L/day for females and 2.5 L/day for males. Have these numbers changed? How many members of each student's family drink the recommended amount of water each day? How much of the family liquid intake includes sugar? Which drinks contain the highest amount of sugar? How does that affect the absorption of liquid by our body? What happens to our bodies if we don't drink enough water? Let's find out more.

Another essential factor related to water consumption in the family unit is the quality of the water we are drinking. What do students know about the historical, geographical or geological sources of local water? Do they have any Clootie wells in the neighbourhood? What do students know about this fascinating tradition? The Scots word 'clootie', or 'cloutie', refers to a piece of cloth, and some Scottish families may still make 'clootie dumplings', a sweet dough containing dried fruit, which is wrapped in a piece of cloth then steamed or boiled in water, and served with custard or cream. How many families still make clootie dumplings? Do they use recipes inherited from grandmothers or great-grandmothers? To what extent have the ingredients changed from one generation to another? How many families would like to try to make one for the first time? Which recipe is the most popular within the family?

But what is the connection between clootie dumplings and clootie wells or clootie trees? Of course the answer is that they all involve strips of cloth and water. The dumpling is wrapped in a piece of cloth before being cooked in water and clootie trees are found close to sacred Celtic water sources, sometimes referred to as clootie wells, and have strips of cloth attached to their branches to bring luck or good health. Alexander Crow, writing for the online site 'Culture Trip' explains clootie trees or wells as follows:

> The 'cloots' of the clootie well are scraps of cloth hung from trees surrounding a sacred well or spring. These sources of clean water have been places of healing for millennia, with ancient Celtic beliefs in spirits and nature being absorbed by the Christian church, and sprites and local gods replaced with saints.

[6] Scientific Opinion on Dietary Reference Values for Water. **European Food Safety Authority Journal**, 2010; 8(3):1459.

> Traditionally, the well would be visited at special times of the year, such as Beltane, the May Day festival of Spring, or when someone needed a cure for an illness. The well would draw people from across the local area, a social pilgrimage, each taking their turn to dip their cloth offering in the water and say a prayer, before affixing it to a tree or bush. Closely linked with good health, the pilgrims would hope for a good year ahead. Those afflicted with an illness or injury would wash an affected area with water from the well, then attach their cloth to the tree, the idea being that as it rotted and faded away so did their affliction.

Have any students visited such ancient water sources? Have they seen any clootie trees? How many family members have hung a strip of cloth (biodegradable cloth, of course) from a clootie tree? How much information can they discover about this topic? What kinds of texts appeal most to different members of the family? Which members prefer scientific texts, descriptive texts, images, oral texts, narrative or literary texts? If each member of the family, or each member of a small group selects a different style of text containing references and information about the same topic, the group will not only acquire a considerable diversity of data, they will also be exploring a variety of reading materials and writing techniques. For example, here is a brief selection from a poem[7] by Dilys Rose called '*Spirit of the Cloutie Tree'*:

> She ties clean clouts to her family tree –
> they bleach in the sun, drip in the rain,
> tussle in the wind, starch in the frost –
> guards keepsakes of all her drifted bairns
> on the offchance that in some idle moment
> one or two have a mind to come back home.

What can readers deduce about the woman referred to in the above lines? Why has a pronoun been used and not a name? How much information is contained in the verbs used in this extract? How could students present the meaning of these lines in dance? What is this person feeling as she ties strips of cloth to the tree? Why have the bairns (children) drifted away … and why might they come back – to the clootie tree or to their mother? A few lines of poetry can contain multiple layers of meaning which students might enjoy exploring.

Once each group has gathered together enough information, they should then decide how they want to present their conclusions. Perhaps they will be inspired to create poetry of their own, or they might prefer to produce an image or sculpture using

[7] The poem '*Spirit of the Cloutie Tree* by Dilys Rose can be found in the book *Lure,* published by Chapman in 2004.

recycled materials. They could create a map which registers the geographical positions for all of the clootie wells they have discovered, or they might search for the historical roots of the traditional Celtic reverence for pure water sources and compare this ancient respect with present day attitudes to water sources.

Our rubbish

In Chapter 1 we suggested that students should examine their own personal rubbish (or waste) and try to come up with strategies to reduce, reuse and / or recycle some of the things they normally throw away. In this chapter we are focusing on our immediate family. If any of the students have already attempted to reduce their own waste, they will now have the opportunity to work with the rest of their family to try to make an even bigger difference to the global waste problem. How much rubbish does each family throw away every day? What are their suggestions for reducing, reusing, recycling or composting? What do students already do in their homes to reduce waste? How many families already separate their waste into appropriate categories such as 'paper', 'plastic', 'cans' and 'glass' and place them in suitable containers for recycling? How many families produce compost for their gardens or for community vegetable or herb plots? Are any members of the students' family interested in talking to the class about the strategies they use and the results they have observed? For example, do any families use 2/3 white vinegar mixed with 1/3 baking soda as a general cleaning mix? How would they describe the results? How many families use their own bags when doing their shopping? What are the preferred characteristics of the family's favourite shopping bags? What do family members reuse glass jars for? What are the most unusual options for glass jar recycling identified by the class?

Students could explore suggestions for reducing, reusing and recycling online and share them with their families in order to decide which strategies to try out first. Of course, one of the simplest ways of reducing our waste is simply to consume less. There is currently a serious imbalance between populations considered to be obese and populations who do not have enough to eat. Huge numbers of people are eating far too much and making themselves extremely unhealthy in the process. This means that many health systems worldwide are using extra resources to care for people who have already used extra resources in order to become unhealthy. In the abstract of 'Obesity and its relation to mortality and morbidity costs' (2010), Behan and Cox state the following:

> There is substantial evidence that obesity is a worldwide epidemic and that it has a significant negative impact on health, mortality and related costs. Overweight and obesity are associated with increased prevalence of diabetes, cardiovascular disease, hypertension and some cancers. There also is evidence that increased weight is associated with kidney disease, stroke, osteoarthritis and sleep apnea. Moreover, empirical studies report that obesity significantly increases the risk of death. We used the results to estimate costs due to overweight and obesity in the United States and Canada. We estimate that total annual economic cost of overweight and obesity in the United States and Canada caused by medical costs, excess mortality and disability is approximately $300 billion in 2009. (BEHAN; COX, 2010, p. 2)

Clearly, if young children are encouraged to eat healthy portions of healthy food, together with all of their family members, they will form a support group which will contribute towards a much fairer distribution of food resources worldwide as well as a reduction in global health costs.

CHAPTER 3

THE ENVIRONMENT OF MY SCHOOL

What is the main purpose of a school? Should a school be an integral, active part of the surrounding community? Or should it be an isolated group of people whose main focus is for students to learn theoretical concepts? What is the relationship between 'my school' and 'my community'? Are students happy with the way things are? What would they like to change? How do the teachers feel? What would they like to change? How does the community feel about their local school? What is the school's attitude towards their immediate surroundings? To what extent is the school actively involved in local environmental campaigns? How does the school contribute towards positive change in the community? And how does the community support their local schools?

'Keep Scotland Beautiful' is a charity that "campaigns, acts and educates on a range of local, national and global issues to change behaviour and improve the quality of people's lives and the places they care for." (2016, p.2) According to their online booklet:

> We provide environmental campaigns, services and practical initiatives that help Scotland with its environmental ambitions and problems. Our unique spectrum of activities focuses on four main areas; sustainable development education, local environmental quality, sustainability and climate change and environmental services.
>
> We provide Eco-Schools in over 98% of Scotland's schools. Eco-Schools is the world's biggest sustainable schools programme with over 15 million children, young people and educators involved. In March 2016 the Foundation for Environmental Education (FEE) recognised both the Scottish Government and Keep Scotland Beautiful for their outstanding contribution to sustainable development education through the Eco-Schools programme.

During 2016/17, 'Keep Scotland Beautiful' (KSB) worked with more than 3,000 schools which were registered with the Eco-Schools Scotland programme, 1,000 of which were located in the most disadvantaged parts of the country. 'Eco-Schools' is the largest sustainable schools programme in the world, operated internationally by the 'Foundation for Environmental Education' (FEE). The programme connects 19.5 million children, young people and educators through sustainable development education with the participation of 67 countries on all five continents. How much do students know about the 'Eco-Schools' programme? Is their school involved or have they visited any of the schools who are participating? Is the school registered with other

programmes or projects which promote environmental improvements locally? To what extent are the students actively taking part? Do they have original ideas they would like to develop? Hopefully, some of the themes which will be explored in this chapter might stimulate students to contribute to positive environmental changes in their school which also produce benefits in the local community.

Topics: ❁ *My school environment* ❁ *The history of my school* ❁ *The structure and organization of my school* ❁ *What do we eat at school?* ❁ *Our school vegetable and herb garden* ❁ *Water use at my school* ❁ *My school's rubbish*

❁ *My school environment*

How do students and teachers get to school? How many people come by car, bus, bicycle? How many people are in each car? How many people walk? How much time do people take to get to school? How much exercise do they get on the journey? How could their journey be made healthier? Is there a school transport system? What percentage of students and teachers use this system? Which class is the most sustainable in terms of transport? How are students going to work this out? How many families have electric cars? According to an International Energy Report, "the global electric car stock surpassed 2 million vehicles in 2016 after crossing the 1 million threshold in 2015" (MAJOE, 2017, p. 5) What do students know about electric cars? Are other electric vehicles used in their area? What are the advantages and disadvantages of electric vehicles compared to other transport systems?

Which is the most sustainable form of transport in the students' opinion? What has changed if they compare the current situation with transport in their parents' time or in their grandparents' time? How do school transport systems vary worldwide? Which system do students find most interesting or most innovative? What are the questions students have about the effect of current transport vehicles on the environment? Transport in general is frequently linked to environmental problems such as air quality, noise, water quality, soil quality, biodiversity and land use. What do students already know about these areas and what would they like to investigate further?

As students discuss ways and means of exploring these questions, which curricular areas might be involved? Clearly any investigations which examine transport linked to environmental problems will inevitably involve *Social Studies, Science* and

Technologies. And as students build up databases and compare the results they have gathered they will also be using *Maths* and probably *Languages* in order to present their conclusions. Of course they should also be encouraged to explore the *Expressive Arts* to stimulate their imagination, creativity and empathy as they observe human experience through the eyes of others. And if students explore the positive and negative aspects of different transport options, they will also be exploring concepts related to *Health and Wellbeing* as well as *Religious and Moral Education*. For example, a 20 minute walk to school through a local park offers not only the benefit of healthy exercise but also the opportunity to breathe in clean air as well as extra oxygen produced by the trees. However, being driven to school in a car or getting a lift on a motorbike offers zero exercise, produces air pollutants and exposure to diesel exhaust. Which aspects of health or moral issues do students wish to explore first and why? Which options will be beneficial for our health? Which options are preferable on moral grounds? To what extent do our choices affect the lives of others? What are the positive and negative effects of our transport choices on ourselves and on others?

Another area for research is the physical route that students take to school. Which routes are the most popular? Can each class mark the different routes used on a local map? Could different groups build complementary sections of a three-dimensional scale model of the area around the school in order to appreciate the geographical organization of the space? How has this space changed over the past 50, 100, 150 years? How many trees, bushes, gardens, or parks do they pass on their way to school? Do they know the names of any of the trees, flowers, birds or animals that they pass? Can they describe or draw them accurately? How many different bird songs can they recognize? What other sounds do they notice along the way? Which is the most 'green' route to school? How many patches of wasteland, empty buildings, or building sites do students pass on their way to school? Can they come up with ideas to improve any of the abandoned areas? How many community allotments or projects are there near the school? Does the school itself have a green play area, a vegetable or herb garden, a flower garden? Is there space to develop an allotment to contribute towards school meals? Are students interested in developing hanging herb gardens around the school to flavor the meals with freshly-picked, school-grown herbs?

Questions such as these could encourage students to observe their surroundings and think critically about how to improve them, and by participating in group work, they have the opportunity to learn skills considered necessary for the future.

> Effective collaboration increasingly is a requirement in a great many contexts of adult life. The intellectual demands encountered in adult life are not only many and varied but also subject to frequent and rapid change. A large proportion of these are encountered in contexts that are collaborative. Collaborative cognition thus […] warrants a place as a core component of what educators are today calling 21st century readiness. Young people have not been well prepared for adult life today unless they are comfortable and well-practiced in addressing collaboratively the kinds of problems and objectives that 21st century life poses. Without question we need to learn how best to prepare them for these roles. (KUHN, 2015, p. 51)

The organization P21, or 'Partnership for 21st Century Learning'[8], believes that all learners need educational experiences in school and beyond to be able to build knowledge and skills for success in a globally and digitally interconnected world. The organization represents over 5 million members of the global workforce, uniting business, government and education leaders to advance evidence-based education policy and practice and to make innovative teaching and learning a reality for every child. In collaboration with the University of Connecticut, USA, P21 produced a research series with annotated bibliographies on four key conceptual issues which they believe are fundamental for innovative teaching and learning: Creativity, Critical Thinking, Collaboration and Communication. And as part of this series, the P21 Framework emphasizes the following abilities which need to be developed in order to invest in successful collaboration:

> (a) demonstrating the ability to work effectively and respectfully with diverse teams; (b) exercising flexibility and the willingness to be helpful in making necessary compromises to accomplish a common goal; (c) assuming shared responsibility for collaborative work; and (d) valuing the individual contributions made by each team member. (PLUCKER et al., 2015b, p.2)

As teachers, we need to continue to invest in our own learning in order for our students to learn as effectively as possible. How much do we know about the 4 Cs elected by the organization P21 as fundamental aspects of teaching and learning? Are we promoting creativity, critical thinking, collaboration and communication in and out of our classrooms? According to Kuhn (2015, p. 51) "Intellectual collaboration is a skill, learned through engagement and practice and much trial and error. Without sufficient

[8] The Home Page of P21, the organization 'Partnership for 21st Century Learning', is available at: <http://www.p21.org/about-us/our-mission>. Accessed on: 04.06.2021.

skill development, children may fail to benefit from it." Let's find out more about this subject and analyse what happens in our classrooms based on the knowledge we have acquired, and hopefully will continue to acquire, through research, sharing ideas with others, experimentation, observation and analysis in our classrooms.

❁ *The history of my school*

What do students know about the history of their school? What do they want to know? Previous chapters have suggested that students might be interested in exploring the history of their own names, and their family history, amongst other possibilities within the areas of Social Studies and Technologies. Which aspects of their school would they enjoy delving into? How far back in time is it possible to go? Are there any historical documents which mention local schools or centres of learning?

For example, when Columba moved from Ireland to settle on Iona in 563 AD, he established a monastic community which became an outstanding place of learning and a place of pilgrimage famous throughout Europe. The Book of Kells, a unique, highly illustrated copy of the New Testament, was produced by monks of the order of St. Columba, who lived on this tiny Scottish island around 800 AD, but then moved to Kells, in Ireland, to escape Viking raiders. Have students ever seen any of the art work from this book? The calligraphy and Celtic art work of the illustrations are exquisite and use an astounding array of colours. How long do students think it would take for one person to create one page of the Book of Kells? How much training would they need in order to complete this extremely delicate and complex art work? Can students construct a replica of any part of the book? Can they use the artistic style of this book to produce some art work of their own?

What kind of Technology was employed by the monks on Iona to produce the Book of Kells? The pages were made from *vellum,* using the skin of calves or sheep. How was calfskin transformed into *vellum,* is this process still used today? How were the different colours of the inks produced and where did the basic materials come from? For example, purple dyes were made from a specific kind of shellfish, as well as from elderberries, blueberries and various lichens; yellow from yellow ochre; and one specific shade of blue included *lapis lazuli* which could only be obtained from Afghanistan at that time.

As students learn more about the Book of Kells, they are not only exploring topics related to Religious and Moral Education, History, Geography and Social Studies, but they are also considering Technologies related to Art, colour theory and the production of illustrated books – a truly interdisciplinary undertaking. What other historical documents mention centres of learning or schools in Scotland? In the first chapter of a book called 'History of the Burgh and Parish Schools of Scotland' written by James Grant in 1876, he mentions documents dated between 1100-1200AD which prove that schools in places like Aberdeen, Abernethy, Glasgow, Kelso, Lanark, Linlithgow, Perth, Roxburgh, St. Andrews and Stirling, already existed at that time and were closely connected to the church.

What information can students find out about their own school? Was it associated with the local church as well? How many students are registered in the oldest documents available? Did the school teach boys and girls? What ages were they? What subjects were taught? Were the teachers men or women? How many teachers were there in the oldest document and how have the numbers changed since that time? How did teachers qualify for the post and how were they selected? When did these older teaching practices change and why? What has changed most during the life of the local school? How has the building changed, or the infrastructure, the organization of the classrooms, the equipment, the subjects that are taught? What changes would students like to see in the future for their school?

Perhaps students could form teams and decide amongst themselves what exactly they should investigate and how, and also what their desired outcome should be after a specific amount of time. How many teachers of different subject areas would like to work together on these projects and how are they going to organize their timetables? Collaborative interdisciplinary work sometimes requires reorganization of the school structure in order to function effectively. Is this possible in your school? If not, what needs to happen in order for innovative practices to be tried out?

❁ *The structure and organization of my school*

What do students think about the infrastructure of the school? What are the positive aspects and what would they like to change? Can they make a floor plan of their classroom or of the whole school? Can they produce graphs showing the number of chairs, desks, books, laptops, musical instruments, games and other equipment

available? Is the school colourful and inviting or dull and institutional? How do students and staff feel when they get to school – happy and excited or dispirited and cast-down? What would they like to change in order to generate a more exciting, creative atmosphere? How are they going to organize and finance these changes? What might be a first step?

Perhaps each classroom could come up with imaginative, forward-thinking ideas for their 'Dream School', then representatives from each class could meet and organize priorities which could be voted at a school assembly. How democratic is your school? To what extent are students and teachers involved in decisions related to the structure and organization of the school? When decisions are taken democratically, are they taken more seriously? If not, why not? How open and successful are communication channels at different levels throughout the school?

Many different kinds of games can be used to motivate learning at school – which are the most popular games at your school? How many of the popular games involve physical challenges, visual challenges, language, mathematical or logical challenges? How many of the games require group collaboration, creativity, critical thinking? According to Dr. Chuck Cadle, Chief Executive Officer for Destination Imagination Inc.:

> Learning how and when to be creative, how to build cross-cultural teams, how to manage budgets and risk, how to present a compelling proposal, and how to manage a project from beginning to end will provide students with the necessary skills to become the next generation of problem finders and solvers, innovators, cross-cultural collaborators, entrepreneurs, and leaders. (CADLE, IN. PLUCKER, et al., 2015a, p. 2)

To what extent does the school invest in music and drama? How many students are involved in school orchestras, or singing and instrumental groups which involve a wide range of music styles and ability levels, combining students and teachers? How many students participate in a school or community drama society? Do they produce their own props and costumes? How many performances do they give each year? How frequently does the school promote a Science Fair? How many students are actively involved? Does the Science Fair involve teachers and students interested in *Expressive Arts* and *Languages* as well as *Science, Maths* and *Technologies* in order to communicate and demonstrate their findings successfully?

The government body 'Creative Scotland' emphasizes the importance of creativity as follows (2013, p. 9):

> […] we need to be creative. We need to generate the ideas that will allow us to rise to the challenges of a global economy and an endangered environment. We need to be able to invent and develop our science and technology. We need to be able to write the poems and stories that reflect and enrich who we are. We need to express that through the visual arts, music, through theatre and dance, through film. And in doing so, we need to eradicate the false demarcation lines between the expressive arts and every other subject. Creative learning and teaching is the most fulfilling route to both deep learning and a rounded adulthood.

So what are the creative ideas that students have for improving their school environment and how do they intend to present these ideas to the school and to the community in order to transform them into reality?

❁ *What do we eat at school?*

How many students have school lunches, how many take their own lunch to school? What do parents know about the school lunches? To what extent are menus multicultural? Does the catering staff provide 'tasters' for parents and students to try 'different' or more unusual dishes? Where do students eat? Can students with packed lunches mix with those taking school lunches? To what extent is the social aspect of eating taken into consideration? How much do students and parents know about healthy eating? In the previous chapter we asked whether students were applying in their own homes what they had already learned about healthy food at school. Now we can ask whether the information that is being taught about healthy eating is in fact being put into practice in the school itself. For example, does the school offer fresh fruit and vegetables regularly? Do students consume the recommended daily intake of fresh fruit and vegetables at home and at school? Which drinks are consumed most frequently by students? Do they bring them from home or are they made available by the school?

Do schools offer soft drinks, fruit drinks or flavoured milk to students or do students bring their own drinks? What is the sugar content of all the different drinks being consumed by students at school? How much do students know about what happens to their bodies and their brains when they consume too much sugar? Do they know that excess sugar can impair both our cognitive skills and our self-control, since sugar often stimulates a craving for more? Where might students obtain more information about these topics? What kind of books are there in the school library? If they decide to look

for information online, do students know how to identify reliable sites? How often do they simply believe the first answer that comes up in their search and how often do they compare information from different sites? Do they know how to look for the author's name or the date of publication for each site they explore? Have they ever checked the site's home page to understand more about each source of information?

It is important to remember that although most students are 'digital natives', this does not necessarily guarantee digital literacy and proficiency in online communication. For example, many digital natives seem very happy with a 'one-click' answer. They ask a question online and immediately accept the first answer that comes up. They very rarely take the time to analyse or compare different answers or check their sources. They seem to believe that any written text is true and tend not to investigate sources or analyse texts for anomalies or contradictions. For these reasons, they may also be susceptible to persuasion and bias. Students should therefore be taught to examine texts in depth in order to identify techniques which can be used to influence the opinion of the reader. They need to learn to check the reliability of a text by searching for complementary texts by different authors about the same topic, and comparing what each author has to say on the same subject. They should also learn to check the credibility and authenticity of their sources in order to develop informed opinions about the issues they are investigating. According to Erin Wilkey Oh (In. DILLEY et al., 2015a, p. 4):

> […] communicating today requires skills and competencies unimagined in generations past. To communicate successfully in our personal, academic, and professional lives, we need technical know-how, an understanding of the protocols and norms of various digital tools, intrapersonal communication skills that support interactions with a wide variety of people, and a developed awareness of how to use technology safely and responsibly.

It may therefore be necessary for teachers to explore online information together with their students in order to help them identify reputable sites as well as analyse and compare various sources of information. For example, how many teachers or students have heard of the nine-year-old Scottish schoolgirl Martha Payne who started a blog called *NeverSeconds* in April 2012 writing about her school meals. She was concerned about the quality of the meals, as well as the nutritional content, and she also became very interested in the organization, *Mary's Meals*, and its fight to feed hungry children across the world. Are these two sites still accessible online? What do students think of them? Can they find similar sites and compare them? What are the positive aspects and some of the negative aspects of each site they find? After a general search and

discussion perhaps the students could form teams around different aspects of the sites they have found and analysed in order to come up with proposals for a site of their own? What would be the main aim of the students' site, how would it be organized and who would their potential readers / contributors be?

Martha Payne started her blog as a writing exercise and also to chat with family and friends about her school lunches and was amazed when she reached a million hits by May 23rd, after receiving many fascinating comments and photos of school lunches from students around the world. Martha had already raised some money for *Mary's Meals* the previous year, so she decided to try to raise money to build a new kitchen for this organization in Malawi using her blog, and, through her blog, Martha managed to raise over £130,000.00 for them by the 4th February 2014 – an amazing achievement for such a young girl. The aim of the organization is to provide one good meal every school day for some of the world's poorest children. The site describes the desired impact of their work as follows:

> By providing a daily meal in a place of learning, we meet the immediate needs of hungry children and encourage them to go to school to gain an education that can, in the future, be their ladder out of poverty.
>
> Our programmes work to bring about the following positive changes in the lives of children and their communities:
>
> **Short-term changes**
>
> - Reduced hunger.
> - Increased school enrolment.
> - Improved attendance, concentration and learning.
> - Increased progression between grades.
> - Improved health and wellbeing.
>
> **Long-term changes**
>
> - Encouraging community support for education.
> - Support for smallholder farmers.
> - Increasing government recognition of school feeding. [9]

Sample research based on some schools in Malawi described the following findings on the same site:

> For example, the percentage of children saying they feel hungry at school at least 'sometimes' decreased from 87% to 13%. The percentage of teachers saying 'children in my class never complain of hunger' increased from 7% to 87%. [and] 98% of teachers said that children pay more attention in class since Mary's Meals started feeding at their school. [also] 99% of children said they find it easier to learn at school.

[9] Mary's Meals: The impact of our work. Available at: <https://www.marysmeals.org/what-we-do/the-impact-of-our-work/>. Accessed on February 27th, 2019.

What do any of the teachers or students know about *Mary's Meals*? Are they familiar with any other charities or organizations which are concerned with providing school meals or improving existing school meals? Perhaps students could search for similar sites and analyse their aims and results in order to compare different aspects of their work. What nutritional changes would students like to see at their own schools? Are they in contact with other schools in Scotland, in the UK or internationally? What have they discovered about school meals elsewhere which they find interesting? How could these areas of interest be developed into projects to promote in-depth communication and nutritional improvement? To what extent can healthy eating and drinking be explored across subject areas? The ES publication 'A Curriculum for Excellence' makes the following connections:

> The development of the health and wellbeing curriculum provides an opportunity for working across curriculum areas. For example, successful participation in expressive arts activities can make an important contribution to a young person's sense of wellbeing, and there are clear connections between, for example, science and healthy eating and physical activity, and between learning about relationships and religious and moral education (ES, 2006, p. 11)

So, for example, students could select any of the food or drinks that are available for consumption at school as a topic for research. We will discuss water more specifically in the following section, but students could analyse any other liquids which are offered to the students as part of school lunches or those which they bring to school themselves. Are students able to discover the sugar content for 100ml of different commercial drinks, do they notice that different sources use different measurements? Can they convert teaspoons into grams and fluid ounces into milliliters, or the number of grams in 250ml cans into the correct proportion for 100ml? These exercises would definitely involve Mathematical knowledge. And if students decided to analyse the nutritional value of the drinks available, Science would also be included as part of the project.

Perhaps students could study the nutritional value of different fruits and promote a competition to discover the most popular smoothie in the school, with different teams producing, describing and analyzing the nutritional aspects of their favorite drink. Students could also be asked to identify the different components which have been put into assorted smoothies by tasting them. For example, chef Davy Devaux shows how to

make his favourite green smoothie on YouTube[10]. His ingredients are: apple, pineapple, avocado and mint. He illustrates the texture of the drink by dropping a teaspoonful of the smoothie into a glass of water. The smoothie blob floats in a ball near the surface of the water – a fascinating demonstration of buoyancy, density and texture. How would students describe the different flavours and textures of their favourite smoothies?

On the other hand, some students might be more interested in trying out some of the 'rainbow' smoothies suggested by Honeysuckle Catering published on 1 Jan 2017[11]. The pink smoothie includes strawberries, pineapples and bananas as well as several other ingredients; the yellow one is based on mangoes, banana and peaches; the orange one has a carrot, papaya, mango, banana and ginger; the green one has kale, banana, apple, avocado, pineapple and parsley; the blue one has blueberries, strawberries and banana; and the purple one has acai, blackberries, strawberries and goji berries. Let's try different combinations to produce an alternative rainbow smoothie? By using some frozen fruits, there is no need to add ice to the mixture, which would dilute the juices, and by including ingredients which are naturally sweet – such as bananas, pineapple, beetroot, carrots and blueberries, extra sugar or sweetener becomes unnecessary.

Colour is clearly an extremely important factor in the making of these smoothies, so depending on the disciplines involved and the age and interests of the students, tasks involving the exploration of colours could be proposed. For example younger students could produce graphs using different colours to represent each student's favourite fruit. They would be investing in the application of mathematics while exploring colour, taste and nutritional value, thus promoting links to the expressive arts and healthy eating habits. If they are asked to present and discuss their results, they will also be investing in the development of language and communication.

Older students could investigate connections between the colours and patterns of fruits, flowers and seeds, their nutritional implications and the associations between colour and pollination which are integral components of the lifecycle of plants. Do students know that "we as humans perceive [colour] with our limited trichromic (red, green, blue) vision" whereas bees, butterflies and hummingbirds also have "visual receptors for the

[10] Chef Davy Devaux makes the best smoothie in the world. Available at: How to Make Sushi. Published on 4 Sep 2013. Available at: <https://www.youtube.com/watch?v=uzZX_vGsbPM>. Accessed on: 04.06.2021.
[11] 7 Life-Changing Healthy Smoothies. Published by Honeysuckle, on 1 Jan, 2017. Available at: <https://www.youtube.com/watch?v=WSa5J8BN4Ww>. Accessed on: 04.06.2021.

ultraviolet"? (QUINA & BASTOS, 2018, p. 681) According to these authors the colours and the patterns produced by plants "provide a contrast against the green-brown background colours of vegetation and can serve as strong visual clues for pollinators" (Ibid) Perhaps students would enjoy finding out more about the different visual results when humans, bees or butterflies look at the same flower?

What other aspects of visual processing related to plant development and food would students like to explore? Depending on their areas of interest and the specific teachers or subject areas involved, students could explore some of the very different connections between the perception of colour, the chemical properties of colour, pollination, and the pigment of plants and food choices, which could lead to discoveries related to the history of art as well as botany and human attraction to colour, texture and taste. When the history of schools was discussed earlier on in this chapter the different dyes used to illustrate the Book of Kells was mentioned, and several were plant-based. So clearly it is possible to explore topics related to the Expressive Arts, Science, Health and Wellbeing, Social Studies, as we use Languages, Maths and Technology to communicate students' discoveries to their classmates and the wider community – several content areas working together within one project.

If students taste an unknown smoothie mix, how many ingredients can they identify? How would they describe the taste and texture of each smoothie? Can they also describe the taste and texture of each separate ingredient? How much do students know about the different nutritional characteristics of each ingredient? What would it cost to create each of the drinks they have tasted? Which fruits are in season at different times of the year? Does the school have access to orchards or allotments which produce different kinds of fruit for school consumption? Perhaps students could compose different kinds of texts, word games or puzzles using the ingredients, or the descriptions they have used related to each drink. Once again students can combine different disciplines as they explore the nutritional properties of specific ingredients and focus on the strong links between food choices, sustainability, health and wellbeing. Meanwhile the school itself can concentrate on providing food and drink which is in line with a whole school approach to promoting health and environmental sustainability. The Convention of Scottish Local Authorities (COSLA) believes that:

> Food on the plate should be promoted in line with learning across the curriculum and there should be a clear connection between the choices on the

> menu and the values around education and health. This can be achieved through: menus which educate young people by providing information about the provenance of food on the school menu and describe the characteristics and flavour of the recipe; menus which, through the produce featured, indicate the values of the catering service, e.g. fish from sustainable stocks; and menus which make reference to: authority standards (such as fair-trade), the avoidance of genetically modified ingredients, or the healthier cooking methods used. (COSLA, 2014, p. 33)

However, we should remember that the schools themselves are not the only organizations who should be concerned about what children are eating during their time at school.

> Public health, GP surgeries, hospital services, leisure and cultural services, environmental health and licencing services and planning, roads and transport departments in local authorities can all support schools and catering services improve the experiences and opportunities for children to promote healthier choices in school. (COSLA, 2014, p.17)

Food choices in schools depend on a network of decisions and agreements which should encompass the values being taught in schools and the health and wellbeing of the students who frequent them. If schools are environmentally conscious and intend to teach students to become aware of the necessity for a more sustainable lifestyle, then relevant information should be made available, and schools and their associates must demonstrate that they are practising what is being taught.

Our school vegetable and herb gardens

Have any teachers or students proposed hands-on learning activities involving the catering staff and school kitchens? Perhaps each class could analyse their food preferences and discuss some of the changes they would like to make in order to include items which they find more appealing, reflect more cultural diversity or which add more colour, remembering of course, that nutritional value must always be maintained. Students could work together with the catering staff in order to produce a menu which reflects the proposals of each class, perhaps choosing one day in the week as 'student choice day', with a specific class being responsible for the menu for that day each week. Students would learn about nutritional balance, portion sizes, costing, how to work with a budget, how to make use of seasonal foods, amongst many other aspects of school catering. According to COSLA (2014, p. 13), research carried out by 'Children in Scotland' showed that "children do not always put their learning into practice and that schools could pay more attention to children and young people's preferences and also involve them in improvements." Children of all ages could therefore be encouraged to

become more actively involved in decision-making which takes account of their own inclinations and healthy choices.

The food offered at schools should not only be following the standards stipulated by those responsible, but should also attempt to influence future behaviour related to food choices, since nutrition education should be considered a priority for the development of healthy adults. “An enjoyable and satisfying school meals service which inspires young people toward a healthy appreciation of food and therefore a more positive food culture in Scotland has to be at the core of what drives school food and drink provision.” (Ibid., p. 32)

One strategy which can serve to encourage students to try different foods is for them to be actively involved in the production of food. Does the school have a vegetable garden? Are there any fruit trees planted within the school grounds or fairly close to the school location? Have students made ‘hanging herb gardens’ to decorate some of the external school walls? What other strategies would stimulate students to become more enthusiastic about trying out healthy food options – what do the students suggest? How would they organize these school gardens? Who would take care of the plants? Who would help with the food preparation? If there is no space within the school grounds can students discover any alternatives – such as a nearby allotment or a piece of waste ground? Are there any families who would be willing to offer their own vegetable plots for school use whereby a rota system could be organized so that the work is shared between several class members? By involving students in planning and decision-taking at different levels, they will tend to participate more actively.

Are there any dietary needs or religious constraints that require specific foods, combinations or preparation? What do students know about the different herbs or spices used by particular cultures or age groups? Are they aware of the fact that many herbs and spices were used primarily for medicinal purposes throughout history before being used to flavour food? For example, sage, one of the four classic herbs ‘parsley, sage, rosemary and thyme’, well known because of the traditional ballad ‘Scarborough Fair’, was even said to help against the plague in medieval times. According to Leech (2017, online):

> Sage gets its name from the Latin word *Salvere,* which means "to save." It had a strong reputation for its healing properties during the middle ages, and was even used to help prevent the plague. Current research indicates that sage

> may be able to improve brain function and memory, especially in people with Alzheimer's disease. Alzheimer's disease is accompanied by a drop in the level of acetylcholine, a chemical messenger in the brain. Sage inhibits the breakdown of acetylcholine. In a 4-month study of 42 individuals with mild to moderate Alzheimer's disease, sage extract was shown to produce significant improvements in brain function. Other studies have also shown that sage can improve memory function in healthy people, both young and old.

Can students think of different foods they have eaten which have included sage? For example, I have fond memories of my mother's sage and onion stuffing for roast chicken. Sage is often used to make meat patties (or burgers), to flavour fish dishes, soups, gnocchi, ravioli or to make pesto with other herbs. Do students have favourite recipes which include this herb? Has anyone tried sage in a smoothie? How many students have sage growing in their garden? How would they describe the plant or would they prefer to draw it? Perhaps it could be planted in a pot at school and be looked after by a group of students? Which other herbs would students like to grow at school? Looking after plants and observing their growth is an interesting and educational process which can involve several different disciplines as students register their observations through writing, measuring, drawing, etc.

Another common herb with many powerful medicinal properties is peppermint. In an article written by Sayer Ji (2018, online), founder of the site *GreenMedInfo*, we are given the following information:

> A favorite herbal medicine of the ancients, peppermint leaves have been found in Egyptian pyramids dating back to 1,000 BC. […] Today, modern scientific investigations are revealing an abundance of potential health benefits associated with the use of different components of the peppermint plant, including aromatherapeutic, topical and internal applications. Most of the human research on peppermint performed thus far indicates this plant has great value in treating gastrointestinal disorders, including: Irritable Bowel Syndrome […] and infantile colic.

Students could develop projects which combine Science and Social Sciences as they investigate the use of plants to promote Health and Wellbeing. In the same article the author also refers to scientific studies which indicate that peppermint oil has been found to reduce tuberculous inflammation; alleviate hay fever; improve the pain associated with shingles; enhance memory; reduce nausea caused by chemotherapy; inhibit the growth of prostate cancer; and can protect against radiation-induced DNA damage. (JI, 2018, online). Nevertheless, the same author also warns us about the possible effects of the overuse of plant remedies:

> Like all plant medicines, extreme caution must be exercised when using extracts and especially essential oils. Also, remember that more is not always better. A recent study on the use of rosemary in improving cognitive performance in the elderly found that a lower 'culinary' dose (750 mg) was not only more effective in improving cognition (as measured by memory speed) than a higher dose, but the highest dose (6,000 mg) had a significant memory impairing effect. This illustrates quite nicely how less can be more, and why an occasional nightly cup of peppermint tea may be far superior as preventive strategy than taking large 'heroic' doses of an herb only after a serious health problem sets in. (JI, 2018, online)

In this section Ji emphasizes the importance of Mathematics as well. How many students have personal experience of plant remedies in their own families? To what extent were they effective? What do they remember about the dosage, the frequency, or the methods used? Did family members infuse leaves or fruits to make tea? What other methods did they use to produce ointments, tinctures, syrups or conserves? What are the specific proportions of different ingredients, or the frequency that the remedies would be given / applied? How much experience do older members of the community have related to plant remedies? Students could prepare a list of questions they are curious to know more about and figure out how best to find the answers. The acquisition and sharing of knowledge through personal contact and practical experience will help to broaden students' experience and understanding.

❁ *Water use at my school*

If students do decide to embark on the organization of hanging herb gardens or a vegetable garden at school or elsewhere, they will necessarily have to think about water sources to keep their plants alive. In the previous chapter we focused on the amount of water each family member should consume each day, but now we will be focusing on the water consumption of the school. How much water will the vegetable garden consume? To what extent will the vegetable garden add to the school water bills? Where does the school water come from? Is it drinkable? Is drinking water provided for the students at all times?

There are three main sources of water – ground water, surface water and rain water. Which sources are used to maintain the school? Perhaps rainwater could be collected to water the gardens and for cleaning purposes? How would the rainwater be collected, what could be used as recipients, where should they be placed? Is the water consumption controlled in any way? Which aspects of school life consume the most water? Could the collection of rainwater help to increase the water efficiency of the

school? It is possible to calculate the amount of rainwater you can harvest by multiplying 1mm of rainfall by 1 m^2 of roof which will give you 1 litre of water. The small book 'Water Efficiency in Schools', lists several questions which can help students understand how their school uses water:

> - Do we have any leaking taps, toilets, or drinking fountains?
> - Where, when and how do we irrigate? And how much water is required to irrigate our green spaces?
> - What kind of water sources do we use and what else could we use?
> - What size rainwater tank do we need?
> - How do we connect it to toilets and gardens?
> - How efficient are our water devices?
>
> (SUSTAINABILITY VICTORIA, 2016, p. 6)

This booklet also offers several suggestions to help students discover more about the school water consumption. The first suggestion is to look back at previous bills for water consumption. These bills can be used to calculate average annual, monthly or daily costs, as well as the average water use per person, and can also help to work out how much would be saved if the school reduced their water consumption by a specific percentage. Water meters and sub-meters can help students to compare water consumption in different areas of the school and can also help to identify leaks. The infrastructure of the school can be analysed to help pinpoint areas which require structural improvements and to identify possible alternatives.

How economically and environmentally sustainable are the toilets, urinals, basins, drinking fountains, hot water systems, canteens, kitchens, gutters, rainwater tanks, gardens? Has the school installed dual flush toilets? How many taps use aerated water which can reduce the quantity of water used by up to 50%? How much excess water from water fountains is being collected and used for cleaning or for gardening? When students are actively involved in investigating these processes they might become more motivated to promote changes in behavior which will contribute to more sustainable water use. Sustainability Victoria (2016, p. 2) holds the position that:

> Water efficiency benefits your school in many financial, educational, social and environmental ways.
>
> 1. *Reduces your water and energy costs.* 2. *Builds young leaders and provides learning opportunities.* 3. *Builds a strong school culture based on good communication and shared goals.* 4. *Raises the school's profile.* When the school is involved in water efficiency activities it connects with the community through partnerships and local networks. 5. *Contributes to a*

> *better environment through water efficiency*. You will be doing your part in building a better and more sustainable planet now and into the future.
>
> This guide reflects the fundamental principle of ResourceSmart Schools by encouraging a whole school approach to embedding sustainable practices across the school. The whole school approach is a more successful approach because the whole school is working together and celebrating the achievement of shared goals.

This advice comes from Australia, a country which contains some of the driest locations on the planet, so it is understandable that they should be strongly concerned about water efficiency. However, even though it may seem to rain frequently in the UK, the growth of industry and the overall increase in population show that water efficiency has become a global necessity which requires local action as well as global cooperation. So students should commemorate any significant changes they make and share their success with their community. They could also contact other schools around the world to find out what they are doing to improve their water efficiency. By sharing knowledge and building sustainable strategies through collaboration, everyone will reach their goals.

My school's rubbish

Earlier in this chapter the subject of school lunches was explored in some detail but now that we are considering how to deal with the school's rubbish we may want to ask the following questions: How much waste is produced during lunchtime? Is more waste produced by students who consume school lunches or by those who bring lunches from home?

How many open-ended questions' are students able to come up with related to school waste? Questions which are open-ended and require a variety of answers often instigate more thought-provoking projects than the more simple 'one-option-only' style of questions. For example, when students analyse the food that is left over after school lunches, they might discover that a considerable amount of potatoes is included in the 'rejected' food. If they decide to investigate the question: *Do students prefer mashed potatoes or fried potatoes?* There are only two options being offered, and the person being asked the question is expected to select one of these two options. Therefore the outcome of their research will be a majority decision in favour of one of the options offered.

However, if they ask questions like: *What is your favourite recipe for potatoes?* They are much more likely to receive a plethora of answers which will lead to further research and deeper levels of questioning. What could students do with the answers to this question? They might select some of the most popular answers (such as 'mashed potatoes') and ask students about the ingredients for their favourite version of this dish. After analyzing the results they might then decide to publish the results on school noticeboards and set up a competition for the most creative, the most colourful, or the most nutritious recipe for an innovative version of mashed potatoes, which would be judged by representatives from the student body and served as part of a special school lunch. It is therefore important to stimulate students to formulate as many open-ended-questions as possible during the initial phases of every group discussion or project in order to encourage them to explore any and every topic at different levels and follow diverse lines of enquiry.

So what kind of open-questions might arise related to school waste? What kind of food or drink is being left on the plates after school lunches? What different kinds of recipients are being used to serve drinks? Which recipients are most eco-friendly? What happens to any bottles or cans after use? How many students bring in their cup, mug, water bottle from home? When students bring in their own lunches, what kind of waste is produced? What is the nutritional value of home lunches compared to school lunches? What is the difference between the various lunch options (home-made, commercial, school lunches) in terms of nutritional value and the amount of rubbish produced (plastic wraps, cardboard boxes, cans, etc.) How can this situation be improved? What can be done to motivate students to reduce their own personal waste? According to COSLA (2014, p. 50) one of their challenges is: "To use school food as an entry point for young people to learn about the impact of food choices on individual health and the environment, and to understand their role in the conservation of natural resources, food waste and recycling."

What happens to the kitchen waste after the preparation phase for school lunches? How much is used to form compost for the school garden? What happens to food which has been cooked but has not been served? How much is recycled or donated to needy families or institutions? How are the ingredients for school lunches delivered? How many layers of packaging are involved? How many alternative fresh food sources can be found near the school which would deliver in more sustainable ways? What kind of

packaging do students bring with them to school? For example, if they bring chewing gum or sweets with them, an apple or an orange, what do they do with the papers, the cores or the skins? If the school has selective rubbish bins, to what extent are students conscious that they should use the correct bins? If there are no selective bins, what do students do with their rubbish? How much waste can be found in playgrounds or in classrooms at the end of each school day and what solutions can students suggest to improve the situation?

Perhaps students could carry out a general waste inspection to discover more about the habits related to rubbish awareness in their school. The Minnesota Pollution Control Agency in the USA analysed the waste produced by six schools over a two-day period in April 2010. All of these schools had organics programmes in place. There were two elementary schools, two middle and two high schools, and both urban and suburban schools were included. Their conclusions were as follows:

> The most prominent materials in Minnesota schools' waste are food waste and recyclable paper (cardboard, office paper and mixed paper). True garbage (material that cannot be readily recycled or composted) is only 15% of what schools are throwing away. Just by fully capturing for recycling traditional recyclables (paper, metal cans, plastic bottles and glass bottles) and compostables, **schools could divert 78% of what they generate**. As recycling markets expand and collection infrastructure is developed, materials like plastic film and other types of plastic containers have the potential to push diversion rates higher.
>
> […] the way waste is handled at schools sends an important message to all the students who will form habits there and carry them into Minnesota's future. Making the effort to act on the potential for improved waste management at our schools will return dividends in schools' saved dollars and in conserved natural resources. (CIOCI; FARNAN, 2010, p. 31, my emphasis)

How can we reduce the waste produced in school? One possibility is to use reusable trays, plates, bowls and utensils and get students who have school lunches to organize what they have not eaten into (a) items which are still wrapped or unopened which can be returned for consumption by others, or (b) leftover food on plates or partially consumed food which can be placed in a receptacle for food-to-animals programmes. Students who bring their lunch from home can also place leftovers in a food-to-animals bin or take home what they have not eaten to provide feedback for parents.

However, the time available for eating and the social aspects of eating in groups should also be considered when analysing the amount of food left on students' plates. Perhaps students could be encouraged to produce 'food waste' diaries where they could describe

and register the weight of the food they have wasted and write about the reasons they have not consumed it. Also, if they are writing online and intend to print out the final version, students should remember to reduce the margins and use both sides of sheets of paper to reduce waste paper. Group discussions of these diaries might help students to become more aware of the amount of food which satisfies them and the reasons they are rejecting some types of food categories. Hopefully this expanded awareness could help them to reduce the amount of food they have been wasting by controlling the amount of food they take and not accepting food they know they are not going to eat.

The analysis of waste production in the Minnesota schools showed that some materials were being recycled successfully while others were not. For example, more than 95% of the cardboard collected had already been placed in the correct recycling container, whereas only 33% of the plastic bottles and 39% of the glass bottles had been correctly placed for recycling. However, the organization of materials which can be recycled through composting proved to be an area requiring even more investment. The same study showed that more than 60% of the material which could have been recycled through composting was not placed in the appropriate bins available. "For all schools combined […] 15.5% of the trash could be recycled and 47.4% could be composted Thus, 63% of what is now disposed of could be handled in a more environmentally friendly manner." (CIOCI; FARNAN, 2010, p. 25-26)

Although these schools already had recycling systems in place, the study detected 11% of contamination within the recycling system. In other words 11% of the recycled items had been placed in the wrong containers. "The most prominent contaminant found in the recycling stream was liquid which accounted for 47% of the total contamination." (Ibid. p. 28) Clearly liquids were not being emptied from their bottles or cans before being placed in the recycle bins. "The second most prominent contaminant […] was non-recyclable paper which accounted for 17% of the contamination. There is often confusion about which types of paper are recyclable and which are not." (Ibid) So perhaps students need to understand more about the different categories used for recycling, and could have been reminded to empty their liquids, in order to become more efficient in terms of their waste management.

Recycling contamination occurs when materials are sorted into the wrong recycling bin, when they are mixed, or when they are not properly cleaned. Contamination occurs, for

example when the following materials find their way into recycle bins: plastic containers with leftover food or drink; hazardous or unwanted materials such as batteries, paint, needles or other sharp objects; potential recyclables with oil and grease on them; Styrofoam or frozen food containers with shiny exteriors, which are not recyclable. Also, if we put recyclable materials such as textiles, glass, or metal objects into plastic bags before being placing them in recycle bins, the plastic becomes a contaminant. Moreover, if one person places their recyclable materials in the wrong bin, the whole bin will become contaminated, and might be rejected and sent to landfill, or cause safety hazards for recycling workers, or even damage recycling equipment. According to various National Waste statistics, "Over a quarter of the material in the recycling bin does not belong there. Glass, metal, wood, textiles, food, garden waste and hazardous waste should all be in other bins or brought to a separate collection." (EPA-Ireland, 2018, online) Since increased contamination leads to increased processing costs, and loss of recyclable materials, it seems to be the case that the general population needs to learn more about how to recycle successfully, because the Minnesota students had only contaminated 11% of their waste compared to some national figures of 25%.

CHAPTER 4

THE ENVIRONMENT OF MY COMMUNITY

How many people in the local community have heard of the young Swedish schoolgirl, Greta Thunberg, who became aware of climate changes related to human activities when she was only eight years old? She became clinically depressed when she was about 10 because she was so concerned about the topic climate change and the fact that nothing seemed to be being done about it. A few years later, when she was 15, she started a one-person school strike outside the Swedish parliament, which launched a global movement of school strikes within a very short space of time. In the same year, 2015, she gave a TED talk in Stockholm, and was referred to as an international climate activist in the interview 'Straight Talk' for the group *ScientistsWarning.org*.

What do we know about climate change? Have we examined climate change as it has affected our local community in geological terms? To what extent do human actions affect climate change? What other factors are involved and whose voice are we listening to?

> **Climate impacts:** Children in communities around the world are already experiencing the impacts of climate change. […] Children are the least responsible for the causes of climate change and yet are most vulnerable and bear the most significant impacts.
>
> **Environmental degradation:** The most disadvantaged children are also the most likely to live in poor and environmentally degraded environments. […] Air pollution in urban areas, risks from chemicals, waste, polluted water, and the lack of green and clean areas for children to play are crucial issues for UNICEF.
>
> **It is our collective responsibility to leave a sustainable world for our children and their children, who will have to face the impact of climate change and environmental degradation.** (UNICEF, 2014, online)

Where do we live? How many schools are there in our community? What do we know about climate change? To what extent is the local population concerned about human-induced climate change or environmental degradation? Are local schools promoting active community involvement to guarantee a safe and healthy environment for present and future children of the community?

I lived in Lockerbie, Dumfriesshire, Scotland, for the first 18 years of my life and studied at Lockerbie Academy for 13 of those 18 years, the only school in a town of

approximately 4,000 inhabitants. While I was at school, in 1960, the total human population increased to three billion from the 1930 count of two billion. I was already aware that there was a global 'greenhouse effect' being studied by scientists, but I was not consciously aware of possible consequences.

I then lived in Edinburgh between 1972 -79. I studied and worked there before leaving for Brazil, where I still live – in a small village near the sea which has one modest primary school. During my time in Edinburgh, the human population reached four billion in 1975, an increase of one billion in only 15 years, half the time taken for the previous increase of the same magnitude. In the same year, the term 'global warming' was beginning to be discussed – but I knew very little about possible causes of this phenomenon. I was also unaware that local action might help reduce adverse effects caused by the ever-increasing growth of the human population. The term 'global' did not seem to stimulate local action. Instead, the term created the impression that the problem was too overreaching, too overwhelming for individuals to be able to make a difference. This lack of connection between 'local' and 'global' phenomena is, of course, one of the main reasons that the present book begins by promoting each individual's awareness of their own actions, since our 'global' problems will only be solved by the sum of the individual changes we make to our present way of living.

In order to promote a more conscious awareness of every student's local responsibility to his immediate community, the following topics will be explored in this chapter:

Topics: ❁ *The history of my community: ethnic diversity* ❁ *The geography of my community* ❁ *Local ecosystems* ❁ *Local soil* ❁ *Local water* ❁ *Rubbish collection in the community*

We will start off by examining some historical aspects of our local community.

❁ *The history of my community: ethnic diversity*

What do students know about the history of their community? How can the ethnic characteristics of the community be traced? Have they read any of the historical documents held by their local library? What can students discover online? According to Dr. Francis Pryor (2011) writing about the Neolithic and Bronze Ages for the BBC:

> Around 10,000 years ago, the latest ice age came to an end. Sea levels rose as the ice sheets melted, and Britain became separated from the European mainland shortly before 6000 BC.
>
> The people living on the new islands of Britain were descendants of the first modern humans, or *Homo sapiens*, who arrived in northern Europe around 30,000 - 40,000 years ago. Like their early ancestors they lived by hunting and gathering.
>
> The introduction of farming, when people learned how to produce rather than acquire their food, is widely regarded as one of the biggest changes in human history.
>
> This change happened at various times in several different places around the world. The concept of farming that reached Britain between about 5000 BC and 4500 BC had spread across Europe from origins in Syria and Iraq between about 11000 BC and 9000 BC.

What do students know about Neolithic, Mesolithic or Bronze cultures? Have they heard of the Neolithic site called Skara Brae on the west coast of mainland Orkney which dates from 3180 – 2500 BC? Orkney also has several groups of standing stones (Neolithic henge monuments) such as the Ring of Brodgar, believed to have been erected between 2500 – 2000 BC, as well as the Standing Stones of Stenness which are thought to be one of the oldest groups of standing stones in the British Isles, dating from around 3100 BC. In fact two archaeologists, Higginbottom and Clay (2016), studied the circle at Stenness, as well as the Callanish stones on the Isle of Lewis, to try to discover whether there were links between the stone monuments and astronomy. They describe their findings as follows:

> *Through innovative statistics and software* we show that visible astronomical-landscape variables found at Bronze Age sites on the inner isles and mainland of western Scotland were actually *first established* in stone nearly two millennia earlier, likely with the erection of two of the earliest dated British 'great circles': Callanish on the Isle of Lewis and Stenness on the Isle of Orkney. It is seen that whilst different standing-stone monuments were created over time […] with a mixture of landscape variables […], we nevertheless see that highly relevant landscape markers and other aspects *remained unchanged* through these years. This suggests that there is some continuity of this cosmological system through time, despite the various radical material and social changes that occurred from the late Neolithic to the Late Bronze Age […]. (HIGGINBOTTOM; CLAY, 2016, p. 249, authors' emphasis)

How fascinating to discover that ancient monuments which were raised more than 5,000 years ago focused so strongly on emphasizing compelling connections between the landscape and the cosmological system. Are there any remains of ancient cultures in the local community which help us to broaden our knowledge in specific areas? What questions do students have about such ancient cultures? How can they discover answers? What would everyday life have been like at that time? Students could list

some of the basic similarities and differences between the Neolithic and Bronze cultures compared to their own lives. What would these people eat and drink? How would they prepare their food? What would they wear? How would they make their clothes? How would they move from one place to another? What other questions would students enjoy exploring? How can the results be presented most effectively to the community? Through theatre, song, art exhibitions, a display of artefacts, a blend of different options? How would they compare the differences in environmental impact caused by these ancient cultures compared to the impact of our present way of life?

If we move along the historical timeline to the period of the Roman Empire, we encounter a large number of written documents which register many important facts. For example, an online site maintained by the BBC (2014, online) presents information about the major tribes who lived in Britain at the time of the Roman Conquest between 55 BC and 410 AD. Roman writers of the time, Tacitus and Ptolemy, registered at least twenty-seven different major tribes, eight of which were living in the area now denominated Scotland. However, when we read the description of the tribe Caledones, often referred to as the Caledonians, who lived in the North of Scotland, we discover that this name refers not only to the main single tribe 'Caldones' but also includes all other tribes living in the North at that time, including the Cornovi, the Smertae, the Caereni, the Vacomagi, the Carnocae and the Creones. Have students heard of any of these ethnic groups? The other main tribes living in Scotland at this time were the Taexali, the Venicones, the Epidii, the Damnonii, the Novantae, the Selgovae and the Votadini.

The tribes who lived in the south-west of Scotland were the Selgovae (thought to be hunters) and the Novantae who are believed to have been farmers and herders, although there is little archeological evidence for these people before the Romans invaded. The area between Edinburgh and Northumberland was occupied by the Votadini, a tribe of considerable size composed of several smaller groups. They built massive walls, banks and ditches around their farms, as well as huge hillforts on the top of prominent hills which were used for refuge, meetings and religious ceremonies, whereas the Novantae did not leave any evidence of structures like these. The Venicones, who lived around Tayside, buried their dead in stone-lined graves and, like the Taexali, who occupied the Grampian area, made offerings of valuable decorated objects such as impressive bronze amulets worn on their arms. None of the other tribes used ornaments such as these.

Therefore it is clearly the case that the various tribes inhabiting Scotland at this time were very diverse cultural groups.

What do students know about this historical period in Scotland? Have they seen any artefacts which are evidence of the Roman occupation of Britain? Where did they see them and what did they learn from them? How many artefacts or archaeological sites related to any of the tribes who lived in Scotland during the Roman invasion have they seen? How would they compare Roman culture with the local 'tribal' cultures of that time? How did these different groups coexist and communicate with each other? We should remember that although Latin was the official language of the Roman administration, the Roman army was composed of soldiers from all of the territories which had previously been conquered, so there would be speakers of many different languages in the same army.

As different languages melded with Latin in a variety of ways, a family of Latin-based languages developed in several regions of Europe, such as Italian, Spanish, Portuguese and French. Similarly, the large numbers of Scottish dialects, which can sometimes be mutually unintelligible even today, may have links to the languages spoken by the original tribal groups who used to populate different parts of the country. How can we find out more about these topics? Which aspect of this historical period do students find most fascinating? How do they want to explore this period in more depth?

The English language also contains a considerable number of Latin-based words since the Romans ruled over Britain for more than 400 years. Then, later on, in 1066, the French speaking Norman dynasty conquered England, and French became the official language of the elite, co-existing with Latin, for the following 300 years. So perhaps students can relate some Latin-based words in English, to similar words in languages such as Portuguese, Italian or French? For example, the online site *CognateLinguistics*[12] offers a list of words from the same Latin origin in these languages, as follows: *accent (Eng), acento (Port.), accento (It.), accent (Fr.)*; *adult (Eng.), adulto (Port.), adulto (It.), adulte (Fr.)*; *animal (Eng.), animal (Port.), animale (It.), animal (Fr.).* Interestingly, although some of these words look identical in different languages, the pronunciation is usually quite different. Do students know how to pronounce all of the

[12] Cognate Linguistics. Available at: <http://cognates.org/research/mfcogn2.html>. Accessed on: 04.06.2021.

above cognate words in their respective languages? If students engage in research related to cognate vocabulary they might realise that some languages are easier to learn than they might have believed previously, and they will also become more conscious of the different ways that language can reflect historical and cultural change.

In the autumn of AD 84, Agricola, the Roman Governor of Britain, led his final battle against the Caledonians at Mons Graupius in the North of Scotland and this battle is described in some detail by his father-in-law, the famous Roman writer, Tacitus. According to Tacitus, Calgacus, leader of the Caledonians, made a memorable speech to his people before this final battle:

> Robbers of the world, having by their universal plunder exhausted the land, they rifle the deep. If the enemy be rich, they are rapacious; if he be poor, they lust for dominion; neither the east nor the west has been able to satisfy them. Alone among men they covet with equal eagerness poverty and riches. To robbery, slaughter, plunder, they give the lying name of empire; they make a desert and call it peace.
>
> Nature has willed that every man's children and kindred should be his dearest objects. Yet these are torn from us by conscriptions to be slaves elsewhere. Our wives and our sisters, even though they may escape violation from the enemy, are dishonoured under the names of friendship and hospitality. Our goods and fortunes they collect for their tribute, our harvests for their granaries. […] Creatures born to slavery are sold once and for all, and are, moreover, fed by their masters; but Britain is daily purchasing, is daily feeding, her own enslaved people. (TACITUS, *Agricola* 29-32, c. AD 85)

Although this speech is being reported by a Roman citizen, the Romans are certainly being strongly condemned for their actions. The famous Roman Empire is being openly accused of "robbery, slaughter, plunder". Children of the conquered are being torn from their families and sent elsewhere as slaves. Their 'lust' for power and domination is never satisfied. So the question arises – to what extent did the Romans 'civilize' the territories they conquered and to what extent did the conquered territories suffer under domination? How far back does the history of slavery go? What do students know about the Modern Slavery Act of 2015? To what extent are diverse world cultures able to work together for the greater good? Do students believe that world peace and harmonious co-existence is possible? What can each individual do to make this goal feasible?

Perhaps older students could analyse their local community in an attempt to identify areas of dispute as well as examples of teamwork. Can we learn to listen to different points of view and truly understand what the other person is trying to say? What are

some of the techniques which can be used in order to solve disagreements? How can young children learn to work together successfully? What can be done in the community to promote greater collaboration in as many different areas as possible? How can we learn to share different areas of expertise, resources and responsibilities in order to join forces to achieve the goals which have been defined by the groups we are working with?

Are there any minority groups in the community who speak different languages and find it difficult to participate in community projects? Multilingualism is crucial for intercultural relations and, as we have seen already, was certainly present in Britain during the Roman invasion. However, given the present growing rates of global access to communication, it is essential to consider the different motivations for language learning while becoming more aware of the complex linguistic landscape which exists around us. For example, there are many communities in which speakers of minority languages are unable to communicate with public service providers. According to Taylor (2013, p.3): "language barriers may challenge the provision of basic human rights, particularly in court procedures [where] a lack of linguistic skills or access to effective interpreters or translators can restrict access to justice."

Are there any language barriers in the local community? Are there any dialect barriers? Do members of the older generation use any dialect words which the younger generation does not understand? How many languages are spoken in the community today? How many languages are spoken in each classroom? Does anyone use sign language or braille? Perhaps the students could conduct a survey to discover the current percentage of speakers for each language spoken in the community. They could also organize the results according to a time scale if they gather information for specific age groups.

Which languages are being taught in the schools of the community at the present time? Which languages did the students' parents and grandparents learn at school? In Lockerbie in 1836, parish schools generally taught Greek, Latin, French, English, writing, arithmetic, book-keeping and practical geometry amongst other subjects. (DOUIE, 1836, p. 457) Which languages have students learned independently of school – and how did they learn them? Which languages are offered at evening classes or community centres? Which are the most popular or the most needed?

The Reverend Douie (Ibid) also registers the fact that there were two libraries in Lockerbie and "Every person in the parish above fifteen years of age can both read and write. About eight young men go annually to attend the different classes at the University of Glasgow and Edinburgh." What is the existing situation in the local community? How many males and females attend university? How important is reading and writing for the local community? What is being done to promote these activities? Is the local population encouraged to read and write in different languages? How are libraries being used – have they been modernized to accompany technological development? How many community projects involve the active participation of the library? To what extent are local students using different languages to communicate the aims and outcomes of their community projects to a wider and more diverse audience?

> Language is at the core of thinking. We reflect, communicate and develop our ideas through language. Literacy offers an essential passport to learning, helping young people to achieve to the full and be ready for active involvement in society and work. Literature opens up new horizons, and a love of reading can be an important starting point for lifelong learning. As we communicate increasingly through digital technologies, we need to be able to interpret and convey information in new ways and to apply discernment. (EDUCATION SCOTLAND, 2006, p.13)

One fascinating aspect of language change is the speed with which slang appears and disappears over time. So perhaps students could collect examples of slang words (and their meanings) from different age groups to help them become aware that language is constantly changing and developing. Another way in which language can indicate historical change is by examining the etymology of place names, since the history of geographical names illustrates the way various languages contributed to the formation of the United Kingdom as we know it. For example, the origins of the place name 'Lockerbie' seem to come from *'loc'* which means an 'enclosure', together with *'hierde'* meaning a 'herd' of sheep or cattle, both words coming from Old English. However, the addition of *'bie'* seems to come from Old Norse, meaning a village. What an interesting mixture of Angle, Saxon and Viking heritage in one small place name. If indeed this information is correct – because other sources suggest that *'longp(h)ort' or 'lock(h)art'* is a Celtic word meaning a 'dwelling'. So clearly, more research is required. What do students know about the origins of local place names? How much do they know about the cultures of the people who spoke these languages? What do their parents and grandparents know about these topics? How would students like to register and share the information that they discover?

How has the local community changed over time? We have already suggested several possible areas for exploration, but we could also investigate changes in professions. Once again Douie provides interesting information. In 1836, with a population of 2.283, the professions listed for the population of Lockerbie are as follows:

> Professions: 20 grocers, 1 hardware and 4 cloth shops, 5 surgeons and 2 apothecaries shops, 2 midwives, 5 writers, 4 messengers, 8 weavers, 13 tailors, 7 joiners, 2 wheelwrights, 9 blacksmiths, 4 nailers, 3 watchmakers, 4 bakers, 3 fleshers, 1 barber, 3 cloggers, 2 saddlers, 2 tanners, 4 stocking-framers, 1 cabinet-maker, 8 shoemakers, 12 stone-masons; in the country part there are 4 millers, about 100 ploughs, 400 horses and 50 farmers. (DOUIE, 1836, p. 459)

Does this list of professions help students build up a clearer picture of life in Lockerbie in 1836? How does it compare with a list of the existing professions? Which of these professions would students have preferred to practice in 1836 and why? Do students know whether any family members of previous generations were involved in any of these professions? Have any artifacts from past professions survived in the family's possession? What was the impact on the environment of the professions in 1836? How does that compare with the impact of the existing professions? How many members of the older generation remember tales or stories told by their grandparents or great-grandparents about life in the 19th century? How many traditional arts and crafts survive locally? How many family members remember traditional folk songs or dances from the different cultures that made up the community at that time? How many students know these songs or dances? Is there anyone locally who is willing to teach them? How far back do local memories go? Are students able to unearth any historical photographs, books, diaries, shopping lists? What can these diverse sources of information tell us about the relationship between the community and the environment at various times in history? According to Education Scotland (2006, p. 34):

> Through social studies, children and young people develop their understanding of the world by learning about their own people and what has shaped them, other people and their values, in different times, places and circumstances, and how their environment has been shaped. They learn about human achievements and to make sense of changes in society, conflicts and environmental issues. With greater understanding comes the opportunity to influence events by exercising informed and responsible citizenship.

Perhaps students could build up a flow chart, a series of murals, a play, or a video which shows how the community has changed over time? How could the results of such investigations be presented most successfully to the community? As students try to discover more about their community, the community as a whole will gradually become

more strongly connected to school life, just as the school will become a more active participant in the life of the community. The relationship between school and community should be mutually interactive as they collaborate with one another to improve the environment which surrounds them.

❁ *The geography of my community*

In the previous chapter, students investigated the route between their homes and their school. If each student has already made a map of their specific route, perhaps teachers could suggest that they now try to join these different routes together in order to build up a geographical representation of where the different members of the class live in relation to each other. Students could work together with members of the community to produce a colourful mural as a result, or a three dimensional model, applying their knowledge of the *Expressive Arts*.

> There is tremendous scope to work in partnership with the wide range of artists and musicians, co-ordinators and organisations in culture and the arts who are able to enliven and enrich young people's experiences and learning. The school's own community of parents, neighbours, staff and children will also have a wealth of skills and experience to contribute. (EDUCATION SCOTLAND, 2006, p. 7)

Which students live very closely together, and which students live far away from each other? What is the minimum distance a student covers from home to school and what is the maximum? What is the fastest route? What is the time difference according to the transport used? Which is the preferred route and why? Even more questions could be asked in order to develop students' knowledge of *Maths,* bearing in mind, however, that students should also be encouraged to ask their own questions in order to develop abilities related to *Scientific Thinking* since: "The most important goal for science education is to stimulate, nurture and sustain the curiosity, wonder and questioning of children." (Ibid, p. 30)

Do students have access to a large-scale map of their community? Can they mark the homes of each class member on the map? If they are using online maps, the students could be organized into small units. Then if adjacent units turn their screens sideways so that each unit can only see their own screen, Group A could use a 'street view', where the visual information looks as though you are walking along the street, and Group B could use a 'map' view. Then each pair of groups would take it in turns to describe the route between one student's home and another while the partner group tries to follow

the instructions. For example, Group A could use the 'street' view to give instructions to Group B as to how they should go from the home of student R to the home of student T, while Group B uses the 'map' view to follow the instructions.[13] This kind of exercise helps students to use language with more precision and focus and also learn how to follow instructions more easily while making visual connections between the different ways of representing local topography.

Students could also make observations about the positive and negative environmental aspects of each route. For example, are they walking along roads with heavy traffic or along a river bank? How many alternative routes are there between the same homes which would increase students' *Health and Wellbeing*? Which would be the preferred route by the majority of the class – and why? According to Education Scotland, "Learning through health and wellbeing promotes confidence, independent thinking and positive attitudes and dispositions. Because of this, it is the responsibility of every teacher to contribute to learning and development in this area." (2006, p.10) Of course, students should not restrict themselves to simply 'learning about' the topic *Health and Wellbeing,* they should also be putting into practise everything they learn. After working with online maps, it is important for students to compare the online versions to reality. So each group should then follow the route they were given in the classroom and take notes of the similarities and differences when they compare the online maps with the actual route. What features would they change in order to enhance their health and wellbeing?

What other aspects of community life can be observed while travelling from home to school? How many churches or other religious meeting places can be found along the route? What do they know about the beliefs of these different groups? Perhaps students could investigate the different beliefs represented in their community. How would they do this? One possibility would be to elect representatives from each class and ask them to work together to produce a simple inclusive questionnaire about students' belief systems or religious affiliation. Of course the questionnaire should be as neutral and multicultural as possible and would be completed by everyone. The data collected for each class could then be analysed initially by the class that produced the data. Then all

[13] I would like to thank a previous student of mine, Lucas O. Martins Silva, for this excellent idea.

of the class reports could be evaluated and interpreted by the original group of representatives from each class in order to present their results to the whole school.

During the production of the questionnaire, and the various stages of analysis, students and teachers could take notes of specific topics and questions which stimulate curiosity. These can then be explored further in projects involving the participation of community members. It is extremely important for schools to promote the discussion of beliefs and feelings in order for society to learn the meaning of true collaboration for the greater good.

> Children and young people need to learn to respect and value other people and to develop an understanding of their beliefs and feelings. This will help them to develop positive relationships, promote equality and fairness and counter discrimination. (EDUCATION SCOTLAND, 2006, p. 9)
>
> Through religious and moral education, children and young people can be encouraged to develop an understanding and respect for people of faiths and beliefs other than their own and for those who adopt a stance for living which is independent of religious belief. By considering moral and ethical questions in a secure environment, children and young people can develop their own ability to make moral and ethical judgements about right and wrong. They can learn to act with concern for others and for the world we live in. (Ibid. p.23)

We will be able to collaborate much more successfully during any project which aims to improve the environment of our community and beyond, when we are able to respect and value people who think differently from ourselves.

❁ *Local ecosystems*

Community geography is an aspect of research which analyses the interaction between human beings and their immediate environment. For example, the Human Geography Research Group (HGRG) at the University of Glasgow studies "stressed environments and communities", described as follows:

> A developing strand of HGRG research examines how environments and communities become stressed, and with what emotional, ecological and earthly consequences. Stress is a common term in ecosystem and human health, which refers to a physical or mental pressure, strain, or tension exerted upon an individual or environment. […] New environmental conditions experienced worldwide are producing unexpected multispecies entanglements and conditions for life-threatening trans-species infections.
>
> […] Our distinctively geographical approach taken to the study of these stresses is committed to collaborative and interdisciplinary inquiries […]. Together, we seek to forge new spaces, impacts, and modes of being-in-common that are less stressed, less fractured, and more caring. (HGRG, online).

According to Paul Wheelhouse, Minister for Environment and Climate Change, Scotland, "We urge local communities to seize opportunities to manage and improve their local environment. […] We need more landowners and managers to appreciate that protecting nature is a vital part of their role because so much of our nature relies on their stewardship. Together, we can make a difference." (SCOTTISH GOVERNMENT, 2013, p. 3) Are students able to identify areas of 'stress' in their community? Which areas of human stress would they single out as requiring immediate attention? What are the signs which help them recognize areas of environmental stress? To what extent can these disparate areas of stress be improved together? What would be students' initial proposals for reducing both human and environmental stress?

Martin Faulkner from Scottish Natural Heritage (2016, p. 19) emphasizes the necessity for creating and improving existing green infrastructure in urban areas because "access to natural and semi-natural habitats has a significant positive impact on physical and mental well-being. It has the potential to reduce the causes of many illnesses of modern life such as cancers, diabetes, obesity and anxiety and depression." How many students agree with this statement? How do they feel when they find themselves in natural green habitats compared to urban built-up areas? Which green areas could be improved? What are their ideas for improving or expanding these areas?

Would they like to renew the local flora by collecting seeds and cuttings from the wild flowers in old woodlands, as they work together with volunteers and plant experts from the community? Or would they prefer to plant native shrubs, plants and trees to produce nuts and berries? How many students still forage in local woods or hedges for different native berries, such as blueberries, brambles, raspberries or elderberries? How many families still make jams, jellies or pies with these fruits? Or are they used for medicinal purposes? For example, hawthorn berries are said to help reduce cardiovascular problems, whereas the flowering plant Meadowsweet contains salicylic acid which relieves pain and reduces fever. According to Stewart Borland (2015, online)

> Our hunter-gatherer ancestors lived in the **wildwood**. They collected the fruits of trees and shrubs, ate an amazing variety of greens and roots from the forest floor and hunted wild animals large and small that shared their ecosystem. Along with the fruits to be gathered from the nearby sea and shore, such as fish, sea-kelp, and crustaceans, the ancient woodland offered humans enough nutrients and medicines to survive and thrive.

What do we know about the fruits and medicines of the ancient wildwood? For example, the plant comfrey is considered by many authors to be one of the most effective medicinal plants for accelerating cell growth and was used in medieval times to stimulate the healing of broken bones. It is also anti-inflammatory and can be used to soothe stomach ulcers. Another common plant which often appears on garden lawns, and is highly recommended to farmers as a forage herb, is the Broadleaf Plantain (*plantago maior).* The leaves can be made into a poultice which can be applied to wounds or stings to prevent infection and to promote healing. However, it is also nutritious, containing high levels of calcium as well as vitamins A, C and K, so young leaves can be added to salads, and older leaves to stews.

Perhaps students could share their proposals for creating or improving green areas in the school catchment area with their parents and other members of the community, since, according to the Scottish Government (2013, p. 7) "communities involved in decision-making take pride in their local environment." This quote is taken from the publication *2020 Challenge for Scotland's Diversity: a strategy for the conservation and enhancement of biodiversity in Scotland* which approaches the topic 'sustainable management of land and seas' while adopting an 'ecosystem' or network approach. The writers explain this approach as follows:

> This idea of a 'network' is grounded in a well-understood feature of nature that species depend on each other in complex relationships; that movement of species across or through the environment requires proximity or connectivity of habitat; and that some species require different habitats for different aspects or stages of their lives. It also recognises the fact that energy and information are carried through natural systems, and that water, nutrients and elements such as carbon are cycled, stored and recycled in complex ways. The term 'network', then, encompasses this idea of functional connectivity, interdependence and the channels of energy, material and information flow that life requires. […] But, as we have seen from the *UKNEA 2011* [*UK National Ecosystem Assessment*], some ecosystem services are deteriorating. Work on a national ecological network should endeavour to redress and restore these services. Development of green infrastructure in and around our towns and cities will help, as should enhancement of ecosystem health across river catchments. (THE SCOTTISH GOVERNMENT, 2013, p. 16)

The Scottish Government offers the 'Place Standard' tool[14] online to provide a framework for analysing some of the physical as well as the social aspects which should be taken into consideration when adopting an ecosystem approach for the analysis of our community. This tool asks us to think about aspects such as: public transport,

[14] SCOTTISH GOVERNMENT. Place Standard: how good is our place? Available at: <https://www.placestandard.scot/#/home>. Accessed on: 04.06.2021.

feeling safe, streets and spaces, influence and sense of control, housing and community, play and recreation, natural spaces, social interaction, work and local economy, etc. Perhaps students could use this tool to analyse various facets of their community, then evaluate alternative proposals, before deciding which aspects they would consider essential as part of their own ecosystem framework to improve their local environment?

After applying the 'Place Standard Tool' to discover which areas require priority investment, students could form teams around issues which interest them most, such as the topic 'Play and Recreation'. They could then start off their investigations by analysing the opportunities which are already available in the community to decide what could be done to improve them. They should check whether each area is easily accessible to the public, including people with disabilities. How many public bus routes provide a stop nearby? Is there adequate bicycle and wheelchair access? Is there adequate lighting for the recreation area to be used in the evening? Is there sufficient protection from the weather and how safe is it? What permanent apparatus or equipment is available and what condition is it in? Can the equipment be used by different age groups, including people with disabilities? How often is the area used for organized activities such as team sports or competitions? When organized activities are taking place, can the area still be used by individuals or small groups? What are the most frequent activities being practised in each specific area? What other activities could function there? How often is the space being used and what could be done to make more effective use of the space? What would students like to improve in each area and how could they bring about these improvements?

As students analyse these questions and work together with other members of the community to enhance or create local areas for play and recreation, they will be investing in the physical as well as mental health and wellbeing of the community as active collaborators working towards a positive ecosystem which they can be proud of.

Another team might form around the topic 'Natural Space' in order to analyse and improve the natural spaces which already exist in their community and perhaps create additional green areas. They could start off by mapping the natural spaces which already exist, then work out how many students have access to natural spaces near their homes. How safe do they feel in these spaces? How accessible are they for all age groups, including those with disabilities? How many areas of their community have very few

natural spaces? What could be done to help make these areas greener? How many abandoned spaces or waste spaces could be transformed into community allotments to produce fruit and vegetables? How many landfill areas could be converted into parks? How can students persuade the local population to convince official representatives to help transform their ideas into reality?

As students work together to improve their community, they will be investing in their sense of place and place identity, which will probably strengthen their attachment to the environment around them. This identification with the place where they live will also contribute to their own sense of personal identity.

Local soil

One of the aspects of the community which can also be analyzed is the condition of the local soil. What do students know about the ground which surrounds them? How much access to different types of soil do they have? When they travel from home to school do they go past areas with natural soil or is the whole journey taken over man-made surfaces with no gardens or green spaces on route? How many students have access to gardens? How frequently have they planted vegetables or fruit? How experienced are they in taking care of flowers, bushes, trees? How close do they feel to the earth and growing vegetation?

Have students ever wondered why the planet where we live is called 'Earth'? According to the online dictionary of Etymology, the word comes from Proto Germanic, through Old English, meaning "ground, soil, dry land". The meaning gradually expanded to refer to "country, the material world, the abode of man" and was first used to refer to our planet around 1400 AD. Do students want to know more? What names would they choose for our host planet – and why?

What would they like to change about our planet – and why? What are they doing now to help our host planet continue to sustain life forms as we know them? One of Earth's environmental aspects which requires careful nurturing is of course the soil, which can be thought of as the outer 'skin' of our planet. Why is it important to look after the earth? What are some of the different uses for the soil in our community? What is growing from the soil around us? How many plants do we eat which are produced in local soil? Remember that plants growing from the soil are part of the food chain which

also involves insects (pollination, honey) and animals (meat). What do we grow in our gardens? Who decides what we grow? What would students change about their present plant environment – and why?

We also use the soil as a foundation for building and transportation. However, these activities usually seal the soil, which is one of the main causes of soil degradation, since the surface no longer receives air, or water which are essential for the health of the soil. The Scottish Environment Protection Agency (SEPA) has produced several interesting booklets related to soil, one of them has the title 'Soil: an introduction to the issues' where we are told that the basic composition of soil is: 25% air; 25% water; 45% mineral particles; and 5% organic material. This booklet also provides the following information:

> Soil consists of a mixture of minerals of different sizes, organic materials (including roots and living and dead organisms), as well as varying amounts of air and water filling the spaces in between the complex structure of solid particles. The relative amounts of these materials and what they are made of determines the properties of the soil. (SEPA, online, p. 4)
>
> Healthy soil allows us to grow food and valuable raw materials. It cleans our water and can help to reduce the risk of flooding. We build our homes on it and it supports habitats and biodiversity. Soil plays an important role in the battle against climate change by storing carbon and it helps to maintain the balance of gases in the air. It also preserves our heritage. (Ibid., p. 6)

What are the characteristics of the soil in the students' community? Does it vary in different places? Are there sandy areas as well as dark earth areas? What does the colour and texture of different soil types tell us about the properties of the soil? What do students know about local geology? What is the proportion of sealed soil to open soil in their school grounds? Do students practise sports on grass playing fields or on sealed soil? Which do they prefer – and why? What other questions do students have about the soil? Do they know that almost half of the world population lives or works in buildings made from the soil? Scottish construction also uses earth in different ways – how many buildings in the community have used soil as part of their construction?

Do students know that "one gram of healthy soil can contain approximately one billion organisms" and that "almost all of the antibiotics that we take to help us fight infections were first made using soil micro-organisms."? (SEPA, online, p. 6-7) How can we find out more about what happens in the soil? One obvious suggestion is to mount a wormery in the classroom. The SEPA publication 'Wriggle: connecting life in the soil'

offers instructions on p.14. This booklet is based on a social networking site which was originally set up for four worms, *Fety*, *Terry*, *Cali* and *Rubi*, who would interact with students to demonstrate various facets of their lives underground. The booklet provides a wide array of information about the relationship between worms and the soil and was also used to produce a board game for younger students in 2015.

What are the main environmental problems related to the soil and how can they be solved? According to the SEPA booklet 'Soil: an introduction to the issues':

> By reducing the erosion of sediments and nutrients into rivers and lochs, we help to prevent diffuse water pollution. Keeping soil in the fields also ensures that the nutrients are available for the plants.
>
> By reducing ammonia emissions from intensive agriculture – including pig and poultry farms – we help to prevent ammonia from being emitted to the air and subsequently deposited on the land. This helps to protect the soil, as well as vulnerable habitats and species.
>
> By ensuring the application of organic materials to land is controlled we help to ensure that the soil is not inadvertently damaged when we enhance its productivity. (SEPA, online, p. 14)

How can we keep local soil as healthy and productive as possible? In a special edition of the magazine *SepaView*, produced by the Scottish Environmental Protection Agency in 2015, the International Year of Soils, several projects currently functioning in Glasgow were mentioned. For example, *Playbusters*[15] set up a project to encourage people to grow their own food and to adopt more active and sustainable habits; *Urban Roots* had a mission to "transform derelict or unused green spaces into thriving, blossoming community gardens where herbs and vegetables, fruit and flowers can be grown."; members of the *Glasgow Local Food Network* were "striving to produce more of what we eat and eat more of what we produce."; and the *Federation of City Farms and Community Gardens* offered various resources including a 'Community Growing Resource Pack' specifically for Scotland. (SEPAVIEW, 2015, p.9).

However, the main topic of the article 'Urban Food: growing in the city' in the magazine *SepaView*, is the project 'Lavacore Glasgow', a social enterprise founded and managed by Reuben Chesters who states: "Our overall purpose is to build a local food system that's better for our environment, better for our communities and better for local

[15] The references given for the projects in the *SepaView* magazine, 2015, are as follows: *PlayBusters* (www.playbusters.org.uk); *Urban Roots* (www.urbanroots.org.uk); *Glasgow Local Food Network* (http://glasgowlocalfood.blogspot.co.uk); *Federation of City Farms and Community Gardens* (www.farmgarden.org.uk).

economies. We think the best way to get people to think about their food is actually to produce it locally." (Ibid., p. 8) He promotes a subscription vegetable bag scheme where several growers produce a variety of crops such as fast-growing rocket, white beetroot which has edible leaves, and a Japanese species of kale which can survive during the winter months. Reuben started his business by cultivating small plots in the back-courts of tenements, but in 2015 he was using an abandoned tennis court to develop his Urban Croft, or city smallholding. Since many abandoned industrial spaces around and within Glasgow were heavily contaminated in the past, growing sites must be chosen very carefully since it can be costly to restore contaminated soil to healthy soil where food can be produced.

What could students do in their own community to learn more about different kinds of soil and perhaps adopt the idea of 'producing more of what we eat and eating more of what we produce'? Can students come up with other catch phrases which might stimulate the community to invest effort in protecting and reclaiming local soil? Are there any abandoned tennis courts locally? How many community members would be in favour of transforming this space into a communal allotment? Are there local tenements with back-courts? If so, what are the back-courts being used for? How many tenants would be interested in using part of the space to plant fruit trees, or vegetables?

David McVey and his colleagues investigated the motivations and experiences of community garden participants in Edinburgh, and they discovered that "community gardens grow much more than just food, they grow community." (2018, p. 1) At the time of their investigation there were more than 44 community gardens in Edinburgh, many of them localised in former council estates. Perhaps students could interview people who have already worked with community gardens to find out more about their experiences before investing in community gardens of their own? Before starting a garden, of course, it is essential to know more about the quality of the soil. Are there local industrial spaces or waste grounds which have been abandoned? Has the soil been contaminated in any way? What would have to be done to recuperate the soil?

One of the most common causes of soil degradation is soil erosion which can be caused by natural processes or human activities. The author Joel Gruver, in 'Nature Education Knowledge' compares soil erosion caused by natural processes with the erosion caused by human activities:

> Geologic erosion is a natural process through which wind, water and ice have carved the earth's surface for thousands of millennia. […] Natural erosional processes occur most intensively in mountainous regions and generate approximately **20 gigatons** of sediment annually (Wilkinson and McElroy 2006). In comparison, human geomorphic activities, principally agriculture, construction and mining mostly occur at lower elevations and annually move **more than 100 gigatons** of earth materials (Hooke 2000). Humanity has surpassed the timeless contest between uplift and erosion as the dominant agent of geomorphic change. […]
>
> Human activities that significantly reduce soil cover (e.g., tillage and clear-cutting) and/or intensify wind or water movement (e.g., the removal of windbreaks and channelization of streams) often result in accelerated erosion that exceeds geologic erosion rates by several orders of magnitude. (GRUVER, 2013, p. 1, my emphasis)

Clearly, thinking about soil does not limit students to studies of *Geography*, since geological studies can take us back literally millions of years. Through the analysis of rock or soil samples, we can discover a considerable amount of information related to the history of climate change throughout the existence of our planet Earth, which might even help us to understand our present situation more clearly. We can also discover important aspects about the relationship between human beings and the environment through *Archeological* studies of the soil from sites of historical human habitation. And as we compare human soil use in the past with soil use in the present, perhaps we can learn how to invest in future soil use in order to maintain and improve the health of our soil.

Local water

In the previous chapter the main focus was on promoting sustainable practice and water use in schools. Obviously, the same practices can be expanded and adopted by the local community which serves each school. However, in this chapter, we will examine community resources and problems in order to consider how students could be involved in raising awareness and proposing solutions.

Nevertheless, it might be important to check that students understand the basic water cycle before further investigation. Scottish Water[16] provides teaching ideas for different levels which include several practical experiments which will help students to understand the basic Water Cycle of 'Evaporation – Condensation – Precipitation'. For example, they suggest breathing onto windows; drawing round puddles at specific times

[16] Scottish Water – Education – Modules. Available at: <https://www.scottishwater.co.uk/Help-and-Resources/Education/Modules>. Accessed on: 04.06.2021.

during the day; making a condensation trap; collecting rainwater in a jar and observing the levels as it evaporates in the classroom; comparing 2 glass jars with the same amount of water set on a windowsill, one with a lid and the other without, remembering to mark the water levels over at least 4 days, etc. Another experiment uses a stick of celery (or white flowers) standing in water mixed with food dye to show that the water moves from the soil up the plant.

What do students know about their local water resources? Is the interactive site 'Water Classification Hub'[17] provided by SEPA (the Scottish Environment Protection Agency) still active? This site provides general as well as specific information about surface water sources, groundwater, protected areas, bathing water and shellfish waters. For example, the small river where I used to bathe as a child near Lockerbie, the Water of Milk, is classified as being in a generally Moderate condition (data from 2015), whereas the Black Esk river a few miles away is considered to be in Good condition for the same time period. However, if we explore further, we find that both the Water of Milk and the Black Esk are considered to be Poor in the items 'Overall Ecology' and 'Fish' but High in 'Aquatic Plants', so the general condition of the river does not refer to all of the specific conditions which were analysed. Nevertheless, when I checked the 2017 data for the coastal area and the groundwater of Edinburgh, both were considered to be in Good condition across almost all of the data collected.

How many different tools are available at the present time for analysing local bodies of water and which aspects are being analysed? To what extent are students able to follow the different characteristics of water quality across time? Which aspects are improving and which aspects still need investment? Are there any specific features which are deteriorating over time where the community could help to improve the quality of local water sources? In 2014, SEPA produced the document 'Current Condition and Challenges for the Future: Scotland river basin district' and they start off with the following comments:

> We all enjoy the benefits of a clean and healthy water environment. Protecting these benefits and maximising their accessibility is at the heart of river basin planning. It is our role to ensure that we sustainably manage the many ways in which we use the water environment – from generating electricity to supplying communities with drinking water to enjoying walks near our many rivers, lochs and coastal areas.

[17] Water Classification Hub. SEPA. 2015. Available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/>. Accessed on: 04.06.2021.

> Obtaining benefits from the water environment, such as hydroelectricity and drinking water, can sometimes come at the cost of adverse impacts to ecological quality. A key aim of river basin management is to appropriately balance competing demands when making decisions about protection of the water environment. (SEPA, 2014, p. 6)

What do students enjoy most about the water environment in their community? Do they live near duck ponds, small streams, rivers, lochs? Or are they closer to the coastline? Do they enjoy swimming, fishing, collecting tadpoles? Have they ever tried rowing, kayaking, snorkelling, kite surfing, white water rafting, windsurfing or other activities which involve water? Which of these activities are more eco-friendly? To what extent can these activities help promote awareness for the necessity of maintaining our waters as clean and ecologically sustainable as possible? How many fish, prawns, eels, frogs or other aquatic wildlife have students caught themselves? Have they taken care of frogs' eggs as they metamorphosed into tadpoles and then into young frogs? How did they register their experience? How many students are 'otter spotters' or birdwatchers? How many students have spotted any of the Eurasian beavers which were reintroduced to Argyll in 2016 by the Scottish Wildlife Trust in partnership with the Royal Zoological Society of Scotland, 400 years after they had been hunted to extinction? What else do students want or need to know about local water resources?

How much do students know about where their drinking water comes from? And what happens to the waste we produce? How much do they know about water production and waste disposal processes? The booklet 'Resource Smart Schools – Water: A How-To Guide', produced by Sustainability Victoria in Australia, mentioned in the previous chapter, suggests the following steps for students to learn more about how water is being processed:

> Talk to your local council, water corporation, or catchment management authority to learn more about water distribution and its uses in your area.
>
> Learn about stormwater and sewage systems and how we can help protect the water in our rivers, lakes, bays and oceans.
>
> Organise a visit to a water treatment plant with your water corporation to see how water is processed to make it ready for different types of uses. (SUSTAINABILITY VICTORIA, 2016, p. 4)

What do students know about the local water cycle of 'supply – use – treatment – return'? Water is normally piped from lochs and reservoirs to the treatment plants where it is cleaned and made ready for drinking. It is then piped into homes and businesses to be drunk, or used for cooking, washing or flushing toilet waste. It then goes to waste

water treatment plants to be cleaned again and is finally returned to the environment. Treated waste water is not reused as drinking water. As SEPA explains:

> Scottish Water provides drinking water to 97% of the 4.8 million people living in the Scotland river basin district. The majority of Scotland's drinking water sources are local to the population served. However the major population centres are provided with drinking water supplies from centrally located treatment plants. […]
>
> Water lost by leakage within the supply network represents a waste of high quality drinking water which causes unnecessary abstraction from the environment. On average, leakage within many of the public water supply systems is estimated to be about 50%. […] The progressive increase in the demand for water is unsustainable, making demand management an important priority. Improving water efficiency standards for domestic appliances such as washing machines and dishwashers and moving to dual flush toilets is crucial. The application of building standards to promote grey water use and the collection of rain water for gardens is also important. (SEPA, 2007, p. 53-54).

What can the community do to reduce leakage within the water supply system? Naturally, it is Scottish Water who is responsible for the maintenance of underground piping, but the community could check for surface leakage, for example, by making sure there are no leaks within their own homes. How has access to clean water changed in the community? Do any older people in the area remember carrying water to their homes from a communal tap or well? Or do they remember their grandparents talking about this? Does anyone remember heating water on stoves? How is water heated in different homes locally nowadays? How often did people wash, shower or take baths two or three generations ago? How often do people take baths or shower at the present time? Which option is most economical? Which option is more environmentally friendly? Do different generations use different amounts of water or bathe more frequently? How often do people use washing machines and dishwashers? How efficiently are these utilities being used? How frequently do people wash their cars using a hose, or a bucket and sponge? How many homes already collect rainwater for washing their cars or watering their gardens? Let's find out the answers to some of these questions. What other questions do students have about water supply, consumption and conservation?

Are there any disused mines in the area? Sometimes when the groundwater levels return to normal within an abandoned mine, minerals from old workings can dissolve in the water, causing changes in the chemistry and ecology of the water. Are there any

discoloured streams in the vicinity of old mining sites? What can the community do to help solve the problem? Are there large industries nearby? SEPA reminds us that:

> Inadequately treated industrial discharges can result in the following impacts: […] Chemicals that are persistent and bioaccumulative […] can be transported over long distances and accumulate through the food web. Studies on the effects of high chemical levels in humans suggest that toxic chemicals can lead to reproductive problems, cancer and neurological disorders. (SEPA, 2007, p. 43)

If students want to know more about this topic, it might be a good idea to invite representatives from local industries, SEPA or Scottish Water to talk to students, in person or online, about their control measures and treatment of industrial waste.

One of the main problems related to water management in Scotland is the effect of pollution from several sources. For example, agricultural production has increased considerably since the 1950's and, according to SEPA (2007, p. 24), "Production systems have relied on the use of fertilisers and pesticides, not all of which reach their intended target and can run-off or drain into rivers and groundwater resulting in a deterioration in water quality." However, the same document also notes that "Much of this pollution is unintentional and good agricultural practice can help address the problem." (Ibid) Nevertheless, on the following page, we discover that when the document was published in 2007, "In rivers, diffuse agricultural pollution is now the single most important pollution pressure" (Ibid., p. 25).

Agricultural run-off affects freshwater fisheries, shellfish waters and private drinking water supplies. How can this form of pollution be reduced? What can be done within the community? One idea is to plant trees or shrubs around fields which are close to rivers or lakes. Also, animals (and their waste) should be kept away from streams, ponds and lakes, and attention should be paid to using only the correct amount of fertilizers at recommended times and using recommended methods. However, the interplay between economic pressure, healthy water, and environmental issues is extremely complex and as SEPA points out, it is 'important to achieve the correct balance':

> Agricultural land alongside rivers has often been cultivated through centuries of investment to protect it from flooding and to improve drainage. […]. But constraining the space available to a river can harm the environment, create problems for downstream landowners and increase flood risk in urban areas. It will therefore be important to achieve the correct balance. […]

> There is a close relationship between measures to protect rivers from diffuse pollution and measures to restore river morphology or improve natural resilience to flooding. For instance, the creation of buffer strips alongside rivers to reduce pollution also provides rivers with space to recover habitat diversity. Riparian woodlands reduce diffuse pollution and contribute to lower rates of bank erosion. Floodplain vegetation can also help store flows on floodplains, thereby alleviating downstream flood risks. (SEPA, 2007, p. 63)

How many rivers in the community flow through farmland? How closely are crops planted to the banks of local rivers, lochs or sea estuaries? How many sheep, cattle or horses graze right up to the edge of the river or even have access to the river? What are the environmental implications? How many local farmers have already planted strips of grass, hedgerows or trees between plantations and the river banks? How many local riverbanks show signs of erosion? Can students draw pictures of their ideal 'healthy' river banks or pictures of riverbanks which might be susceptible to flooding?

Has the community ever experienced droughts or flooding? What is being done locally in order to avoid these extremes? Once again SEPA (2007) offers important information:

> The management of surface water drainage is critical to a successful solution to the problems of both pollution and flooding. All aspects of the drainage network need to be taken into account when considering its development. Solutions to pollution (quality) problems in the sewerage network need to be linked to flooding issues – the two cannot be addressed separately. […]
>
> Pollution caused by inadequately treated sewage is the second most important source of river pollution and the most important for transitional and coastal waters. […] More housing means more sewage and new impermeable surfaces resulting in increased run-off. It is important to consider the effects on the existing network and the environment at the planning stage. (Ibid., p. 37)
>
> Poorly planned or designed engineering structures can exacerbate flood risk. Culverts and channel realignments can reduce the storage capacity of the river channel and increase the risk of flooding of adjacent and upstream land. Deepening rivers, draining floodplains and creating flood embankments can isolate rivers from their natural floodplain, increasing the risk of flooding in downstream reaches. Flooding impacts on communities, the economy, the environment and Scotland's cultural heritage. The annual cost to society of flooding is estimated to be around £31 million. (Ibid., p. 60)

What can be done in the community to reduce the effects of flooding? What do students know about the importance of floodplains where the river can expand after heavy rainfall? How often have heavy rains flooded local sewage systems – especially in urban areas where most of the soil surface is sealed by tarmac or cement? What do students know about the different causes of flooding? Heavy rain may be the cause we

are most used to, but a long period of light rain can also result in flooding. After a fall of heavy snow, even if the snow was most severe in a distant mountain area, when it starts to melt and the water runs into small mountain streams, this builds up as the rivers increase in size and can cause flooding in low lying communities which were not necessarily strongly affected by the snowfall. Are there any dams in the area? Sometimes excess water can cause the dam to break, or water can be released deliberately to avoid the dam breaking, but in both cases flooding may be the result. Strong winds in coastal areas can also carry sea water further inland than usual which, together with excess rainwater can cause flooding.

Students could compare the volume of water produced by light rain and very heavy rain; analyse different types of soil to discover how much water can be absorbed before water floats on the surface; compare the water absorption of soil with the runoff effect of sealed surfaces; take measurements at specific cross-sections of local streams to work out the volume and velocity of water flow; analyse real-life situations and make predictions and recommendations to alleviate the problem; calculate recurrence intervals based on historical data; produce questionnaires to discover more about the effects of flooding on the local population; invite members of the community to visit the school (in person or online) to talk about their experiences; etc.

However, students could also read about flood myths and compare them with the narrative in the book of Genesis which tells the story of Noah and his family. Mark Isaak has collected many such stories and published them online in 'Flood Stories from Around the World'. One of the examples is a Scandinavian flood myth which describes how three heroes killed the great ice giant Ymir, and icy water flowed from his wounds and drowned most of the Rime Giants. Ymir's body became the world we live in and his blood the oceans. Another example is from the brothers Grimm, who tell the story of a louse and a flea who were brewing beer in an eggshell. The story continues as follows: *The louse fell in and burnt herself. This made the flea weep, which made the door creak, which made the broom sweep, which made the cart run, which made the ash-heap burn, which made the tree shake itself, which made the girl break her water-pitcher, which made the spring begin to flow. And in the spring's water everything was drowned.* Perhaps students would enjoy inventing another effective sequence of events which would result in a flood? An Aborigine story from Lake Tyres near Victoria in Australia is as follows: *A giant frog once swallowed all the water, and no one else could get*

anything to drink. After many other animals failed, eel, with his remarkable contortions, made the frog laugh, releasing the water. Many were drowned in the flood. The whole of mankind would have perished if the pelican had not picked up survivors in his canoe. Once again students could be encouraged to write or act out a flood story, but this time using the natural attributes of animals to move the plot forward.

There are also fascinating links between myths and science, as David Montgomery points out in his article 'The Real Landscapes of the Great Flood Myths' published online in 2015. He is a geologist, specifically a geomorphologist, who "studies landforms [to] construct scientific narratives to explain the evolutionary processes that created and molded them." He links mythology and geological processes as follows:

> There is some evidence, however, that many geomyths are in fact grounded in events that actually happened.
>
> The story of the great flood is one of the oldest and most widely told. A version of this legend appears in so many cultures that some pseudoscientific theorists have invoked its ubiquity as evidence of a global flood. But while flood myths share common elements – catastrophic inundation; a harrowing escape, usually by boat – the nature of the deluge varies from region to region. And the differences are telling. Often, the features of a fabled flood bear a striking resemblance to local geological processes, suggesting that many myths record real catastrophes witnessed in antiquity. (MONTGOMERY, 2015, online)

Do any of the older generation of local inhabitants, perhaps those whose grandparents and great-grandparents also lived locally, remember any stories related to flooding which were passed down through the generations? Perhaps they could be invited to the school for a storytelling session or record their stories on camera. Do different people remember the same flood in different ways? Are there features in common when stories are told about different floods? What does this tell us about how we process information? How did the population cope during the flood? What did they do afterwards to try to mitigate future floods? In what ways have circumstances changed from one flood experience to the other? How many students already knew about these floods? What did they learn from listening to these stories? What does this experience teach them about the importance of collective memory? Students could register these stories, illustrate them and produce a booklet for the community. What other ideas do they have after the storytelling session? Let's put them into practice.

The town of Hawick in the Scottish Borders has experienced heavy flooding on several occasions (for example in 1903, 1924, 1938, 1955, 2005, 2015) and the Scottish

Borders Council worked together with Scottish Borders Climate Resilient Communities (SBCRC) in order to produce a flood protection scheme. In order to involve the local community, workshops were held in Hawick in 2015 and 2016 to identify and develop community benefits with proposals for implementation in 2019. The SBCRC 'Workshop 2 Report – Hawick' serves as an interesting example of collaboration between the local community, the Scottish Borders Council and the various institutions which constitute the SBCRC, i.e. the University of Dundee, Southern Uplands Partnership, Tweed Forum, Scottish Association for Marine Sciences and the International Futures Forum.

The community members who participated in the workshops were first asked to identify any impacts that they or others had experienced locally in relation to flooding, these included ruined homes, evacuation, cost of repairs, inability to travel, loss of business, loss of stock, cost of cleaning up, higher insurance payments, loss of income, inability to reach health centres or hospitals, loss of vehicle, dangerous driving conditions, loss of power, sewage spray, no access to day care centres and communication difficulties, amongst many others (SBCRC, 2016, p. 5-9). After discussing these problems in small groups, a whole group discussion then analysed some of the issues in more depth and discussed possible improvements. They considered how to reduce flood risk as well as the problems which arise during and after flooding.

Participants were then asked what the community should be like in the future in order to eliminate the hardships and be more resilient. And again, small groups discussed their ideas then shared them. Some of the proposed ideas were as follows (SBCRC, 2016, p. 10-12): use the water as a power source; consider the old system of managing the water through lades, culverts and a working water wheel; build a water storage unit upstream from Hawick to generate income; make an artistic feature of floating structures; build new housing on stilts; plant more trees along the river bank, landscape wriggly rivers and remove 'hard landscape' to slow water down, etc.

Participants then formed small teams, together with representatives from the different organizations involved, to discuss and develop existing ideas, add new ideas, and sort them according to priority (high, medium, low) and timescale (short, medium and long). At the end of the team session, the results were analysed by the whole group. Proposals were organized into topics such as: culture / identity; health / wellbeing; supporting the

local economy; natural flood management; energy. (Ibid., p. 14-17) For example, some of the high priority, short-term ideas were: a local heritage trail; a heritage centre using the mill; kayaking; changes of land use to slow runoff over land; reinstate water wheels, amongst others. And some of the high priority, medium-term ideas were: water trail with water wheels, slides, lades and waterfalls; in-river community energy, etc. Results were then presented according to: present concerns, innovations and ideas, future aspirations.

In the group discussion summaries (Ibid., p. 19-20) several intriguing features arise, such as the emphasis on using the river itself to generate energy, provide sports facilities, display public art; innovative ideas for alternative construction projects using local materials and local workforce to boost the local economy; the necessity of involving young people actively; high priorities given to the production and selling of local food; and the necessity for more natural water management solutions.

Which aspects of this Hawick workshop could be applied in the local community to help solve a variety of water-related problems? When local community members collaborate effectively with people who have experience in different fields and spheres of influence, and the youth of the community are included to guarantee that plans will be carried out in the future, positive results are more likely to occur.

Ruth Johnson and Ayesha Ahmed (2018) studied collaborative problem-solving among small groups of 14-15-year-olds in schools in Manchester and Cambridge using multistage problem-solving tasks. Their aim was to discover what highly performing groups were doing differently from the other groups. They conclude:

> Our study showed that if all participants are contributing roughly equal amounts of talk to a discussion, and if they're responding to each other by building on ideas and taking them further, they can solve the problems set for them more easily. What's more, if students explain their ideas – rather than simply asserting them – and invite ideas from others and ask each other questions, the group does better. Some specifics of the language are important, too – for example, the use of "shall we" rather than "I think" was common in the better-performing groups. JOHNSON; AHMED, 2018, online)

What have students learned about collaborative techniques in school and as members of a family? How often are they aware of building on the ideas of others rather than simply rejecting them? How frequently do they ask each other questions – and wait for the

answers? Which aspects of collaboration do they feel they need to learn more about? Which elements do they believe they need to apply in practice more often?

❁ *Rubbish collection in the community*

The Scottish Cabinet Secretary for Environment, Climate Change and Land Reform, Roseanna Cunningham, made the following strong claim in 2019: "We aim to make Scotland a zero waste society with a circular economy. This means minimising the population's demand on primary resources and maximising the reuse, recycling and recovery of resources, rather than treating them as waste."[18]

Do students have access to waste data related to their local community? What are local authorities doing to maximize recycling and recovery of waste products? For example, when writing this section in 2019, I was able to access the data made available by the site 'Scotland's Environment'[19] maintained by the Scottish Government. Data is given for each local authority in such a way that students can discover how much waste was generated and managed by their local authority.

So for example, I found out that Dumfries and Galloway, the local authority for Lockerbie, generated 76.289 tonnes of household waste in 2017 and recycled 21.245, approximately 28%. Whereas in the year 2011, the same local authority produced 81.620 tonnes of household waste and recycled 17.441 tonnes, roughly 21%. So between 2011 and 2017, Dumfries and Galloway reduced their waste by 5.331 tonnes and increased their recycling by 7%. If we compare these results with East Lothian, the local authority for Edinburgh, we find that in 2011, East Lothian generated 53.164 tonnes of waste and recycled 23.432, which is roughly 44%, considerably more than Dumfries and Galloway. And in 2017, East Lothian generated 50.612 tonnes and recycled 26.885 tonnes, roughly 53%. So between 2011 and 2017 East Lothian reduced their waste by 2.552 tonnes and increased their recycling by 9%, positive results for both local authorities.

It was also possible to discover more details about types of waste, trends, carbon impact, management and generation per person. So, for example, in 2017, Dumfries and

[18] SCOTTISH GOVERNMENT. **Managing Waste**: POLICY. 2019. Available at: <https://www.gov.scot/policies/managing-waste/>. Accessed on: 27.03.2019.
[19] SCOTTISH GOVERNMENT. **Scotland's Environment**: Data – Data Analysis – Household Waste. Available at: <https://www.environment.gov.scot/data/data-analysis/household-waste/>. Accessed on: 27.03.2019.

Galloway was generating an average of 511kg per person with a carbon impact of 1,47 per person while East Lothian was producing 483kg per person with a carbon impact of 1.07 per person. Do students understand the importance of the carbon impact and know how it is calculated?

> Scottish recycling performance in 2008/09 according to the tonnage based metric in 2008/09 was 33%, but using a carbon-metric it was 27%. If, however, effort was prioritised toward the recycling of materials with the greatest benefits a different consequence of using the carbon-weighted metric can be seen. If even 90% of material in each of the three groups with the greatest benefit are recycled (that is the largest weighting factors: paper and card, metals and plastic) the recycling percentage achieved would be 87% using the carbon-metric, but require the collection of only 31% of total waste arisings by tonnage. (DONNELLEY, 2010, p. 37)

What are the implications of the information provided by Donnelley? What questions would students choose to explore in greater depth? Which tools are available at the present time to allow students to analyse waste generation, recycling and related subjects? As students explore data they are obviously applying their knowledge of *Maths, Science* and *Technology*, but depending on the data they are analysing, they will also be including areas such as *Social Studies* in this particular case. Furthermore, the analysis of data involves reading and registering throughout the process, therefore the use of *Language* is present, and if students are encouraged to present their conclusions using a variety of formats they can delve into the *Expressive Arts* and go well beyond the traditional graphs and tables in order to express their ideas as convincingly as possible.

How can ideas and proposals related to waste reduction and recycling be presented powerfully enough to convince the community that ever more drastic action is required? As an example, Elisha McFarland presents the following convincing arguments against the consumption of fizzy drinks in her article '22 Ways Drinking Soda Will Shorten Your Life' (2016, online): fizzy drinks can harm your kidneys, cause asthma, change your metabolism, deplete your mineral levels, increase the risk of diabetes, obesity, heart disease, as well as dehydrating your body. The caramel colouring in fizzy drinks can be linked to cancer and vascular issues; the acidity wears away dental enamel; and the artificial sweeteners which sometimes substitute sugar are linked to many different diseases including cancer. Therefore, in order to invest in our personal health and wellbeing, we should clearly stop buying fizzy drinks and accumulating the plastic bottles and metal cans which fill our rubbish bins.

Are we taking the time to sort our waste so that we can identify items which could be substituted by reusable options? For example, how much plastic still finds its way into our rubbish bins? What percentage is being recycled? Are there still a few single-use plastic bags or are we already reusing bags made from materials such as cotton, canvas or jute which can be cleaned and used again? Are we using biodegradable rubbish bags, eco-friendly light bulbs, rechargeable batteries, solar-powered phone chargers? Are we using showerheads which reduce the amount of water but compensate by using a pressurized spray? Does the shower have a timer? To what extent are we composting our kitchen waste? Does the community have allotments or waste ground that could be transformed into community vegetable plots where food waste from families who don't have gardens can be composted? To what extent is local food waste being collected and composted correctly?

What are local supermarkets doing to reduce their use of plastic? Did they sign the UK Plastics Pact in 2018? What do students know about this pact? It was promoted by the 'Waste and Resources Action Programme' (WRAP), launched in April 2018, and signed by governments, local authorities, producers, manufacturers, retailers, recyclers, and NGOs. Both the Scottish Government and Keep Scotland Beautiful signed this pact – what are the results so far? Videos are available on the WRAP[20] site where representatives of different businesses describe their journey to meet the main goals established in the pact. Perhaps these videos, together with more recent ones from different sites, could be shown and analysed in classrooms and community gatherings? The targets established by the UK Plastics Pact in 2018 are as follows:

1. Eliminate problematic or unnecessary single-use packaging through redesign, innovation or alternative (reuse) delivery model.
2. 100% of plastics packaging to be reusable, recyclable or compostable.
3. 70% of plastics packaging effectively recycled or composted.
4. 30% average recycled content across all plastic packaging

What can the local community do to support these targets? How many families choose brands and businesses which are eco-friendly? What can be done to persuade more people to buy eco-friendly products and reduce or recycle the plastic they buy? Perhaps students could work together with members of the community to explore the *Expressive Arts* by recycling waste products, including plastic, in artistic ways to convince the community to become more and more eco-friendly? Plastic bottles can be transformed

[20] 'Waste and Resources Action Programme' (WRAP). See www.wrap.org.uk Accessed on: 30.03.2019.

into decorative plant holders, piggy banks, solar bottle lamps, brooms, utensil holders, jewellery, ribbon dispensers, terrariums, amongst many other possibilities. How many ideas can students find to transform bottle tops, glass jars, an old pair of jeans, CD discs, discarded keys into other useful or decorative objects? By working together with members of the community, students would be actively involved in a project using the creative arts to illustrate how many of the items in our rubbish bins can actually add more zest and colour to our lives.

If they decide to form a theatre group, students could even consider recycling some of the community waste paper by hand and use natural dyes as paints to produce the programmes for the performance. They could check out organizations such as 'Re-Set Scenery Scotland', which passes scenery on to small organizations and schools in Scotland, as well as providing materials to make sets from recycled materials. They could visit sites like 'The Edinburgh Remakery', which offers creative repair and upcycling workshops in woodwork, sewing and textiles. These and similar organizations can be found on the site 'Creative Carbon Scotland'[21] which was initiated by Edinburgh's Festivals, is supported by the City of Edinburgh Council and works in partnership with the 'Federation of Scottish Theatre' and 'Scottish Contemporary Art Network'. Creative Carbon Scotland aims to promote sustainable practices which they hope will grow together with the Green Arts community.

Which online sites have students found to be most helpful for them to create innovative ideas for reusable art ideas? How can they communicate successfully with their local community in order for more people to save materials which can be readily reused or recycled? Have they considered how and where these materials might be stored? Perhaps they could start up an online community group which would coordinate different eco-friendly needs and supplies? Of course we should also remember that donating items to a charity is an excellent way to recycle and help others at the same time. How many charity shops are there in the community? Do they work mainly with clothes, toys and books or do they also have a section for furniture, musical instruments, appliances, etc.? To what extent are local authorities involved in promoting learning opportunities that motivate students to engage in collaborative community projects which focus on the reduction of waste?

[21] CREATIVE CARBON SCOTLAND. Available at: <https://www.creativecarbonscotland.com/sutype/reuse-and-waste/>. Accessed on: 04.06.2021.

According to the Child Development Institute at Sarah Lawrence College in New York:

> Children are powerfully influenced by what is modeled around them, and strongly motivated to take part in communal action when teachers effectively convey the message that their participation is vital and valued. As environmental educator David Sobel notes: "We've been spending way too much time focusing on conveying environmental knowledge and way too little time on developing environmental ***behaviors***. In addition, in most schools, we've got a situation of 'Do as we say, not as we do.' We disseminate knowledge about how environmental systems work but we don't design schools to be models of sustainable systems. And as we know, ***actions speak louder than words***." (SLC-CDI, ca. 2008, p. 6, my emphasis)

Based on the words of David Sobel cited in the above quotation, let us try to spend more time developing collaborative environmental behaviour instead of spending most of our time worrying about how to pass on environmental knowledge.

CHAPTER 5

THE ENVIRONMENT OF MY MUNICIPALITY[22]

How much do students know about their local government council area? To what extent do they understand the relationship between the council areas established in 1996 and the counties or shires which were geographic areas established during the Middle Ages? Apparently, the shires, or sheriffdoms, were introduced by Malcolm III who reigned over Scotland between 1058 and 1093, each shire being under the jurisdiction of a sheriff. According to the online Etymology dictionary, the word 'sheriff' comes from the Old English *'scirgerefa',* which means a 'representative of royal authority'. So, modern associations between the words 'sheriff', cowboys and the Wild West, is much more recent. During the reign of David I (1124-1153) many royal burghs, created or upgraded by the crown, were established, including the royal burgh of Edinburgh, however Dumfries was only registered as a royal burgh in 1186 during the reign of King William I, grandson of David I, who reigned from 1165-1214. So the shires, or sheriffdoms, of Dumfries and Edinburgh were both transformed into Royal Burghs more than 800 years ago.

What do students know about their own municipality, shire, county, burgh, local authority? Which words do they use to refer to their local governing body and how much do they know about its infrastructure?

Since 1996, local government in Scotland has consisted of 32 local authorities and each local authority is governed by a council, made up of councillors who are directly elected by the residents they represent. Do students know who their family members voted for in the last election and why they made their choices? How many local councillors can they recognize? What do they know about councillors' duties and responsibilities? According to the Local Authorities Factsheet[23] provided online by the Scottish Government, the *Powers and Duties* ascribed to the council include: mandatory duties – such as providing schooling for 5-16 year olds and social work services; permissive powers – such as economic development and recreation services; and regulatory powers

[22] I have chosen to use the term 'Municipality' to refer to a region occupied by a population governed by self-elected representatives, which is greater than a local community and smaller than a country.
[23] SCOTTISH GOVERNMENT. **Local authorities:** factsheet. Available at: <https://www.gov.scot/publications/local-authorities-factsheet/>. Accessed on: 04.06.2021.

– such as trading standards, environmental health and licensing for taxis and public houses.

How has government changed over time? Which aspects of government and social organization interest the students most and why? Which topics would they like to explore and why? In order to investigate different issues related to local government and social organization we will explore the following topics.

❁ *History of the Municipality: cultural aspects* ❁ *Natural Environment of the Municipality* ❁ *Circular Economy and the Environment* ❁ *Tourism as a means of preserving the environment*

❁ *History of the Municipality – cultural aspects: Art and Folklore*

What do students know about social organization prior to the establishment of shires? For example, what was the purpose of megaliths such as the Lochmaben Stone, known as the Clochmabonstane in the 14th century, found near Gretna, a few miles south of Lockerbie on the Scottish border with England near the Solway Firth, and thought to be part of a stone circle dating back to about 3000 BC? The word *'cloch' or 'clach'* means 'stone' in modern Gaelic, and 'Mabon' or *Maponos* refers to a Celtic god. Was the stone circle a place of worship for Mabon whose name seems to relate to the concept of divine youth? Was it a gathering place for festivities and celebrations? Or a meeting place for local leaders to share their problems and take group decisions?

The Lochmaben Stone was well known throughout the history of the area and was used as a reference point for a variety of functions before the Union of the Crowns, such as an assembly point for Scottish raiding parties. Also, according to Sir Herbert Maxwell (1896), Scottish and English prisoners were exchanged at the Lochmaben Stone in 1398, and in 1473 the Scottish and English Ambassadors met to agree that the Marcher Wardens should have more frequent meetings at the recognized sites on the marches, while a hundred years later, in 1557, an army assembled there.

What do students know about the marches? Do any of the towns in the area have a 'Riding of the Marches' festival during the summer months, where riders take their horses around the local boundaries to check that everything is as it should be? During the 12th century, officials on horseback would inspect the common land belonging to their burgh to check that neighbouring landowners had not invaded the burgh's common ground. However, this tradition was strengthened during the period of the Border

Reivers in the 13th to 15th centuries when border Scots would steal cattle from their English neighbours, and vice versa.

I have fond memories of the Lockerbie Gala and the riding of the marches, since the cavalcade of horses passed very close to the house where I lived. I particularly remember one specific year when the Italian owner of my favourite ice-cream shop was elected to be the councillor to read the traditional proclamation in Old Scots on the morning of Gala Day before sending the horse cavalcade off to ride the final marches of the week. At the end of the proclamation (which he declaimed with a strong Italian accent) he shouted out '*Avante'*, as the horses started off, and the local population cheered even more loudly, yelling '*Avante*, *Avante*, *Avante'* at the top of their voices.

What do students remember most strongly about their local festivals such as *Up Helly Aa* in Shetland, strongly connected to Norse traditions? How many other festivals involve boats? Which communities still celebrate Beltane's Day on May 1st which goes back to the Celtic festival *Bealtaine* celebrating the birth of summer? What are the most common traditions associated with this festival? How do they differ from one town to another within the same council area? What do students do at Halloween – which dates back to the Celtic celebration *Samhain* at the end of the harvest season? The other two Celtic seasonal festivals are *Imbolc*, or *Là Fhèill Brighde*, which celebrates the beginning of spring with the traditional spring cleaning, visiting holy wells, or making woven crosses from grass. And the fourth is *Lughnasadh* which celebrates the beginning of the harvest season and involved offerings of the first fruits, handfasting (a traditional form of marriage), fairs and sports competitions.

How would students like to register their memories? Do they have photos or videos of their experiences which could be blended into a class video covering a specific year or event? Perhaps they could discuss their memories in small groups and elect specific memories to serve as the basis for a theatrical, musical or dance production. Alternatively, teams could be formed around specific events which had triggered special memories, they could write a fictional story together based on their common memories, then the stories could be gathered together to form a book – which could also include illustrations. Another possibility would be for students to present storytelling sessions to other classes or to the community, accompanied by PowerPoint presentations or colourful posters, using recycled materials to represent the recycled memories.

Since we are focusing on council areas or regions in this chapter, such as Dumfries and Galloway or East Lothian, which contain a considerable number of schools, perhaps different schools could get together and share their memories of similar events. For example, in Dumfries and Galloway, many different towns hold their own 'Riding of the Marches'. We have already mentioned Lockerbie, but other towns in the same council region include Annan, Dumfries, Kirkcudbright, Langholm, Sanquhar and Wigton. So perhaps schools in the different towns which celebrate the 'Riding of the Marches' could share their experiences – either online, or by coming together to produce different exhibitions in a grand, regional, memory-sharing experience.

Each school could also research the history of the marches related to their specific geographical area. Not only through analyzing historical documents, they could also interview older members of the community to discover to what extent traditions have changed or been maintained. For example, I mentioned a traditional proclamation, known as 'the Crying of the Fair', which is read out by a council member in broad Scots in Lockerbie on the morning of the main Gala Day – do students know when the proclamation was written and by whom? How much of the speech are they able to understand? What are the main objectives of the proclamation? The only phrase that stands out in my memory was something about people who misbehaved having their '*lug'* nailed to the '*trone'* – which I understood to mean that the wrongdoer's ear would be nailed to a 'throne', but according to the 'Scots Language Centre[24], the word '*trone'* refers to the medieval public pillory. How many of the towns in Dumfries and Galloway who ride the marches use the same proclamation or does each town have a different speech? To what extent do older members of each town understand the meaning of their local speech? How many dialect words vary from one town to another? How do these differences in language reflect historical cultural differences? Once again, an analysis of place names can help pinpoint the different cultural groups who lived in specific places at specific times.

If we check the site 'Dumfries and Galloway online' we find a mine of information about many different subjects, but when I decided to explore the 'Entertainment and Events' section to get an overview of the activities that students in this region might be involved in, to my surprise, there were several scheduled visits to archeological sites

[24] Scots Language Centre. Available at: <https://www.scotslanguage.com/articles/view/id/4747>.

where visitors are invited to participate in some of the work in progress. How many students would enjoy coming into physical contact with the remote past? I still remember the thrill of being shown Neolithic flints at a site near Beckton farm in the 60s, where Bill Cormack, a good friend of the family and amateur archaeologist, explained the implications of his discoveries with immense enthusiasm. Since motivation is an important stimulus for the learning process, meeting people who are passionate about what they do may help to inspire students to investigate similar activities.

What do students know about recent discoveries related to an Iron Age lochside settlement, dated around 500 BC, at the Black Loch of Myrtone, between Monreith and Port William, not very far away from the famous historical site at Whithorn, associated with Bishop Ninian and the Latinus Stone, one of the earliest Christian monuments in Scotland? According to an article by the archeologists Anne Crone and Graeme Cavers, responsible for the Black Loch site:

> Wetland archaeology in Scotland has focused almost exclusively on a site type known as the crannog: an island, usually artificially constructed, with structures on top; their occupation spans nearly two millennia, from the first millennium BC to the seventeenth century AD (Crone 2012: 147; Henderson & Sands 2013: 269). […]
>
> Recent excavation at the Black Loch of Myrton (BLM) shows that there is probably an even greater variety of site types to be uncovered. The site had been classified as a crannog since its discovery in the nineteenth century, but investigations in 2013 demonstrated that there is no artificial foundation to the settlement. Excavation, survey and a sediment coring programme have revealed a settlement of at least seven structures – each surviving as mounds – built directly on the peat around the margins of a now dried-up loch. BLM is therefore a *lochside settlement*. (CRONE; CAVERS, 2015, online, author's emphasis).

Two or three years later, more details about the site became available when Crone and Cavers gave a lecture to the Centre for Scottish and Celtic Studies at Glasgow University. Jamie Kelly describes some of the details:

> The basic structure of these dwellings was provided by thick wooden posts, while numerous sturdy wooden beams in the interior suggest that the indoor space would be subdivided. At the centre of each construction was a hearth, indicated by mounds of cobbles on top of clay. The floors were constituted of a foundation of branch-wood bundles beneath compacted layers of plant-litter, mostly bracken and sedge. […] Alterations were also made to the entrances, with some incorporating thick oak beams. This was possibly done with an eye to impressing guests and travellers, as we are now aware that at the time of one tree's felling in 435 B.C., oak was very uncommon and therefore valuable. (KELLY, 2018, online)

Each dwelling was a round wooden structure with the walls made from wattle and daub or turf sods and a central hearth for the fire which would provide warmth and light as well as being used to cook food. The floors were made from layers of branches with bracken and grasses laid on top. Since the settlement was built at the edge of the Black Loch, the people who lived there obviously had access to water, and since they used timber to build their houses, wood was also available. What would their main activities have been? Very few artefacts were found at the site. Does this suggest that it was a temporary site, and that the inhabitants moved from one place to another according to different seasons or necessities? Do larger forts represent regional centres in control of specific territories which included smaller groups?

Have students visited or actively participated in any local archaeological sites? If they explore the historical section of the online Dumfries and Galloway Council site[25], they will discover that, in April 2019, their database contained details of around 22,000 sites of archeological and historical interest, including standing stones, stone circles, rock art; Iron Age dwellings; medieval churches; tower houses; abbeys such as Sweetheart Abbey, built by Cistercian monks and founded in 1275; castles such as the moated triangular Caerlaverock Castle, also built in the 13th century; and religious monuments such as the Ruthwell Cross made in the 8th century and carved with inscriptions in both Latin and Old English, using the runic alphabet, interlaced with leaves, birds and animals. This cross is extremely important because the inscription in runes includes a version of '*The Dream of the Rood'* – which is one of the oldest surviving poems written in Old English.

During the Iron Age, crops were already being grown and animals such as sheep, cows and pigs were being reared. There is evidence that the central fire in dwellings similar to the one at Black Loch was probably used for smoking meat and fish for consumption during the winter months, and berries and herbs were probably collected during the summer and dried for supplementing the winter diet. But would there have been time for leisure activities? Many Iron Age domestic sites contain remains of looms, carved bone combs, and drinking horns made of antler used to consume home-made beer. And some Iron Age burials have included old glass gaming pieces which might have been

[25] Archaeology and historic sites. **Dumfries and Galloway Council**. Available at: <https://www.dumgal.gov.uk/article/15629/Archaeology>. Accessed on: 04.06.2021.

used for board games. What was life like at this time? There are very few written records, but there is no doubt at all that oral literature and musical traditions existed. Perhaps students could produce poetry, texts, plays, or songs about life around 500 BC in a lochside settlement, similar to the one at the Black Loch of Myrton?

I enrolled in a fascinating course called *'Oral Literature and Popular Tradition'* at the School of Scottish Studies, during my first year at the University of Edinburgh in 1972. The course was taught by several different professors, each an expert in his/her particular field, many of them overflowing with enthusiasm and even attending each other's lectures. The experience was a privilege which I will never forget. The School was established as a research institute concerned essentially with 'folklore' and 'folk life'. Stewart Sanderson, the first archivist, described this area of study as follows (1957:6):

> The study of folklore is, in fact, the study of a certain kind of history; the intimate domestic history of a people. History is not just a matter of kings and queens, battles and treaties, statesmen and parliaments, these are certainly important, moving as they do in splendid and colourful succession into the highlights of time; but they play their part against a more enduring background. Behind them and around them lies the less spectacular but more lasting history of a people's beliefs and customs, notions of right and wrong, good and evil, luck and ill-luck, happiness and sorrow, songs and stories, facts and fancies – all the common places which make up the intricately patterned fabric of our environment. It is this kind of history with which the student of folklore is concerned. The study of folklore begins with the individual and his local and personal heritage of tradition. (SANDERSON, 1957, p. 6)

How many folk tales do students know? Which tale has made the strongest impression on them – and why? How many folk songs can they sing? What is their favourite and why? Do they know that Opus 108 by Beethoven, written between 1815-1818, was based on Scottish folk songs? Have they ever heard this classical version of well-known folk songs? How do they compare the original versions with Beethoven's interpretation? How many folk festivals have they attended? What did they enjoy most about the experience? Which traditional dances do they know how to dance? Which traditional musical instruments are they able to play?

To what extent do family members, friends and neighbours appreciate and invest in the production, participation and appreciation of traditional music, dancing, storytelling, and poetry declamation? In 2014 Alison Burns, a songwriter and choir workshop leader from Dumfries and Galloway, led a group of local musicians to 'sing back to life' a

collection of forgotten folk songs found in historic books in a Kirkudbright library. On her homepage, Alison states that: "I want to recreate the richness of harmony that makes songs of oral traditions around the world so satisfying and joyful to sing but with words that root the work firmly back in my own culture."[26] Alison also researched and devised the project 'Burns: the Giftie Bard', first performed in 2009 for Homecoming Scotland to celebrate the work and legacy of Robert Burns.

Are students familiar with the poetry of Robert Burns? How can his poems be applied to students' lives and experiences? How many students have celebrated his birthday by eating haggis after reciting his famous 'Address tae a Haggis'? Have any family members visited places where he lived? Do students know anyone who participated in the 'Burns Light' celebration in Dumfries, 2009, which marked the 250th anniversary of his birth, with lanterns of all shapes and sizes being carried through the streets? How many other locally born poets have students heard about, such as William Nicholson, born about 20 years after Burns and known as the 'Bard of Galloway'? Or perhaps they prefer more modern poets such as Edwin Morgan, George Mackay Brown, Norman McCaig, Liz Lochhead, Carol Ann Duffy, Kathleen Jamie, Jackie Kay, all of whom can be found at the online 'Scottish Poetry Library'.

The Scottish Poetry Library (SPL) has invested in several intriguing projects such as: '*Living Voices*', which offers older people who are often in care homes, activities which combine stories, songs and poetry to stimulate creative interaction; '*Poetry Helps: Poems for Social Workers',* where poems are selected which explore the meaning of social work and to provide comfort, support and compassion for those who work in this area; in addition there is a section on poetry and mindfulness which is related to *bibliotherapy* – writing, reading or storytelling that can help people improve their health and wellbeing. The SLP also has several *filmpoems* in their collection which combine poetry, visuals, movement and sounds. For example, they posted a *filmpoem* related to equalities and access, using British Sign Language, Shetlandic and English, to show part of the poem '*The stars are the map I unfurl'*, by Gary Quinn from the Shetlands, writing

[26] Alison Burns: Song Maker, Community Choir Director, Music Educator, Workshop Leader. Available at: <https://aliburns.co.uk/what-i-do/>. Accessed on: 04.06.2021.

about Gerry Hughes, the first profoundly deaf man to sail single-handed around the world.[27]

The Scottish Poetry Library promotes poetry as an effective medium of instruction for multiple reasons:

> As an integral tool for learning, poetry is stimulating, engaging, fun, and benefits creative thinking, expression, memory, understanding and interpretation and confidence. As a format for expressing and presenting ideas and findings, it offers a variety of options in text, spoken word and performance, and can be used creatively in conjunction with other art forms and media. […] Poems can help pupils to focus on detail, or provide empathy with others, enabling both learning skills and engagement with historical, environmental or global topics. […] Poems often add a new and unexpected perspective, and we recommend considering their use in all subject areas. (SPL, 2018a, p. 3)

The SPL also offers a section providing learning resources for students and teachers which includes posters like 'Poet in the Past', bringing together poetry and architecture, or teaching notes, which point out techniques such as using the seasons or the weather to suggest or reinforce emotion. This section offers performance advice as well:

> Reading a poem aloud can help to build confidence for all sorts of situations, from making speeches at weddings to giving presentations at job interviews. [It can] provide moral support in the way of sharing readings, or distracting from the reader by providing other visual accompaniment.
>
> Go further and design a group choral performance, working together to decide on parts and voices, repeats, echoes, etc., to turn the flat text into a truly dynamic experience. Compare each group's approach to the same verse, or each group take a different verse and present to the class. Percussion might be included, and other sound effects, and a drama space could be helpful to allow room to experiment!
>
> Used well - with regard to relevance, meaning and the creation of harmony or disharmony - technology can help to further understanding and appreciation of language as well as providing different means of presentation and enhancing ICT skills. (SPL, 2018b, p. 1)

Performance poetry is an ancient form of cultural expression which precedes the written word. And now, with the development of a more multimodal approach, poetry which focuses on expression and comprehension using visual and digital literacy skills may well stage a comeback through the inclusion of audio-visual effects designed to complement the essential message being transmitted.

[27] QUINN, Gary. The stars are the map I unfurl. Available at: <https://www.scottishpoetrylibrary.org.uk/2014/09/signed/>. Accessed on: 04.06.2021.

As students explore the multicultural aspects of the region where they live, and develop ways and means to communicate in ways which will help society to understand and respect different ways of living and being in a society more conscious of the need to understand and protect our environment, they will be "building skills for learning, skills for life and skills for work" (DONNELLEY, 2009a, p. iii) Students will become:

> […] successful learners with enthusiasm and motivation for learning, able to think creatively and independently; confident individuals with a sense of physical, mental and emotional wellbeing able to pursue a healthy and active lifestyle; responsible citizens with commitment to participate responsibly in political, economic, social and cultural life, able to understand different beliefs and cultures; and effective contributors with an enterprising attitude able to communicate in different ways and in different settings, to create and develop. (Ibid)

As we learn more about our cultural heritage and the ways that our ancestors interacted with the landscape in order to live their lives as fully as possible, perhaps we can learn to live in such a way that future generations will benefit from our actions and custodianship of the environment which we will leave as our legacy.

❁ *Natural Environment of the Municipality*

How much knowledge do we have about the past and in what ways does it connect to the present and prepare us for the future? For example, there are geological reports of glacial activity in the first millennium BC, with increased rainfall around 800BC which "drove populations away from established farmland and onto more marginal areas like salt marches" (HUNTER; CARRUTHERS, 2012, p. 14). These authors also state on the following page that: "In many respects current knowledge of Iron Age climate is very refined. This precision in reconstruction needs now to be related to agro-economic models to predict anticipated agrarian responses to climatic stress." (Ibid., p. 15) Evidently, if we know how human settlements during the Iron Age responded to climate stress, it should be possible to predict effective responses to modern climate stress. So what do students know about the environment of their region? What would happen if temperature changes caused a considerable increase in rainfall as well as higher sea levels? We already discussed local flooding in the previous chapter, but students also need to consider what the wider consequences in the region as a whole might be and what we can do to prevent possible ramifications.

First of all – to what extent do students have personal knowledge of the physical environment of their region? A report published by Plymouth University in 2016, concerning the four-year project 'Natural Connections' which promoted outdoor learning, makes the following comment:

> Competing pressures mean that opportunities for children and young people to value and enjoy nature and the environment are under threat. According to the Monitor of Engagement with the Natural Environment Survey, in an average month in 2013-14, only 8% of all children in England (aged 5-16) visited natural environments with their schools. In their leisure time, the area that children explore and play around their homes has reduced by 90% over the past 20 years. A similar decline in opportunity has been observed in children's school access to the outdoors from Foundation Stage onwards, and many thousands of children across England have not even been to their local beach, park or woodland. (NATURAL CONNECTIONS, 2016, p. 6)

So perhaps the first step towards discussing the regional environment is to discover to what extent students are personally familiar with the outdoors. Dumfries and Galloway Council produced a 'State of the Environment Report' in 2017, which describes the region as follows: "Dumfries and Galloway occupies a land area of approximately 6,439 km², making it the third largest of Scotland's 32 local authorities and has a coastline of 350km. Its population of approximately 147,284 is projected to fall to around 146,000 over the next 10 years." (DGC, 2017, p. 4) The report states that one third of the region is covered in woodland and forestry. How much of this woodland do students know personally?

When I was a child, our family would always go for walks in the woods on Sunday afternoons, and we would not only explore the local woods, we would occasionally drive further afield to explore different woodlands and forests in the region. And of course in the autumn we would be gathering blueberries, raspberries and brambles for pies and jams, as well as rosehips from the hedgerows for rosehip syrup, and occasionally elderberries for elderberry wine. How frequently do students walk in their local woods and forests? How would they describe their experience? Do they know the names of the trees, bushes, fungi, flowers, insects, birds, animals to be found in different forests? How many birds are they able to identify from their size, colour, shape, flight pattern, song? Are they familiar with the different smells, colours and forms of the flowers and plants they pass, the textures and tastes of the fruit they are gathering? What are the differences that stand out for them if they compare ancient woodland with more recently planted conifer forests?

> Dumfries and Galloway has a wealth of open space within and around its towns and villages ranging from formal parks (such as Dock Park in Dumfries and Station Park, Moffat) to a vast network of green corridors and natural and seminatural spaces, including forest walks and bike trails on the edge of settlements like Dalbeattie. With the forest parks and other recreational facilities, there is generally a wide range of outdoor leisure and recreational facilities within the region, many at limited costs to participate and with reasonable accessibility. (DGC, 2017, p. 29)

What do students know about the 'Galloway and South Ayrshire Biosphere Reserve', designated by UNESCO in 2012? It has 5,268km^2 of land and a population of almost 95,000 people. How many students live there or have visited the area? What can they tell their classmates about this Biosphere? According to their online site:

> Biospheres are places with world-class environments that are designated to promote and demonstrate a balanced relationship between people and nature. They are places which value and protect the biological and cultural diversity of a region while promoting environmentally sustainable economic development. They are places of cooperation, education and research where local communities, environmental groups, and businesses can work together.
>
> A Biosphere has three main functions: **Conservation:** promoting the preservation of wildlife, habitats and landscape; **Learning:** supporting a better understanding of nature and global issues; **Development:** fostering a sustainable economy and society.[28]

In fact Dumfries and Galloway has already invested in various projects related to renewable energy in an attempt to promote a more sustainable economy.

> In 2010 the region had the highest number of renewable schemes approved/installed or submitted applications in Scotland and the second highest total generating capacity (SNH) in respect of larger schemes which include both on and offshore wind energy developments, large scale hydro works around the River Dee (amounting to over 106MW in total capacity) and a 40MW biomass plant at Lockerbie. (DGC, 2017, p. 52)

How many students live near hydro works, wind farms or biomass plants? Have they visited these places with the school in order to learn more about the importance of renewable energy? How many students use solar energy in some way? Can they come up with different ways of producing energy themselves? For example there are gyms in different parts of the world where special stationary cycling machines produce electricity which helps to pay the gym's costs. Unfortunately, the contribution so far is minimal since at the present time it would take about 40 people pedalling for eight hours a day to cover the energy costs of one house. But this comparison can help us to appreciate more clearly how much energy we use every day. So perhaps students could

[28] GSABR (Galloway and Southern Ayrshire Biosphere Reserve) What are UNESCO Biospheres? What the Biosphere does. Available at: <http://www.gsabiosphere.org.uk/about-the-biosphere/>. Accessed on: 04.06.2021.

create even more innovative ways for individuals to contribute to the production of renewable energy. One scheme which should help stimulate ideas about how to use our personal energy to benefit the community is to use our individual energy in numerous ways to improve our own personal health and wellbeing. Which forms of exercise do students prefer and why?

The Biosphere offers plenty of opportunities for recreation activities such as mountain biking or cycling along roads and trails as well as countless routes for walking. There are also several adventure centres which provide activities such as *archery, sailing, windsurfing, kayaking, climbing, gorge scrambling, river tubing, abseiling, hill walking, bushcraft, mountaineering,* amongst many others. Which of these activities do students enjoy most? Which have they never tried but would like to attempt?

When students explore the environment which surrounds them, they become more directly aware of air quality, soil conditions, water sources and conditions, as well as the presence or absence of pollution and waste. Perhaps students could walk or cycle along trails in the Biosphere and observe the sounds they hear, the smells they perceive, the plants, trees, animals and birds they see, and the surfaces of the trees, rocks, lichens they touch. Then they could compare these sensations to the sounds, sights and surfaces they experience in the immediate vicinity of their homes. How would they like to register their comparisons? Perhaps one group could focus on mathematical aspects and produce lists, graphs or pie charts to display their results. Another group might prefer to invest in a theatrical presentation and exhibit their results to the community in a much more dramatic fashion. A third group might use photography, produce videos, or use different styles of art work. A fourth group might prefer to invest in a musical presentation of the comparison between the two terrains and include instruments constructed specifically from materials which reflect characteristics of each context and which produce corresponding sounds pertaining to each setting. What other ideas do students have and how do they propose to put them into practice?

When these skills are applied to environmental studies, students will perceive more clearly that learning transcends the classroom and may even decide to take responsible action to improve the environment in some way – thus truly becoming authentic global problem solvers. As Paul Chapman explains in his report on 'Environmental Education and Sustainability in U.S. Public Schools',

> An awareness of the widespread environmental challenges we face has motivated many principals and their school communities to make an effort to become greener. In all areas of operation – overall organization, efficient use of resources, healthy operations, environmental curriculum, food and nutrition, and community practices – the survey reveals that public schools have begun to incorporate initiatives focused on environmental sustainability. (CHAPMAN, 2014, p. 7)

Many schools are adopting more environmentally friendly practices and incorporating outdoor learning experiences as part of the core curriculum, and these are fundamental steps towards educating future generations.

How well do students know their regional outdoor environment? For example, there are many public gardens in the region of Dumfries and Galloway, how many students have visited the Logan Botanic Gardens, warmed by the Gulf Stream, which prides itself on a wide variety of exotic plants? Which plants have they never seen before? How would they describe the different shapes, textures and colours found there? Or have they seen the ornamental garden at Threave, which is said to contain over 100 varieties of daffodils? Can they describe the differences between some of these variations? Could they produce an accurate botanical painting of a daffodil? Or design a wallpaper pattern, a mandala, a lampshade, a kaleidoscope, a poster, an abstract bouquet, an X-ray version of daffodils?

How many schools have gardens within their grounds? Do they produce herbs, fruits or vegetables, or are they landscaped with flowers, bushes, mosses and lichens? Are they designed and maintained by the students themselves? Have they used native plants as much as possible so that they are easier to maintain and do not require chemical pesticides? Are they collecting rainwater to water the plants, thus avoiding any strain on water resources? And have they included a compost area to reduce food waste and add nutrients to the soil?

Another unusual landscape in the region is the Galloway Forest Park which received 'Gold Tier Dark Sky Park Status' from the International Dark Sky Association in 2009 "due to the exceptional quality of the night sky in this area. This award demonstrates how clear the night environment is in the Park and gives international recognition to its unique qualities." (DGC, 2017, p. 48) Due to the overall increase in light pollution, the report estimates that 80% of the UK population will never see a truly dark sky, therefore the Dark Sky Park is a unique natural resource that should be protected and appreciated.

How many students enjoy star-gazing at night? Can they recognize and reproduce different constellations? The Dark Sky Park is home to diverse nocturnal wildlife species which thrive in this protected dark landscape. What are some of the differences between creatures which are more active during the day and those which are more active during the night? What contrasts do students notice when they compare the same landscape during the day and when they see it again in the moonlight? Have they ever photographed exactly the same scene at various times of the day? What do they know about the intensity and spectral changes of light during the 24 hour cycle? When they compare several pictures of the same scene, does the comparison provide a fresh perspective of the scene?

If each student in a class took a picture of a specific favourite scene – at different times and from different angles, and all of the pictures were used to produce a montage, what could be learned during this experience? Clearly each individual will receive valuable feedback from their peers and will be given the opportunity to view their work from an alternative perspective. They will also have the chance to acknowledge one another's work constructively as they work together to produce a collaborative end product. Perhaps images can be paired with poems or used to tell stories? They can also be used to detect changes over time and to organize experiences chronologically. Students can use images to illustrate text, mathematical or scientific diagrams. Technology can be related to artistic expression as individual images are organized together in a variety of ways, where communication and respect for the alternative perceptions of others are key.

Interestingly, as students work together with images of local landscapes and are encouraged to associate the images with a deeper understanding of the ecosystems and biodiversity present in the landscapes, their aesthetic awareness, coupled with their growing understanding of the ecological function of the environment, may well foster stronger motivation to conserve the landscape. Anne-Sophie Tribot and her associates make this connection in their article 'Integrating the aesthetic value of landscapes and biological diversity':

> Ecological aesthetics aims to explore the relationship between aesthetic and ecological values. It is based on human engagement with the natural environment coupled with an understanding of ecological function. […] Neuroscience, psychology, sociology, art and humanities are the lenses through which we can understand this relationship […] it has been proposed

> that knowledge shapes the aesthetic judgements of landscapes, in the same way that education influences the appreciation of art. […]
>
> Knowledge and experience enhance the aesthetic value of landscapes through the recognition of ecological functioning; landscapes perceived as aesthetic are more likely to be protected; conservation increases the biodiversity of ecosystems, and biodiversity improves ecosystem functioning and services and increases the aesthetic experience, which, fed by knowledge and experience, further increases the social motivation for conservation, etc. (TRIBOT et al, 2018, p. 7-8)

However, as well as learning to appreciate the aesthetics of natural landscapes and the biodiversity which still exists, we also need to examine landscape problems which require solutions involving the active participation of the community.

What are some of the problems related to the soil of the region? The Environmental Report published by the Dumfries and Galloway Council in 2017 states the following:

> The area of potentially contaminated land within the region is approximately 7486.7 ha which includes land that has previous industrial use, although a great deal of this is, or is likely to be, low risk. These sites include former uses such as gasworks, tanneries, waste disposal sites and military and munitions sites. […] Given the extensive rural character of Dumfries and Galloway, there have been some issues of erosion, most often associated with flood events. There has also been erosion in certain coastal areas along the region's 350 km of coastline. (DGC, 2017, p. 32)

This report focuses on two main problems – erosion and contamination. Soil erosion is a natural process. It occurs when the uppermost layer of the ground is moved from one place to another usually through water or wind action but it can also be caused by industrial agricultural techniques. Jim Ritter, engineer in land management, writing for the Ontario Ministry of Agriculture, Food and Rural Affairs, Canada (OMAFRA), explains some of the causes and effects of soil erosion:

> Erosion, whether it is by water, wind or tillage, involves three distinct actions – soil detachment, movement and deposition. Topsoil, which is high in organic matter, fertility and soil life, is relocated elsewhere "on-site" where it builds up over time or is carried "off-site" where it fills in drainage channels. Soil erosion reduces cropland productivity and contributes to the pollution of adjacent watercourses, wetlands and lakes. (RITTER, 2012, p. 1)
>
> Soil quality, structure, stability and texture can be affected by the loss of soil. The breakdown of aggregates and the removal of smaller particles or entire layers of soil or organic matter can weaken the structure and even change the texture. Textural changes can in turn affect the water-holding capacity of the soil, making it more susceptible to extreme conditions such as drought. […] Sediment that reaches streams or watercourses can accelerate bank erosion, obstruct stream and drainage channels, fill in reservoirs, damage fish habitat and degrade downstream water quality. Pesticides and fertilizers, frequently transported along with the eroding soil, contaminate or pollute downstream water sources, wetlands and lakes. Because of the potential seriousness of

> some of the off-site impacts, the control of "non-point" pollution from agricultural land is an important consideration. (Ibid., p.4)

According to Ritter, tillage action, or ploughing, can cause even more erosion than wind or water, because when furrows are created, the soil structure breaks down and becomes much more susceptible to erosion. Water can gather in the hollows, potentially forming runoff, and the subsoil which is moved to the surface, dries out due to lack of vegetation cover and is much less resistant to wind erosion. How much do farmers know about the effects of ploughing? Do they realize that if several passes are made over the same area, they are essentially reducing the fertility of the soil, which will produce less crops and create more favourable conditions for soil loss?

Agricultural communities need to know more about the causes and consequences of soil erosion in order to maintain healthy, fertile soil which can withstand the impact of wind and rain in a more robust manner. For example, if farmers reduce the number of times they plough the same area, they will still maintain reasonable levels of fertility, although conservation agriculture, where cover crops are planted immediately after the harvest of grain crops, is a much more sustainable practice because it guarantees surface protection while plant matter decomposes and nutrients return to the soil. Another idea for reducing wind erosion is to plant trees or bushes to create windbreaks around the fields which will protect crops. "Wind erosion damages crops through sandblasting of young seedlings or transplants, burial of plants or seed, and exposure of seed. Crops are ruined, resulting in costly delays and making reseeding necessary." (RITTER, p.5)

Responsible regulation of land and ploughing practices would also help, but as conscientious members of the community, concerned about our legacy for future generations, we also need to analyse what we eat, since consumers can help control agricultural practices. By reducing our grass-fed meat consumption and dairy products, preferring seasonal fruits and a greater variety of more sustainably grown vegetables, as well as products made from a wider assortment of whole grains, the consumer market will undeniably affect production practices and choices.

To what extent do students consider the environmental implications of the food products that they purchase? What do students know about any organic farms in the local community or in the region? How many of their products are sold locally? How many community gardens are functioning nearby? What do they produce? Perhaps students could organize visits to these farms or gardens to understand some of the

positive and negative aspects of such undertakings? How many of the students' families are involved in practices which support sustainably produced food products? Perhaps these families could be interviewed about their reasons for the choices they have made.

We also mentioned soil pollution at the beginning of this section. A global symposium on soil pollution was held in May 2018 by the Food and Agriculture Organization (FAO) of the United Nations, entitled 'The Solution to Soil Pollution'. The organization FAO makes the following statements

> Soil pollution is determined by a complex combination of factors, such as the type of pollutant, site history and geological background and is therefore specific to the local and regional levels. […] Prevention of soil pollution is undoubtedly the best solution for the achievement of sustainable societies and for ensuring the legacy of a healthy and productive planet for future generations (FAO, 2018a, p. 10)
>
> Sustainable remediation emerges as a new alternative, cost-effective approach to deal with legacy polluted sites, with the objective of balancing economic viability, conservation of natural resources and biodiversity, and the enhancement of the quality of life in surrounding communities. (Ibid., p.. 11)

Clearly, industrial sites which have been contaminated by gasworks, tanneries, waste disposal sites and munitions sites, such as those which were identified in the Dumfries and Galloway Environment Report (2017), require remediation which will be overseen by the local authorities responsible. But what can students and local communities do to reduce and prevent soil pollution? Since one of the main causes of soil pollution is the waste that we ourselves produce which frequently ends up in landfills, we need to assume the consequences of our actions and take care to dispose of hazardous waste such as batteries and medicines in a responsible manner. We can also work on improving our recycling habits, by choosing eco-friendly and reusable packaging when shopping, and we can be more consciously eco-friendly when buying gardening, cleaning and personal care products. Also, if we compost our food waste, we help nurture our soils, and if we reuse or donate common household items we give them a second life.

However, we also need to think very seriously about electronic waste, also known as e-waste. In a report produced by the 'Platform for Accelerating the Circular Economy' (PACE), under the aegis of the World Economic Forum, and in support of the United Nations E-waste Coalition, the following information is made available:

> Electronic goods, from solar mini grids to smartphones, bring huge benefits to humankind and offer new opportunities for development. They present new tools to address the challenges of climate change, expand education, deliver healthcare and facilitate trade. Digitalization and connectivity are also critical to help achieve all 17 Sustainable Development Goals.
>
> At the same time, the current system of production and consumption is ready for a reboot. In the mining, manufacturing, transport, retail, consumption and disposal of electronics, there are vast amounts of wasted resources and the system has several negative impacts. Each year, approximately 50 million tonnes of electronic and electrical waste (e-waste) are produced, equivalent in weight to all commercial aircraft ever built; only 20% is formally recycled. If nothing is done, the amount of waste will more than double by 2050, to 120 million tonnes annually. (PACE, 2019, p. 5)

According to this article, e-waste, half of which includes personal devices such as computers, screens, smartphones, TVs, household appliances, as well as heating and cooling equipment, can represent up to 70% of the hazardous waste that ends up in landfills. Dangerous chemicals such as lead, chromium, cadmium, mercury, as well as flame retardants which are persistent organic pollutants, can pollute water sources and eventually food supply chains. Therefore electronic waste must be dealt with correctly to avoid soil, water and air pollution.

If each student made a list of all the electronic appliances in their home – including the old mobile phones, tablets, keyboards, printers, toasters, clocks etc., that have been substituted by more modern models but have not yet been thrown out of the house or garage, how many items would there be on each list? And if a new list was compiled for each classroom, then for the whole school, and lastly for every school in the region – would students become more aware of the dimension of the problem of e-waste? Unfortunately, the electronics economy seems to have a built-in obsolescence clause, whereby even young children are now demanding new cell phones or tablets each year or whenever a new model is launched. So what do they do with their previous models? How can they be recycled or reused? How important are electronics in their lives? Do they need all of the gadgets and equipment they have? For example, if a student has a smart phone, a tablet and a laptop – are all three devices equally important or would one be sufficient? What are these devices currently being used for? If students had to select one of these three devices as the only device they could keep, which one would they choose and why?

Students could be asked to produce mathematical diagrams, lists, or drawings of the various purposes or applications for each device. How much overlap is there? What

could they do with any out-of-date models they still have in their home? Are there any local organizations who buy used models in order to repair and resell them? Or groups who accept obsolete devices which can be taken apart and recycled in different ways? What are the students' ideas for reducing their own e-waste? Let's put their ideas into practice and spread the word around the community and the region, in order to promote a more sustainable way of life.

❁ *Circular Economy and the environment*

In the previous section we mentioned several economic initiatives which contribute to a more sustainable environment. Among them were investments in the production of sustainable energy, such as hydroelectric stations, biomass plants and wind farms. However, there are also proposals for promoting a more circular economy related to e-waste. Again information is provided by the 'Platform for Accelerating the Circular Economy' (PACE):

> That same e-waste represents a huge opportunity. The material value alone is worth $62.5 billion (€55 billion), three times more than the annual output of the world's silver mines and more than the GDP of most countries. There is 100 times more gold in a tonne of mobile phones than in a tonne of gold ore. Furthermore, harvesting the resources from used electronics produces substantially less carbon-dioxide emissions than mining in the earth's crust. Working electronic goods and components are worth more than the materials they contain. Therefore, extending the life of products and re-using components brings an even larger economic benefit. […]
>
> There is also an opportunity to build a more circular electronics system, one in which resources are not extracted, used and wasted, but valued and re-used in ways that create decent, sustainable jobs. In short, we need a new vision for electronics. (PACE, 2019, p. 5)
>
> A circular economy is a system in which all materials and components are kept at their highest value at all times, and waste is designed out of the system. It can easily be thought of as the opposite of today's linear economy. […] Many companies have made global commitments to designing waste out of the electronics value chain and others have worked hard to design hazardous materials out of their products. These kinds of experiences must be shared across the industry, creating a pre-competitive, open-source space for collaboration. (Ibid., p. 16)

According to Zero Waste Scotland[29], a circular economy essentially involves "thinking about how waste can be designed out of products and processes in the first place, or indeed re-used as a raw material for making new products." So clearly it is not only necessary to improve our recycling habits, the whole economic system requires a

[29] ZERO WASTE SCOTLAND. Recycling and the circular economy. Available at: <https://www.zerowastescotland.org.uk/circular-economy/recycling>. Accessed on: 04.06.2021.

change of mind set. Designers need to include the possibilities for future reuse, remanufacture or repair as part of the original design. Companies and governments could also include buy-back or return systems where customers are offered incentives for returning old equipment which companies would use to reintegrate materials or components into new products. For example, PACE reports that, "in China, there is a target for 20% recycled content in all new products by 2025" and also that "one recycler in China produces more cobalt than the country mines in one year." (2019, p. 17).

Students of all ages could be challenged to come up with designs for reintegrating different parts of today's technology in future technologies. They could form small teams to examine different examples of their electronic equipment and think about possible future developments in the field. Through analysing a variety of appliances and sharing ideas about inventions which could save energy and reuse different parts of the electronics they already have, they will probably be able to incorporate proposals related to the process of dematerialization which is already beginning to evolve in diverse sectors of society. For example, electronic devices now have streaming apps for music and films which are rapidly replacing DVDs, and people are beginning to use apps to call taxis instead of owning cars. In addition, smart phones and some televisions can be rented or leased for short periods, which gives customers access to the latest technology without necessarily investing large sums of money to own everything. So perhaps students will include proposals related to 'cloud' access or group sharing since these sustainable practices seem to be growing.

The author Edward de Bono published a book called 'Children Solve Problems' in 1972, fascinating reading for teachers of all ages, where he gave young children problems and asked them to design solutions. One of the problems was: how to stop a cat and dog from fighting. A 10-year old girl suggested that food troughs could be strapped to the side of each animal, with cat-food in the trough strapped to the dog, and dog-food in the trough strapped to the cat, so they would have to make friends with each other in order to eat. An 8-year old girl drew a picture of herself holding a dog in one arm and a cat in the other, with noses touching while she was stroking both animals at the same time – so there would be no competition for her affection. A 10-year old boy drew each animal surrounded by lots of different distractions (including a bone and a pair of postman's trousers' for the dog, but a clockwork mouse and cushion to sit on for the cat), clearly believing that if each animal is enjoying themselves, there would be no

reason for fighting. These are all perfectly valid suggestions which could be developed in various ways for a wide range of real-life problems. Therefore it might be interesting to invite professional designers to an exhibition of children's proposals for reintegrating out-dated parts into new electronic devices, in the hope that there might be a profitable exchange of ideas for everyone concerned. PACE concludes that:

> The transition to a circular economy must take place in a way that benefits all stakeholders from the consumer to workers, government, businesses, entrepreneurs and society at large. There will be a need for mass collaboration, system changing ideas, new policy frameworks and new ways of doing business. The organizations involved in this work have a shared commitment to achieve this and invite others to join in this important endeavour. (PACE, 2019, p. 19)

Children of all ages should not be excluded from this mass collaboration. Very young children are extremely creative and motivated, constantly challenging themselves to discover more about all aspects of the fascinating world which they inhabit. If adult entrepreneurs and experts in a variety of domains were invited to observe young children more closely, they would undoubtedly learn immensely important lessons from them. They are fearless, they stretch themselves to their limits in all directions, they explore their surroundings in great detail, they ask questions about everything they see, hear, taste, touch and feel, they are open-minded and they are true scientists. According to John Holt in his book 'Learning all the Time':

> Children are born passionately eager to make as much sense as they can of things around them. The process by which children turn experience into knowledge is exactly the same, point for point, as the process by which those whom we call scientists make scientific knowledge. Children observe, they wonder, they speculate, and they ask themselves questions. They think up possible answers, they make theories, they hypothesize, and then they test theories by asking questions or by further observations, or experiments or reading. Then they modify the theories as needed, or reject them, and the process continues. This is what in "grown-up" life is called the – capital S, capital M – Scientific Method. It is precisely what these little smart guys start doing as soon as they are born.
>
> If we attempt to control, manipulate, or divert this process, we disturb it. If we continue this long enough, the process stops. The independent scientist in the child disappears. (HOLT, 1989, p. 95)

Let us therefore make sure that children's creativity, inventiveness, experience and scientific methods are included as fundamental input towards future solutions for present day problems. After all, they are the citizens and consumers of the future, therefore their vision of the future, active collaboration, and input is of consummate importance.

The necessity for promoting a more circular economy is not limited to the electronics industry and e-waste. What do students know about the environmental effects of textile waste? Do they realise that globally, the equivalent of one waste collection vehicle full of textiles is landfilled or burned instead of being repaired, reused or recycled every second of every day? What do students do with clothes that need repairing, that are too small, that have bad stains, that they simply don't want to wear any more for whatever reason? How often do they wear all of the items in their wardrobe? Are students aware that if everyone extended the average life of their clothes by a mere three months, this would lead to a 5-10% reduction in each of the carbon, water and waste footprints for these items? However, if we manage to wear our clothes for an average of three years, we would reduce all three footprint areas by 20-30%.

According to the report 'A New Textiles Economy: redesigning fashion's future' produced by the Ellen MacArthur Foundation (EMF), "Less than 1% of material used to produce clothing is recycled into new clothing, representing a loss of more than USD 100 billion of materials each year."

> Today's linear system uses large amounts of resources and has negative impacts on the environment and people. The textiles industry relies mostly on non-renewable resources – 98 million tonnes in total per year – including oil to produce synthetic fibres, fertilisers to grow cotton, and chemicals to produce, dye, and finish fibres and textiles. Textiles production (including cotton farming) also uses around 93 billion cubic metres of water annually, contributing to problems in some water-scarce regions. […] the current wasteful, linear system is the root cause of this massive and ever expanding pressure on resources. The industry's immense footprint extends beyond the use of raw materials. In 2015, greenhouse gas (GHG) emissions from textiles production totalled 1.2 billion tonnes of CO_2 equivalent, more than those of all international flights and maritime shipping combined. (EMF, 2017, p. 20)

The clothing industry is also responsible for other environmental problems. For example, 20% of global industrial water pollution can be attributed to the dyeing and treatment of textiles, and when we wash our clothes, around half a million tonnes of plastic microfibers enter the ocean annually. The EMF report mentioned above presents an innovative vision for a circular textiles economy where "clothes, textiles, and fibres are kept at their highest value during use and re-enter the economy afterwards, never ending up as waste." (Ibid, p. 3) However, the same report emphasizes the fact that: "Transforming the industry to usher in a new textile economy requires system-level change with an unprecedented degree of commitment, collaboration and innovation." (Ibid)

Perhaps students could be encouraged to work in collaborative teams around themes which excite them in order to investigate and put into practice creative solutions for textile waste. One team might decide to investigate local services which collect clothing with the idea of producing a map which shows locations and collecting times. For example, does the local council have a clothing collection service? Where and when does it operate? How many local supermarkets have a textiles bank, is there a local Household Waste and Recycling Centre? Perhaps the school could promote a textiles bank? What do these places do with the material they collect – is everything simply shredded and used to fill cushions and mattresses or is it sorted and recycled to reap the maximum benefit of the discarded textiles by attempting to maintain clothing at its highest value for the maximum length of time?

Another team might be interested in learning how to repair, recycle or upcycle some of the clothes that they haven't worn for a while. What do students know about removing stains, repairing jeans, using old T-shirts to make shopping bags, or cutting up clothes that are too small and designing a unique new outfit? Students could explore the site *Love Your Clothes* which has many fascinating ideas, including '101 things to do with old socks'. How many ideas can students come up with? Did they include: soap-on-a-rope; pin cushion; rag rug; stress ball; skipping rope; glasses case; anti-slip coat hangers; wrist-rest; cleaning stick, etc.[30]

Love Your Clothes is part of the Sustainable Clothing Action Plan (SCAP), coordinated by WRAP, mentioned in the previous chapter. *Love Your Clothes* aims to "improve the sustainability of clothing across its lifecycle, because the most significant opportunity for reducing the environmental impact of clothing lies in increasing the active life of the clothes we wear."[31]

A third team of students might be interested in discovering more about how frequently they wear the clothes in their wardrobes. How many items are used regularly and how many items have been abandoned or are rarely used? How long is the active life of the clothes in their wardrobes? How many items were bought during the last month? How many items were purchased during the previous year? How many items have been in

[30] LOVE YOUR CLOTHES. **101 Ways to Re-use Socks**. Available at: <https://www.loveyourclothes.org.uk/tips/101-ways-re-use-socks>. Accessed on: 04.06.2021.
[31] LOVE YOUR CLOTHES. **About.** Available at: <https://www.loveyourclothes.org.uk/about>. Accessed on: 04.06.2021.

their wardrobes for 2-3 years thus reducing their carbon footprints considerably? Are they still being worn regularly? What can students do to promote effective re-use or upcycling to maintain the highest value possible for their unwanted clothes?

A fourth team may decide to focus on answers to this question by exploring possibilities for sharing, swopping, 'swishing' or upcycling their unused clothing. How many students have attended a 'swishing' event – which is essentially an extended clothes swap. People are invited to bring clean, good quality clothing to a school, local community hall or a smaller venue. They should be told if a minimum number of items is being stipulated or whether there will be an entry fee to help cover costs or raise funds. For example, an entry fee could be variable and exchanged for a specific number of tokens so that a £3 entry ticket could be exchanged for 3 items of clothing.

If students decide to promote a swishing event, they would need to reach an agreement as to what their main aims are – whether they want to raise funds for an environmental project, or whether they are promoting community awareness related to the carbon footprint of clothing and the multiple possibilities for extending the active life of clothing at its highest value for as long as possible. They would also have to think about how to organize and showcase the clothes, whether people should bring items on hangers, whether shoes and handbags can also be included, how to create makeshift changing rooms with mirrors, etc. And of course, any unwanted items left over at the end of the event should be donated to charities or used to start up the next swishing event.

The site *Love Your Clothes* has several useful suggestions about how to organize such events in their 'swapping and sharing' section and a number of major stores also promote campaigns to extend the active life of clothing. For example, Marks & Spencer, working in partnership with Oxfam since 2008 with their campaign *Shwopping: Ordinary Clothes made Extraordinary,* provides *Swopp* boxes in their stores for unwanted clothing, which is then recycled / resold by Oxfam in order to fund many projects around the world. How many other possibilities can students discover for extending the active life of their clothing?

If each local community makes a considerable effort to guarantee the expansion and continuity of a wide range of sustainable practices, including the promotion of circular

economies in disparate fields, and these practices are also guaranteed within larger regions and countries, global collaboration may become more prevalent.

❁ *Tourism as a means of preserving the environment*

To what extent is the tourism industry in your region a sustainable or circular economy? Emma Whittet makes the following comments about the possibilities for sustainability within this industry:

> Tourism is the fastest growing sector in the UK in terms of employment. It is predicted to be worth over £257 billion by 2025, growing at a faster annual rate than the overall UK Economy (3.8% compared to 3%). With this level of growth, it is a substantial user of products, materials and services. The impact of this ever growing industry can be mitigated by using the principles of the 'circular economy'. The circular economy aims to establish a virtuous circle that produces goods and services without wasting the limited resources of the earth such as raw materials. (WHITTET, 2018, online)

Whittet identifies five key stages of tourism: travel; stay; activities; feedback; and booking. Regarding travel, she says that "mobility sits at the centre of tourism, however travel and transport still have a long way to go before they can get on board with the Circular Economy concept as transport is one of the highest consumers of fossil fuels." (Ibid, online). According to the 'Scottish Transport Statistics' published by Transport Scotland in 2017, transport accounted for 27% of Scotland's greenhouse gas emissions in 2015. Nevertheless steps are being taken to help visitors adopt more sustainable practices when travelling. For example, public transportation schedules and routes are easily available and sometimes accommodation discounts are offered for visitors arriving by train or bus. Local private car owners are also beginning to adopt sharing techniques by renting out their cars during the day when they would normally be parked. Electric cars can also be used in specific areas of Scotland such as Scotland's North Coast 500 roads which already offer electric charging stations all along the route, as demonstrated by the North Coast 500 Electric Vehicles Tour in 2016.

Places to stay are becoming more varied, giving visitors opportunities to select more sustainable options, such as renting vacant rooms in private homes instead of using hotels which frequently maintain the heating and lighting of communal areas which are unoccupied. And if tourists select places to stay which have a number of attractive places to visit within walking or cycling distance, then private cars can become unnecessary. Of course it is essential that public transport be available for visits or

activities which are further away from visitors' accommodation, as well as for people who are unable to walk any distance. Therefore the activities that tourists decide to pursue can be linked to their travel options as well as to their choices about where to stay. Tourist accommodation businesses can also invest in sustainable travel options for their guests as well as sustainable practices related to food and energy consumption. According to Whittet, feedback and booking go hand in hand. A survey of 2,000 British travellers carried out in 2016 "showed that sustainability and energy use of a hotel is important to 50% of those surveyed and one in five were more likely to stay somewhere if it uses renewable energy sources." (WHITTET, 2018, online) Therefore green practices may well attract more customers and could be emphasized as part of advertising.

Where have students travelled to during their holidays? How did they get there? If they travelled by car – how many passengers were in the car and how far was the journey? Has anyone travelled to a holiday vacation by bus, by train or by plane? Do they know how much fossil fuel is used by different forms of transport and what the carbon emissions are? Kelsey Nowakowski wrote an article for National Geographic in 2018 where he compared the carbon footprint and fuel efficiency per passenger for a journey from Toronto to New York City using a car, bus, train or plane. Calculations were based on average passenger load, and different fuel types were converted to gasoline equivalents.

As might be predicted, the total carbon footprint for an electric car was the smallest, 11 kg per passenger; the next best option was the Greyhound bus, at 24 kg per passenger; then the plane, with 75.3 kg per passenger; followed by an SUV car at 80.7 kg per passenger; and lastly the Amtrak train, at 84.3 kg per passenger. However, the fuel efficiency calculations demonstrated a different ranking: the electric car was again in first place with 239 passenger miles per gallon; in 2nd place, the bus at 180 miles per gallon; in 3rd place the train with 59 miles per gallon; in 4th place the SUV car with 52 miles per gallon; and in last place, the plane with 40 passenger miles per gallon. Since electric cars are not yet readily available, the bus was the most energy-efficient way to travel in this case. The author explains the energy use of the plane and the train as follows:

> PLANE: The short flight [352 miles] and small aircraft size (fewer fliers), compounded by the intense fuel-burn of takeoff and landing, reduce

> efficiency. It improves on larger-craft flights over 1,000 miles. 80% occupancy on this route.
>
> TRAIN: While the train from Toronto outperformed the SUV and the plane in fuel efficiency, its emissions were the highest of all modes, due to diesel fuel and a circuitous trip [544 miles]. (NOWAKOWSKI, 2018, online)

Perhaps students could calculate the carbon footprint and fuel efficiency for their own trips? Afterwards they could investigate assorted travel options available for the same journey – and compare the time taken, cost and comfort as well as the carbon emissions and fuel efficiency. Which options would they use and why?

Several teams could be formed in the same classroom, with each team selecting a specific place to visit. Students could then join forces to work out which travel option would cause the least environmental impact, and all teams could compare their results when the investigations have been concluded. Projects could also be extended if students decide to discuss how long they would stay in their chosen destinations, where they would stay, and which pursuits, special interests or activities they would like to engage in after they reach their destination.

Were any outdoor sports involved as activities, and if so which ones were most popular? What are some of the geographic differences between the places selected by each team? Which location do students find most interesting and why? Were any attractions of scientific interest included? Were there explicit connections between science and history or between science and the environment? To what extent are students able to make connections between science and other areas of the curriculum? How many groups included cultural, historical or artistic elements as part of their planned visit? What exactly attracted them to these options? How far afield did they travel – did any of the teams feel the need to be able to speak another language? Which languages would they be interested in learning – and why?

All real-life problems are interdisciplinary by nature, therefore experience with interdisciplinary learning helps students to develop skills such as critical thinking, collaboration, innovation and problem solving so that they will be more able to apply them in a variety of practical ways. They learn to understand a variety of issues from plural perspectives and to perceive how each approach can influence others.

According to David Perkins, in his book ‘Smart Schools: from training memories to educating minds’, the most important goals for the education system are: “retention of

knowledge; understanding of knowledge; and active use of knowledge. A summary phrase for the goals taken together might be "generative knowledge" – knowledge that does not just sit there but functions richly in people's lives to help them understand and deal with the world." (1992, p. 5) In order to bring this about we also need *thoughtful* learning in "schools that focus not just on schooling memories but on schooling minds." (Ibid, p. 7)

For example, if a group of students from Lockerbie elected Edinburgh as their holiday destination for a 3-4 day trip, they need not depend automatically on a private car in order to get to their destination. They can be encouraged to investigate public transport options such as the train or bus. As students find out more information related to the impact of different kinds of transport on the environment and are asked to use this information to plan a trip to a place of their choice making the experience as eco-friendly as possible, they will be using their minds to apply their knowledge in a more thoughtful way.

According to the City of Edinburgh Council report 'Local Transport Strategy' (2014a) "Rail services are readily convertible to electric operation, with significant environmental benefits which will grow as electricity generation is de-carbonised. Many rail lines are electrified and electrification is currently being extended." (CEC, LTS, p. 56) So hopefully by the time this book is available, electrification will already be the norm rather than the exception, and train travel will be a more eco-friendly option.

If students decide to travel by car, would they consider car sharing or Car Clubs? Car sharing involves motorists who plan to travel together between similar origins and destinations. People who do not own cars are not normally involved in this strategy. However, Car Clubs offer car use without ownership, such that one Car Club vehicle can typically replace five to six privately owned cars. Therefore both strategies can contribute considerably towards a reduction in the number of cars on the roads, parking pressure in cities and the emissions generated.

How many cars are owned by students' families? How frequently are they used? Do any families have electric cars? When cars are used, what is the average number of passengers and the average distance travelled? Are there any uses that could be substituted by walking, cycling or public transport? What would be the difference in

cost and convenience? Do any families use car-sharing or Car Club strategies, and if so how frequently? What are the positive and the negative aspects of these strategies?

When students arrive in Edinburgh, there are several transport options available in the city, as described by Councillor Lesly Macinnes (2018):

> As well as providing a reliable alternative to the car, catering to users of all abilities, the [Lothian Bus] company clearly demonstrates green credentials, introducing its first all-electric vehicles last September as part of the ongoing upgrade of its fleet to electric, hybrid and lower-emission buses.
>
> An efficient, integrated transport system is essential to any plan to create a truly green, sustainable city. Since being introduced in 2014, the successfully operating Edinburgh Tram has worked in tandem with Lothian Buses to provide excellent transport links and an effective, low emission option for those wishing to travel from Edinburgh Airport and through the city centre.
>
> Ongoing projects […] which will each create safer and mostly segregated cycleways through Edinburgh, alongside significant pedestrian and public realm improvements, are part of our aspiration to make cycling a more attractive option for those who may be less confident.
>
> One exciting development, which is certain to increase cycling further in the capital, is the introduction of a bike hire scheme by Transport for Edinburgh later this summer, bringing us in line with many major cities around the world and allowing a whole new group of people the opportunity to explore Edinburgh on bike or e-bike. (MACINNES, 2018, online)

Which tourist attractions have students selected for their stay? Edinburgh Castle, built on Castle Rock formed by a volcano more than 340 million years ago, is clearly visible from most of the city and is the country's most popular tourist attraction. What do students know about the history of this famous castle? The construction we see today was built by David I, son of Saint Margaret of Scotland, but Castle Rock has been inhabited for more than 3,000 years. The Celtic tribe Votadini built Eidyn's Hill Fort there around 600 BC and the first king of Scotland to have lived in the castle was Malcolm III, who reigned from 1058-93. His wife Queen Margaret was canonized after her death and St. Margaret's Chapel was built between 1130 and 1140 and is the oldest surviving building on the castle grounds. The Royal Mile stretches from the Castle down to Holyrood House, the present Queen's official residence in Scotland, which was built beside Holyrood Abbey. King David I founded Holyrood Abbey as an Augustinian Monastery in 1128 (the name Holy Rood comes from Old English and means the holy cross), and in 1501 King James IV built a palace nearby. There is history galore for every preference all along the Royal Mile.

What might students find interesting about Edinburgh castle? Do they know that the one-o-clock gun was originally fired to help ships synchronize their clocks? What do students know about the strong links between timekeeping and navigation? The time of day is based on the location of the sun in the local sky, the month comes from the cycle of the moon, the year is based on the annual elliptical path of the Sun, and timekeeping devices have evolved from the sundial to atomic clocks and GPS. Can students tell the time of day from the position of the sun? Can they predict the tides by looking at the moon? Do they know how to read a sundial? How much do they know about longitude and latitude?

Towards the end of the 17th century, mariners were already able to work out the latitude for their position at sea, but in order to work out the longitude, they needed to compare local time with the standard time on a seaworthy clock, but there were no accurate clocks which could be used at sea at this time. An accurate timekeeping instrument which would function at sea was so important that the British government offered a 'longitudinal prize' in 1714 with a first prize of £20,000 (the equivalent of £4 million in 2019) for anyone who was able to measure longitude at sea. In 1730, John Harrison, a carpenter from Yorkshire, submitted his first project, but it was not until 1761, after another 31 years of work, that he submitted his final chronometer design which became invaluable for future shipping exploration and trade.

How much time are students prepared to invest in order to produce satisfactory results for any of their life projects? What is the longest amount of time they have dedicated to discovering something which really interests them? How much do they know about the concept time? Can they work out their age on a different planet? How do sunrise and sunset times change with altitude? What causes the seasons? What other questions intrigue students?

What do students know about the Stone of Destiny which can now be found in Edinburgh Castle? The Celtic name for the stone is *An Lia Fàil,* which means the 'speaking stone' or the stone which would proclaim the chosen king, and is said to have been used originally to crown the Scots kings of Dalriada in the West of Scotland. When Kenneth I, 36th king of Dalriada, joined together the kingdoms of the Scots and the Picts, he moved his capital to Scone around 840 AD, where future kings continued to be crowned. However, in 1296, the English King Edward I, known as the 'Hammer

of the Scots', removed the stone to Westminster Abbey in London, and it was only returned to Scotland in 1996. Are students aware that there are doubts as to whether it was the original Stone of Destiny that King Edward removed or whether it had been substituted by a 'false' stone? What is their opinion? Where can they find more information on the topic?

There are legends which connect the Stone of Destiny backwards in time through St. Columba and the kings of Ireland, via Egypt and Syria, all the way back to the town of Bethel in biblical times, where it was said to have been used by Jacob as a pillow. But geologists claim that the present stone has the same geological structure as the stone commonly found in the region of Scone and seems to have been prepared for building purposes. So what do the students think? Perhaps they could write their own legends or poems around the Destiny Stone and transform them into theatre productions, musicals, films or comedies. Some students might be more enthusiastic about producing their own Destiny Stone with appropriate carvings and inscriptions which would emphasize its historical significance, or a film which portrays a chronicle of the stone. Others may prefer to work on a series of multi-coloured posters or paintings which depict the legend, or they could produce cartoons based on their own versions of the story. Which ideas would they be prepared to invest more time and effort exploring?

Although there are literally hundreds of opportunities to discover more about many historical periods and events, Edinburgh also offers a plentiful supply of green spaces throughout the city which can be appreciated by nature-loving students. Arthur's Seat, is a 640 acre Royal Park near Holyrood Abbey, and is the main peak of the same volcano which produced Calton Hill and Castle Rock. It is ideal for a city centre hill-walking expedition with tremendous views over the city from the top, where archaeological evidence places a large hill fort, occupied about 2,000 years ago. At the foot of Arthur's Seat is the science centre 'Our Dynamic Earth' which takes visitors on a 500 million year journey through the Earth's history – history, science and nature, all coming together.

Princes Street Gardens lies between Edinburgh Castle and the New Town and contains a world-renowned floral clock composed of up to 30,000 dwarf plants (and hopefully synchronized with the Castle's one-o-clock gun). The gardens include war memorials, statues, sculptures and the Walter Scott monument, and are currently becoming more

integrated with the National Art Galleries at the East End of the gardens. Therefore art and nature are combined in the same location.

However, if students truly appreciate the diversity of nature, they should definitely visit the famous Royal Botanic Gardens whose mission is "to explore, conserve and explain the world of plants for a better future."[32] The Botanic Gardens provide "a diverse range of formal and informal education programmes for people of all ages and all levels. From primary school to PhD, amateur or professional, RBGE is committed to lifelong learning." (Ibid.) They offer activities such as teddy bears' picnics and rainforest adventures for primary school children, as well as one-day workshops on topics such as: an 'Introduction to Japanese Gardens', 'Working with Willow Withies'; or weekend workshops on 'Plant Dying: colours of Scotland', Textural Exotics'[33]; to week and month long courses on a wide range of topics.

However, the fascination for me has always been to discover the endless variations of shape, colour, texture, and smell of the thousands of trees, shrubs and flowers, growing together in 70 acres of magnificent landscape. And on a cold winter's day, it seems incredible to be able to wander around inside the giant glasshouses, basking in a warm, humid, tropical climate, complete with palms, banana trees and more than 3,000 exotic plants from all around the world. When students experience the diversity of nature by wandering around the Botanic Gardens in person or around Edinburgh Zoo, aware that both institutions protect vulnerable and endangered species, this will help them become aware of the necessity to invest more effort in the protection and conservation of such diversity.

Of course natural green spaces can also be used for exercise, and hillwalking, cycling, skateboarding or roller-blading around Arthur's Seat in Holyrood Park are a few of the free physical activities available in the centre of the city. And if you want to challenge yourself on a pump track and MTB trails, you can call in at the SKELF Bike Park, which is suitable for mountain bikes, scooters, rollerblades, balance bikes, basically anything with wheels. This community bike park was built by volunteers on waste ground just opposite Salisbury Crags in Holyrood Park, and is also free of charge. The

[32] Royal Botanic Gardens. Available at: <https://www.rbge.org.uk/> Accessed on: 04.06.2021.
[33] These examples were selected from the options being offered between May and June, 2019.

Royal Botanic Gardens are also free, except for the Glasshouses where adults pay for admission, but for students under 15 admission is still free.

The Botanic Gardens and Edinburgh Zoo both invest explicitly in conservation practices and education programmes, while Princes Street Gardens and Arthur's Seat are maintained by the City Council to guarantee green spaces in the city centre. In fact the City of Edinburgh Council (CEC) maintains a total of 144 parks throughout the city, and offers opportunities for volunteers to contribute towards the upkeep of gardens and green spaces in different parts of the city.[34] In 2014, Edinburgh Council used the 'Social Return on Investment' approach to calculate the environmental and economic benefits of their investment in the provision and maintenance of parks and green spaces. They discovered that "for every £1 invested, around £12 of social, economic and environmental benefits are delivered." (CEC, 2014b, p.2) Their calculations led to the following conclusions:

> Individuals will gain health and wellbeing benefits worth around £40.5 million; The impact on social inclusion and community capacity is calculated to be worth over £6 million; Local businesses and the economy will gain additional revenue from visitors to the parks in the region of £51 million; Schools, nurseries and colleges are able to provide outdoor educational experiences that equate to just under £1 million; The awareness and understanding gained by visitors of their local environment is valued at just under £5 million.
>
> The analysis demonstrates that City of Edinburgh Council's parks deliver multiple benefits and make a significant contribution to making people in Edinburgh feel healthier, wealthier, smarter, safer and greener. (CEC, 2014b, p. 2)

Based on this analysis, it seems to be the case that when green spaces are readily available, and local populations and visitors are encouraged to use these spaces for volunteer work, exercise and learning experiences, it is not only the users who benefit, those who maintain the spaces can also benefit economically. Therefore when planning their trips, tourists should try to include a variety of pursuits as part of their scheduled activities in order to reap the benefits of health and wellbeing as well as increasing their knowledge about a variety of subjects and experiences.

As consumers and tourist businesses both adopt more sustainable habits, tourism will automatically become increasingly circular and sustainable, since tourists will prefer more eco-friendly businesses when booking and will make their personal preferences

[34] Love Edinburgh Love Volunteering. Available at: <https://www.volunteeredinburgh.org.uk/>. Accessed on: 04.06.2021.

for green practices clear in their feedback. With greater numbers of tourists using online feedback information in order to select travel, place and stay options, sustainable collaboration between users and servers will grow and automatically strengthen the circular economy of tourism.

CHAPTER 6

THE ENVIRONMENT OF MY COUNTRY

The organization P21, or 'Partnership for 21st Century Learning', has already been mentioned as an essential component of learning activities in schools "to build knowledge and skills for success in a globally and digitally interconnected world"[35]. I would like to continue to invest in this discussion in the present chapter and include the other three key conceptual issues identified by P21 which are: Creativity, Critical Thinking, and Communication. These subjects will be explored largely within the context of the country of my birth, Scotland, and will involve the following topics:

Topics: ❁ *Critical Thinking and Adaptation* ❁ *Collaboration and Taking Action* ❁ *Communication and Creativity*

❁ *Critical Thinking and Adaptation*

The 'Foundation and Center for Critical Thinking' in California represents two non-profit organizations who work together to promote educational reform. They "seek to promote essential change in education and society through the cultivation of fairminded critical thinking." Part of their Mission statement follows:

> *Critical thinking is essential if we are to get to the root of our problems and develop reasonable solutions. After all, the quality of everything we do is determined by the quality of our thinking.*
>
> Whereas society commonly promotes values laden with superficial, immediate "benefits", critical thinking cultivates substance and true intellectual discipline. Critical thinking […] entails rigorous self-reflection and open mindedness – the keys to significant changes.
>
> Critical thinking requires the cultivation of core intellectual virtues such as intellectual humility, perseverance, integrity, and responsibility. Nothing of real value comes easily; a rich intellectual environment – alive with curious and determined students – is possible only with critical thinking at the foundation of the educational process.
>
> We do not just advocate educational and social reform based on critical thinking, we develop and build practical alternatives. In a world of accelerating change, intensifying complexity, and increasing interdependence, critical thinking is now a requirement for economic and social survival. [36]

[35] The Home Page of P21, the organization 'Partnership for 21st Century Learning', is available at: <http://www.p21.org/about-us/our-mission>. Accessed on: 04.06.2021.

[36] The Foundation and Center for Critical Thinking. **Our Mission.** Tomales, California, 2019. Available at: <https://www.criticalthinking.org/pages/our-mission/405>. Accessed on: 04.06.2021.

The 'Foundation and Center for Critical Thinking' aims to improve education in general by offering information, articles, learning tools and other resources in order to promote empathetic or fair-minded critical thinking. For example, they offer an interactive online learning resource[37] based on the book 'The Thinker's Guide to Analytic Thinking: How to take thinking apart and what to look for when you do', by Elder and Paul (2016). The tool 'Learn the Elements and Standards' helps users to analyse their own thinking habits by offering lists of questions which encourage us to check our own point of view or frame of reference; our purpose, motives, intentions; the question or problem we are investigating; the information we are gathering and its applicability to our question; the relevance of our inferences or interpretations of the data; the concepts or hypotheses we are using to interpret our data; the assumptions or presuppositions we might be taking for granted; as well as the implications or consequences of our reasoning process. This tool also invites us to examine the standards we are applying to our analysis of the elements listed previously, standards such as clarity, accuracy, logic, relevance, significance, depth, breadth, fairness, validity, feasibility, necessity, amongst others. When teachers encourage students to develop a deeper awareness of their thinking processes, they offer them more opportunities to develop profound, contextualized, relevant thinking which may contribute to the quality of their lives.

In Chapter 4 we mentioned the Swedish schoolgirl Greta Thunberg who promoted a worldwide movement to draw more attention to climate change. She not only thought very deeply about the topic from an early age, she also took action by changing her lifestyle to reduce her carbon footprint, then she went on strike from school to raise public awareness. At the end of the paragraph which discussed Greta's concerns and actions, I asked the following questions: To what extent do human actions affect climate change? What other factors are involved, and whose voice are we listening to?

Rafal Miazga, writing for the online site '*sentione'* which deals with Social Listening and Online Monitoring, analysed Greta Thunberg's rise to fame by relating the growing number of her followers to the media events in which she participated. He presents graphs, charts and cloud analyses to demonstrate that online communication has contributed significantly to the spread of information worldwide. According to world

[37] The Foundation and Center for Critical Thinking. **Learn the Elements of Reasoning and Intellectual Standards.** Available at: <http://www.criticalthinking.org/pages/learn-the-elements-and-standards/861>. Accessed on: 24.04.2019.

internet usage and population statistics for March 2019[38], 56.3% of the global population were already using the internet at this time. Of course the percentage varies according to world regions, with North America registering the largest numbers at 89.1%, Europe in second place with 86.6% and Africa with the lowest percentage of 35.9%. Nevertheless, these numbers confirm the idea that facts, figures, data, statistics, reports, articles and books are all much more easily accessible to the younger generation today than ever before. The main question now is – what kind of information is being accessed and what is being done with the information that is available?

Do online listeners truly comprehend what they hear? To what extent do we genuinely understand what we read? How often do we look for accurate information from a variety of trustworthy sources while comparing and contrasting the data we investigate? How much information is being transformed into deep knowledge? How frequently is knowledge being converted into effective action? To what extent do we scrutinize our own thinking habits, question our frame of reference, our interpretation of the data, the implications of our reasoning process? All of these aspects – and many more – must be applied when utilizing our critical thinking abilities.

One of the principal contributing factors to modern climate change is of course the unparalleled growth in human population, together with a lack of awareness of the necessity for sustainable living practices. Consumerism reigns in our modern society and this will have to change to guarantee the survival of the human race. Wim Couwenberg, writing for the Ten Million Club Foundation, a Dutch non-profit organization which promotes overpopulation awareness, points out that:

> The unprecedentedly rapid growth of the world population – with an increase of 160 percent between 1950 and 2005 from 2.5 billion to approximately 6.5 billion people […] will give rise to a number of negative effects [including the] deterioration of the environment and the quality of life and a depletion of our global natural resources – to date we have 20 percent overexploitation of the earth's capacity each year. (COUWENBERG, 2008, online)

Let us consider the population growth in Scotland as an example. In the previous chapter we mentioned archaeological explorations of Iron Age dwellings and the implications for the way of life during that period, around 500 BC. As farming techniques improved during the Iron Age, the population of Great Britain grew and has

[38] **Internet World Stats:** usage and population statistics. Available at: <https://www.internetworldstats.com/stats.htm>. Accessed on: 24.04.2019.

been estimated as reaching around one million at the time of the Roman Invasion. Due to lack of written statistical evidence, estimates also suggest that by the mid fourteenth century the population of Scotland may have reached around half a million, but although the population may have increased considerably during the following one hundred years, numbers would have been drastically reduced by the Black Death, as well as widespread famines in the 1300s, and may have dropped back to around half a million by the end of the 14th century. During the 17th century the population continued to grow despite the fact that people still suffered from failed harvests on multiple occasions, many wars were fought, and a considerable number of Scots migrated to different places, including America, Europe, England, and Ireland.

The National Records of Scotland believe that Alexander Webster's account of the population of Scotland in 1755 is the most credible estimate of the Scottish population prior to 1801. Webster was a minister who worked in Edinburgh, and he asked 909 ministers from all over Scotland to register the number and age of the inhabitants in their parish and his total was 1,265,380. Population continued to grow steadily thereafter, reaching 1,608,402 in 1801, an increase of 27% in almost 50 years. However, the census of 1901 registered a population of 4,472,000, which represents nearly a threefold increase of 278% during the 19th century. This seems surprising, since the Irish potato famine expanded to Scotland in the 1840s when the Highlands were already suffering from the Clearances, and, despite the growth of industry at this time, jobs did not pay well. For all of these reasons, amongst others, about two million Scots migrated to North America and Australia between 1841 and 1931. In 2011, the census registered a population of 5,313,600, an increase of around 19% for the 20th century, markedly lower than the previous century, although contributory factors included emigration as well as the occurrence of two world wars in which the Scots participated in large numbers.

What can students learn as they analyse the growth in population? What are the main problems caused by overpopulation in their opinion? How would they solve them? Are they more concerned about the growing quantities of waste, the pollution of the air, the soil, the water, or the reduction of green spaces and natural woodlands? How can we change our present habits in order to adapt to a more sustainable way of life?

Students could have an initial plenary discussion in order to identify themes which would motivate their investigations. For example, an expanding world population will obviously make more demands on food production. Consequently, an increased need for greater amounts of food could generate intensive farming techniques or deforestation. Intensive farming often relies on mechanization, pesticides and chemical fertilizers, all of which contribute to soil erosion or loss of productivity. Deforestation reduces the capture of CO2 and the production of oxygen. We discussed the relationship between humans and trees in terms of oxygen consumption and production in Chapter 1, but students could try to find more scientific information about the topic.

According to Luis Villazon (online), writing for Science Focus, "Trees release oxygen when they use energy from sunlight to make glucose from carbon dioxide and water. […] It takes six molecules of CO2 to produce one molecule of glucose by photosynthesis, and six molecules of oxygen are released as a by-product." After making all the relevant calculations, Luis worked out that it takes about seven or eight mature sycamore trees to produce sufficient oxygen for one person. So it is clearly not a good idea to keep cutting down forests in order to plant food, since we can survive without food for about three weeks, without water for about three days and without air for approximately three minutes. Therefore the continuity of humankind depends on solutions which guarantee all of these basic necessities. One group might therefore decide to investigate alternative solutions for the problem of deforestation which would not create such strong negative impacts on the environment. What can each member of the group change in their current lifestyle to reduce their eco-footprint?

Another serious problem caused by the expanding population is the lack of fresh water for human consumption. Although there seems to be large quantities of water on our planet, only 2.5% is fresh water, and only about 0,5% is available as drinking water. The demand for fresh water is already very high in specific regions of our planet and the competition is rising rapidly. How would students solve this problem – what are their suggestions and how would they put them into practice? How can we change, modify, readjust the way we live in order to reduce our water consumption?

Some students might be more interested in the investigation of the mass extinction of different species of animals, plants, birds and insects which has been taking place at an unprecedented rate in recent years. According to Prof. Josef Settele:

> Ecosystems, species, wild populations, local varieties and breeds of domesticated plants and animals are shrinking, deteriorating or vanishing. The essential, interconnected web of life on Earth is getting smaller and increasingly frayed. This loss is a direct result of human activity and constitutes a direct threat to human well-being in all regions of the world.[39]

The facts presented in this UN press report are appalling. For example: three-quarters of the land-based environment and about 66% of the marine environment have already been severely altered by human actions. Interestingly, however, these trends have been less severe, or even avoided, in areas held or managed by Indigenous Peoples and Local Communities (IPMG, 2019). There is an estimated total of 8 million different animal and plant species on Earth (including 5.5 million insects), but up to 1 million different species are already threatened with extinction. For example, according to the World Wildlife Organization[40], there are only about 200-300 Cross River gorillas surviving in 11 groups in the rainforests of Cameroon and Nigeria; the Sumatra rhino is the smallest living rhinoceros, and the only Asian rhino with two horns, but there are only around 80 individuals surviving on the islands of Sumatra and Borneo; the Amur tiger used to be found throughout the far east of Russia, northern China and Korea but by the 1940's hunting had reduced their numbers to around 40 individuals. Nevertheless, the species was saved when Russia granted the tiger full protection, and there is now a stable population of around 540 individuals. Which endangered species interest students more – and why? What could they do to help save these species from extinction? What can we learn about environmental adaptation from these examples of species extinction?

Students could form teams around the topics which motivate them most strongly, then they could use a six-step problem-solving process to try to stimulate ideas to solve some of the environmental challenges our planet is already facing. First of all, it is imperative for each team to identify the main issues they intend to focus on. Critical thinking is key at this point since they need to define their problem as clearly as possible, its context, background and symptoms. The second step involves trying to understand the interests of everyone concerned, as students attempt to determine the root causes of the problem. Again, careful analysis of all factors involved is extremely important. Students could

[39] UNITED NATIONS. Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating'. Press Report. **Sustainable Development Goals.** 06 May, 2019. Available at: <https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report/>. Accessed on: 04.06.2021.

[40] WORLD WILDLIFE ORGANIZATION. **Species Directory**. Available at: <https://www.worldwildlife.org/species/directory?page=2&sort=extinction_status>. Accessed on: 04.06.2021.

use fish-skeleton diagrams to relate cause and effect or affinity diagrams to group related issues together. What other possibilities could they use to organize their ideas? For the third step, creativity comes into play as students make a list of possible solutions. Evaluation is not important at this stage – and it is crucial to encourage each student to express their own ideas as everyone else in the team listens carefully to each proposal. When focused listening is involved, new composite ideas, as well as original 'team' ideas will be generated during the process. Once the team has a range of alternative solutions – the fourth step is to analyse them very carefully in order to make a decision about which course of action is to be followed – although the final course of action selected may well contain an amalgam of different proposals as they all work together to judge the feasibility, reliability, effectiveness, benefits and risks. The fifth step entails carrying out the chosen solution, and while this is happening, the sixth step should monitor and evaluate the solution that is being tried out. During this final phase, the team may have to go through the whole process again in order to solve minor problems which occur during the implementation phase.

Can students create visual representations of this six-step process to help them remember each step? When they examine a collection of visually distinct interpretations of the same set of concepts, does this wide array of options contribute to a deeper understanding of the concepts or does it confuse them? Which steps did they find most valuable or helpful and why? As students work together to produce visual representations of this planning process, then compare and discuss the results as a whole class, they will be stimulated to perceive nuances of meaning and connections between the steps which will help them understand many of the basic principles of critical thinking.

As students work through this six-step problem-solving process, they are not only using their ability to think critically, they are also collaborating with their colleagues throughout the process and using their creativity as they share ideas and communicate their thoughts. Therefore all four key conceptual issues identified by P21 are being applied throughout the problem-solving process as students work out innovative proposals and apply them in practice in order to stimulate our ability to adapt to more eco-friendly habits.

Although we do not seem to be sufficiently conscious of our role as the custodians of our host planet, nevertheless, concern is growing regarding the possible effects which may be caused by our increasing population, and one of the main areas of anxiety is related to the various ways that human beings are affecting the natural process of climate change.

Geologists already know that drastic changes in the Earth's climate have already occurred during the history of our planet but, according to the Geological Society of London (2010, p. 2-5):

> The last century has seen a rapidly growing global population and much more intensive use of resources, leading to greatly increased emissions of gases, such as carbon dioxide and methane, from the burning of fossil fuels (oil, gas and coal), and from agriculture, cement production and deforestation. Evidence from the geological record is consistent with the physics that shows that adding large amounts of carbon dioxide to the atmosphere warms the world and may lead to: higher sea levels and flooding of low-lying coasts; greatly changed patterns of rainfall; increased acidity of the oceans; and decreased oxygen levels in seawater. […]
>
> Life on Earth has survived large climate changes in the past, but extinctions and major redistribution of species have been associated with many of them. When the human population was small and nomadic, a rise in sea level of a few metres would have had very little effect on Homo sapiens. With the current and growing global population, much of which is concentrated in coastal cities, such a rise in sea level would have a drastic effect on our complex society, especially if the climate were to change as suddenly as it has at times in the past. […] it is not possible to relate the Earth's warming since 1970 to anything recognisable as having a geological cause (GEOLOGICAL SOCIETY OF LONDON, 2010, p. 2-5).

Based on this analysis of the Geological Society of London, human beings clearly need to reduce their use of fossil fuels – urgently. This topic has been mentioned several times in previous chapters, but it is evidently an area that requires drastic action. If students check online images or short videos on this issue, do any of the images stimulate more original, innovative ideas that they would like to propagate through the media? Once again, they could work creatively to produce theatrical presentations, catchy musical performances, short videos or composite online images to convince people to reduce their use of fossil fuels and experiment alternative options.

In their article 'Adapting to Climate Change: a guide for the energy and utility industry', Finley and Schuchard (2010) point out that:

> Climate change is expected to bring warmer temperatures, a rise in sea levels, ice melting in the Arctic, more frequent and severe extreme weather events, and decreased availability of natural resources such as fresh water. […] these

> and other climate-related effects may result in new engineering challenges and increased capital costs for accessing and developing energy resources. They may also affect the reliability of transportation, logistics, and distribution channels to end users. (FINLEY; SCHUCHARD, 2010, p. 1)

Their analysis shows that "overall adaptation initiatives remain limited in the energy sector, providing ample space for innovation and leadership. This condition appears consistent throughout the energy value chain from production and generation to consumption, management, and customer engagement." (Ibid., p. 2) However, although climate change will affect access to fuel reserves, and fluctuations in energy demand may affect hydroelectric generation plants due to drought or excessive flooding, there are also positive implications for innovation, since: "Hydroelectric generation may outcompete other energy generation sources due to favorable water supply conditions in certain geographical regions." (Ibid., p. 3)

Finley and Schuchard (2010) include illustrations from different companies who are already putting into practice a variety of adaptation strategies. For example, one company invested in water recycling as well as a drainage management system to reduce water intake and consumption. Another company is investing in carbon capture and sequestration research as well as afforestation. Other companies are promoting energy awareness in their customers by designing an interactive game to teach customers about energy efficiency measures, or by offering smart-meter programmes so that customers can monitor their energy use and modify their consumption behaviour. What are the students' suggestions for promoting energy awareness? How would they put their ideas into practice? What would they expect their results to be and how would they evaluate the results during the application of their ideas?

One of the main problem areas related to the increase in population is also the growing need for transport, which is still based very strongly on the use of fossil fuels. We already examined the transport problem to some extent in the previous chapter, when we mentioned that the transport sector was responsible for 27% of Scotland's greenhouse gas emissions in 2015. But perhaps the general public could examine their private car use in more detail and attempt to adapt themselves to more eco-friendly options for getting from one place to another.

What do students suggest? How often is the family car used for journeys with only one or two passengers in the car? Are there more sustainable alternatives? What is the

normal walking distance covered by different family members? How could this be expanded? How many students regularly walk or cycle to school? What is the distance they have to cover – does this affect their decision to walk or cycle? Have they heard of 'walking school buses' in different parts of the world, where groups of schoolchildren walk to school together accompanied by at least one adult? The State of Utah in the USA, for example, has an App available which can be downloaded to a cell phone. On the App, you enter the name of the school and can then form your own 'walking school bus', with pick-up times and adult volunteer schedules. Are students aware that there are scientific studies which show that children who are driven to school are less alert than those who walk or cycle, and also, those who walk enjoy more social interaction than those who are driven. Do students agree with these findings? How about organizing their own 'walking bus' group?

They could also use their critical thinking abilities to discover more about the reasons why colleagues are driven to school. After analysing and discussing their findings, they could then create alternative proposals to reduce or maximize car use, not only on the school run, but for other activities where cars are being used by a minimum number of passengers. What other suggestions do students have for adapting their local community's lifestyle to reduce greenhouse gas emissions?

❁ *The Environment – Collaboration and Taking Action*

Silpa Kaza et al. produced a disturbing report in 2018 for the World Bank entitled "What a Waste 2.0: a global snapshot of solid waste management to 2050". In the foreword they make the following statements:

> As you will see in this report, the world is on a trajectory where waste generation will drastically outpace population growth by more than double by 2050. [...] In 2016, the world generated 242 million tonnes of plastic waste – 12 percent of all municipal solid waste. Plastic waste is choking our oceans, yet our consumption of plastics is only increasing. [...] Meanwhile, an estimated 1.6 billion tonnes of carbon dioxide-equivalent (CO2-equivalent) greenhouse gas emissions were generated from solid waste management in 2016. This is about 5 percent of global emissions. (KAZA et al., 2018, p. ix)

On page 8 of this report, Figure 0.5 shows that Food and Green waste make up the greatest percentage of global solid waste management (44%), followed by paper and cardboard (14%), then plastics (12%).

In Chapter 4 we mentioned the UK Plastics Pact launched in 2018 by the 'Waste and Resources Action Programme' (WRAP). This programme was set up in 2000 to promote sustainable waste management in the areas of: food and drink; clothing and textiles; electronics; and plastics. WRAP brings together individuals, communities, local authorities, businesses and governments, creating collaborative partnerships and initiatives and converting ideas into action. Their mission is to "accelerate the move to a sustainable resource-efficient economy through re-inventing how we design, produce and sell products; re-thinking how we use and consume products; and re-defining what is possible through re-use and recycling." (WRAP, 2017b, p. ii) According to the WRAP report 'Household Food Waste in the UK, 2015', 70% of food waste comes from households: "Food with a retail value of around £13 billion was thrown away rather than being eaten in 2015. This avoidable Household Food Waste (HHFW) was associated with 19 million tonnes of CO2e, which is equivalent to the emissions generated by 1 in 4 cars on UK roads." (Ibid., p. 3) Since households are the source of the majority of food waste in the UK, this section will focus on collaborative activities which might be able to reduce these numbers.

The UK government decided that collaboration across the food industry would be essential in order to reduce biodegradable waste and they assigned WRAP the task of bringing about appropriate partnerships and programmes. One of the partnership programmes instigated and managed by WRAP is referred to as the 'Courtauld Commitment' because it was first discussed at the Courtauld Art Gallery in London in 2005. It is "a voluntary agreement between grocery retailers and suppliers to reduce household food waste, packaging and supply chain waste." (EMF, online) This action programme was selected as a case study by the Ellen Macarthur Foundation (EMF) to illustrate successful waste and resources programmes. In the results reported as part of the case study, a strong connection was made between a voluntary approach and accountability.

> WRAP has found that the commitments have helped to show that a voluntary approach can deliver real and lasting change. It identifies three main elements of the commitments that have contributed to their success:
>
> - Providing a forum for businesses to put aside commercial sensitivities to develop *collectively* a clear strategic framework and set precise targets. This allows the sector to give clear signals to its suppliers on priorities and level of ambition on packaging.
> - Setting a clear vision and *common goal* to encourage real change and stimulate friendly rivalry to push companies further in the same direction.

> - Including regular reporting to add an element of *accountability* to the participating companies. (ELLEN MACARTHUR FOUNDATION, ca. 2016, online, my emphasis.)

Clearly, the fact that the businesses involved are working collectively towards the common goal of reducing and recycling their waste demonstrates the results that can be obtained through collaboration. They are also being held accountable for their actions, therefore they present regular reports which share results, innovative ideas and problem areas which can all be examined, evaluated and improved upon by everyone. This combination of collaboration and critical thinking is essential for the successful solving of problems of all kinds. Therefore students should be encouraged to define problem areas which are meaningful for them, since their commitment to the final outcome may help them learn how to work together successfully to arrive at possible solutions which are acceptable to everyone concerned. As teachers, we must also remember that infants are able to think scientifically from birth, therefore collaborative critical thinking can be promoted throughout the school years.

> The critical thinking-collaboration research has shown that collaboration can enhance the development of critical thinking skills. In a study by Gokhale (1995), students performed both factual knowledge recall tasks and critical thinking tasks individually and as a group. Both methods of instruction were found to be effective in increasing factual knowledge; however, to enhance critical thinking and problem-solving skills, collaborative learning was significantly more beneficial due to providing students opportunities to discuss, clarify ideas, and evaluate others' ideas. (PLUCKER et al., 2015b, p. 4)

WRAP signatories already represent 95% of UK food retail and 40% of council populations (2017a, p. 8), therefore industry and government seem to be uniting in their attempts to reduce waste as much as possible. In the Final Report for the Courtauld Commitment, testimonials from participants in the programme confirm these points. For example, a Group CI Manager for Greencore affirms that: "Having a team from across the supply chain and from various business disciplines meant that the effects of potential solutions could be assessed quickly and ensured a win-win scenario for all participants." (WRAP, 2017a, p. 31) And on the same page, the Head of Sustainable & Ethical Sourcing for Sainsbury's adds that: "We are committed to unlocking opportunities to reduce waste across our supply chains. This project is a great example of partnerships and wider collaborations delivering direct improvements that can be replicated in other areas of our business."

Naturally, reducing waste will save money, and when organized as part of a circular economy can also make more money – another win-win situation. Therefore, businesses are realizing that it is economically smart to reduce waste throughout the food chain. Nevertheless, the actions taken by some of the partners in the WRAP campaign are also making considerable social investments as well. In the same final report we find that "From 2012 to 2015, the data indicates there has been a notable increase in the amount of surplus food and drink being sent for charitable or commercial redistribution, from an estimated 6,000 to 18,000 tonnes." (Ibid., p. 12)

When we examine some of the case studies in the final report for the Courtauld Commitment (Ibid., p. 22-33), we discover that, at the time of the report, Morrison's was working with 420 local community partners, redistributing an average of 200,000 products per month, resulting in a total of around 1.5 million products since the programme's inception. The Co-op was also redistributing supplies – from their warehouse depot. Surplus produce was supplied to the charity *FareShare* who would provide meals for vulnerable people. In 10 weeks, the Co-op had redistributed 32 tonnes of food from one depot. Tesco's also donated over 3 million meals worth of surplus food to over 3,000 charities and community groups through their 'Community Food Connection Programme' run in partnership with food redistribution charity *FareShare*, using an app developed by social enterprise *FoodCloud*. "The scheme enables stores to alert local charities and community groups to how much surplus food is available at the end of each day. Charities simply respond by text message to confirm that they want the food and then come and collect it – free of charge." (Ibid, p. 27)

Asda, on the other hand, decided to help customers reduce their food waste at home. They worked with 'Love Food Hate Waste', a campaign launched by WRAP, to devise various strategies to inform the public about ways and means to reduce food waste. They added information stickers with leftover ideas on packs of some of their most wasted products; they printed a feature article in their magazine which included tips for reducing food waste and recipes for using leftovers; and they promoted face-to-face in-store activities which included interactive games, food waste events and asking customers to 'pledge' to change one thing related to food waste. The Sustainability Manager for the company estimated that around 2 million customers were seriously considering making changes in their homes to reduce their food waste. (Ibid., p. 30)

One other crucial suggestion WRAP made to the signatories of the Courtauld Commitment, was that they should also get their employees involved in waste prevention within their workplace. The collaborative programme 'Imagine Your Workplace Without Waste' aimed to "raise staff awareness, empower them to identify where waste occurs within their business and to take action to reduce it." (Ibid., p. 15). So what can families and households learn from the experiences of the WRAP signatories who pledged themselves to reduce waste? Barbara Milligan writes:

> In Scotland, we throw away around 70,000 tonnes of fresh fruit and vegetables, 39,000 tonnes of bakery products and 38,000 tonnes of home cooked and prepared meals a year – and almost 50% of that is from people's homes. You could save hundreds of pounds a year through reducing food waste. The careful approach of planning and managing your food stocks - much favoured by the wartime generation, is the way forward. (MILLIGAN, 2018, online)

Perhaps we should remember the lessons learned from wartime experiences and try to plan and manage our food supplies more carefully. My father fought in World War 2 at the same time that my mother, the eldest of six children, was a young teenager at school. As a young child, I distinctly remember my mother asking us at breakfast how many potatoes we would want at lunchtime – and we had to stick to that number when lunch came around. We were not allowed to leave any food on our plates at all, and if we were unable to finish something – that would be the first thing we had to eat at the start of the following meal. Both planning and management were very important in the home of my childhood. In Brazil, where I live now, there are many restaurants which function according to a self-service system, where customers take a plate and help themselves to the food they want, then pay according to the weight of the food on the plate. Even though each person is selecting the food they intend to eat immediately – many customers leave considerable amounts of food on their plates, illustrating a complete lack of management as well as a total disregard for the consequences of food waste – despite the fact that one quarter of the Brazilian population live in poverty.

What can students do as individuals, as family members, as members of their local community, in order to reduce their own food waste and also to stimulate others to do the same? In chapter 3, when we were discussing the school environment, we mentioned a student called Martha Payne who started writing about her school meals on a blog called *NeverSeconds*. Less than 2 years later she had raised a considerable sum of money for the organization 'Mary's Meals', who feed hungry children in different parts

of the world, and had visited a school kitchen in Malawi built with the money she had raised. Another success story brought to fruition through worldwide internet communication.

Can students think of ideas to reduce food waste, redistribute food more equally or convince more people to eat healthier food? By working as members of teams with specific shared goals in mind and accountability measures included in the planning, can the internet help them communicate with a larger audience in order to exchange information, ideas and results? Which topics stimulate students more? Enthusiasm and motivation are key ingredients for prolonged investment and in-depth analysis. So after general brainstorming sessions or whole class discussions to identify possible food-related topics, small teams could be formed around the proposals which students are most enthusiastic about.

For example, one team might be interested in reducing the food wastage in their own homes as a first step, in the belief that they would acquire more authority, and be able to communicate with others, using examples from their personal experience. An initial analysis of the planning, management and food waste in each home would be an obvious place to start. For example, to what extent does the family check what is in their cupboards, fridge and freezer before they go shopping? How often do they inspect 'best before' dates on their purchases, and consume goods accordingly? If a product is getting close to the date limit, does the family freeze it in order to extend its consumable life? When a large quantity of food has been prepared, but not eaten, is the excess served up for the following meal or put into the freezer to be consumed at a later date? Which option would students prefer and why? To what extent are meals planned before shopping? Are there meals in the freezer which could reduce the amount of food to be bought?

Once students have identified what is being discarded, they can then investigate ways and means of avoiding the waste – by reducing quantities which are bought, cooked, put on the plate or by discovering innovative ways of using the surplus food from one meal to produce a future meal. So another team of students might decide to investigate new recipes which would help to reduce waste. The WRAP campaign 'Love Food Hate Waste' has many recipes available on their internet pages which could be experimented and adapted for specific tastes. The slogan for this campaign is: *"Don't just eat it.*

Compleat it" They invented the word 'compleat' to mean 'eat' the ingredients 'completely' and don't let any edible parts go to waste. Can students come up with a slogan for their own campaign?

How many students would have fun inventing recipes for edible parts of food which they don't normally consume? Do they peel carrots, potatoes, beetroot, cucumber or do they simply scrub them clean? Do students know that the peel from most fruits and vegetables contain several nutrients, vitamins, minerals and antioxidants, and due to their high fiber content can help reduce hunger and thus potentially reduce our calorie intake? Which information do they want to investigate first? For example, lemon, orange and grapefruit peel can be used to make jams or marmalade and can also be used as zest or flavouring for cooking or baking. Have any students tried a casserole or roast dish with a few pieces of citrus peel added? It's delicious. If you have a large amount of citrus peel, it can be dried (as zest or shavings) and used later perhaps to make a tropical cup of tea. Citrus peel can also be used as a solvent or a natural pesticide, and if steeped in vinegar for 1-2 weeks then mixed 50/50 with water, you have an all-purpose cleaner. Strips of peel can be dried then used as part of a potpourri or you can dry larger pieces of citrus peel to start fires for your campfire or barbecue. What other ideas can students discover for recycling kitchen waste? Which ones do they want to try out first? How might they communicate their findings to convince others to try similar eco-friendly strategies?

Another slogan used by the campaign 'Love Food Hate Waste' is "*Everyday Changes to Climate Change"* to convince individuals and communities that, by taking small, apparently insignificant local actions, we can still contribute to large-scale global effects. The following passage makes this connection very clear.

> **Seeing beyond the bin:** Going from field to fork is only part of the story: it accounts for just a fraction of your food's impacts. What happens after left-over food leaves your plate is just as important. It's tempting to think of our food waste as organic, the kind that decomposes back into the soil. If you compost peelings, eggshells and apple cores to enrich your garden – and eat everything else that can be eaten – then that's a great start. But much of our food waste doesn't end up that way. In the UK, we discard a total of almost one million tonnes of milk, bread and potatoes every year – that's a billion kilos. Most of that goes straight down the sink, or to your local landfill. And our landfills are slowly filling up with rotting food, where it can take many years to degrade completely. Keeping food out of landfill not only conserves limited landfill space, but also helps to reduce greenhouse gas emissions. That's because in landfills, organic materials, like food scraps are broken down by bacteria to produce methane. ***Methane is a potent greenhouse gas and it has a warming potential of 21 times that of carbon dioxide.*** As we try

> to combat global climate change, it's going to be a huge help if we can reduce methane emissions – and saving food will play an important part in that. (WRAP – LOVE FOOD HATE WASTE, 2018, online, my emphasis)

Do students feel more motivated when they realize that even individual actions or single household efforts to reduce food waste can contribute to global climate change? And if small groups of students, whole classrooms, schools, or clusters of schools work together and each one communicates with their local communities, the example set by one small group of students may be adopted by more and more people until they discover that they have initiated global awareness and action in specific areas. How can they communicate their group efforts most efficiently? If they check social media for ideas – which individuals, groups or sites do they find most inspirational and why? Which ideas could they adapt and how would they make their site stand out from others?

Perhaps another team of students would prefer to investigate scientific and technological developments related to the food and drink industry. What do they know about the air and shipping freight, storage, mechanized harvesting techniques, cooking and freezing processes involved in bringing our food and drink from all over the world to our local supermarkets. All of these processes use a considerable amount of energy, fuel and water. Which products have made the longest journey to our plates? Are there local equivalents? Which local food sources do we avoid? Why do we avoid them? For example, although Scotland has a very active fish industry, fish does not seem to be the most regularly consumed item at Scottish mealtimes, despite the fact that Scottish salmon are famous worldwide. How many students eat fish or seafood regularly? How many students have heard of the programme 'Seafood in Schools', funded by the Scottish Government, and supported by Fish for Health, Seafish, the Scottish Salmon Producers Organization, the Scottish Fishermen's Trust and the Scottish Whitefish Producers' Association? Is this programme still functioning? If not, how many students think it would be worth resuscitating? Where could they find out more information about the programme?

> Seafood in Schools is a project run by Seafood Scotland which develops Seafood Industry partnerships with schools promoting the use of fish as a topic for interdisciplinary learning and enhancing children's knowledge and understanding of seafood and its supply chain from sea to plate. The project was designed for delivery across school cluster networks including nurseries, primaries and secondaries and puts an emphasis on progression on young people's experiences. (SCOTTISH GOVERNMENT, 2016, p. 104)

The programme offered many activities including practical workshops at schools where students were offered hands-on experiences in cleaning and preparing fish. They were also encouraged to participate in cookery demonstrations and tasting sessions and were given recipes to try out at home. Community events for parents were also promoted in order to reinforce the message that fish are an extremely healthy food option, and other activities such as visits to fish markets, processors, fish farms, fishmongers and retail outlets were available to help expand students' knowledge about the fish industry even more.

> The project has been running for three years, and aims to give children a greater understanding of the Scottish seafood industry and encourage greater consumption of seafood. […] Schools have been innovative in their projects, with seafood cafes, plays, videos, art displays and cookery challenges all undertaken. Some of the most memorable aspects of the project were working with special needs pupils, whose sensory perceptions of taste and smell were different from our own. (SEAFISH online, ac. 2016)

Plenty of ideas for further exploration arise from this short report. Sensory perceptions seem to have been an intriguing aspect of the experience, so how might students explore this area? Can they recognize different seafood, shellfish or fresh water fish by touch and smell when they are blindfolded? Can they describe a fish successfully while blindfolded so that a blindfolded partner can identify it? How effective are students at representing marine and freshwater animals and fish through drawing or painting? Are they able to identify all the ingredients of a fish dish by taste alone? What other ideas do students have for developing their sensory perceptions?

The Convention of Scottish Local Authorities (COSLA) wrote about an advantageous proposal which involved collaborative partnerships between schools, local authorities and industries, so that students could understand more about different areas of expertise through real life experiences:

> The Scottish Food and Drink Federation partners schools and industry to develop approaches that use food and drink as the context for learning utilising the expertise of industry to support teachers to deliver realistic experiences in the classroom. In one example high school students worked on a product development challenge, extending their skills in marketing, finance, packaging, scientific analysis and food tasting. Another school worked with a local business to develop a new baby food project which enabled the young people to understand the needs of infants and the type of jobs available in the food and drink industry. One secondary school teacher said 'From a teacher's perspective, I have found that having a link with a food company made the course more relevant for the pupils as I could relate it to 'real life'.
>
> Interdisciplinary learning can lead to creative, innovative, inspiring and connected learning which prevents the narrow view of food education as

> being only about 'healthy eating'. These experiences highlight the importance of food in Scottish culture, health and business. Integral to the planning of these learning experiences must be how these will develop the critical thinking skills to support independence and progress in learning. (COSLA, 2014, p. 23)

Students can also be encouraged to make direct connections between the places where they live, the landscape around them, their home lifestyle and habits and the subjects they are learning about. So, for example, if the topic is fish, then students can be persuaded to examine their immediate surroundings as well as the family's eating habits.

Scotland has around 19,000 km of coastline and the area from the coast to our fishing limits is around six times the size of the land area of Scotland. Scotland also has over 25,500 lochs, approximately 125,000 km of rivers, and 220km of canals which, combined, contain 90% of the UK's surface freshwater. (CRITCHLOW-WALTON et al., 2014) Are students living closer to seawater or to freshwater? How many students have caught fish themselves? Did they fish from a boat, or from the bank of a river or loch? What did they enjoy most about the experience? Did they clean and eat the fish they caught? What did they do with the fish remains? Do they know that native peoples of Alaska used the skins of different fish as a leather resource to make footwear and also made clothing from fish skins? Would they like to find out more about this topic and perhaps try to replicate some of these ancient skills? How many different kinds of fish or seafood have students eaten so far? Are they aware that more than 33,600 different species of fish have been identified but that there are thought to be many more in the depths of the oceans which have not yet been discovered? How could they find out more about this topic? Have they tried salmon, trout, haddock, cod, roach, carp, conger eel, sea bass, lobster, scallops, mussels, oysters? Which do they prefer and why? How often do they eat fish or seafood and how is it normally served?

To what extent do students understand which recipes are healthy and which are not so healthy? For example, if they had to choose between fried fish and chips, fish curry or a seafood risotto, are they familiar with any of the related nutrition facts? According to the UK site '*fatsecret',* a portion of fish and chips (weighing 300g) has 765 calories, composed of 50% fat, 34% carbs, 16% protein; 1 cup of fish curry with rice (weighing 284g) has 380 calories composed of 36% fat, 40% carbs and 24% protein, and 1 cup of seafood risotto, including rice, (weighing 340g) has 360 calories, composed of 31% fat,

51% carbs and 17% protein. Which recipe is the least healthy – and why? Of course fat, carbohydrates and protein are only three components of the dishes we mentioned, all food sources contain many more different elements. For example four medium sized oysters, one of the most sustainable sources of protein available, also supply the recommended daily allowance of iron, copper, zinc, magnesium and calcium. What do students know about other nutritional aspects of seafood, shellfish and freshwater fish?

Are students familiar with the 'Scottish Pelagic Sustainability Group' (SPSG)[41] which was established in 2006 and represents all sectors of Scotland's seafood industry, including catching, processing and marketing? SPSG oversees the certification of its main fisheries to the Marine Stewardship Council (MSC) eco-label standard and also promotes many sustainability initiatives. The principal aim of SPSG is to guarantee that the Scottish seafood industry is truly sustainable. The SPSG site offers an extensive quantity of information about many aspects of marine fishing, including the following information about the benefits of eating oil-rich fish.

> Health experts recommend we should eat two portions of fish every week, one of which should be an oil-rich fish such as mackerel or herring. This means there is every scope for households to keep their favourite staples of cod and haddock on the menu, but supplement this once a week with Scottish mackerel and herring.
>
> Scottish caught mackerel is packed full of heart-healthy omega-3 minerals and vitamins. Omega-3 is a type of 'good' fat found in oily fish and plays an essential role in keeping the heart healthy and aiding brain function and development. According to *Seafish*, grilled mackerel has higher omega-3 levels than any other commonly eaten fish and is also a good source of vitamin B6, selenium and niacin, which are all important for our health. All of the above health benefits also apply to herring, which is also a good source of Riboflavin, Potassium and Iodine. The omega-3 fats found in oily fish are also known to play a role in helping to maintain normal blood pressure – yet another good reason to make sure you eat the recommended once a week serving of such fish. Mackerel and herring are also great sources of Vitamin D. Our bodies make this vitamin in sunlight, but in Scotland's climate this is not always so easy, which is why both these fish are so important for a healthy diet. (SPSG, online)[42]

To what extent are students involved in the choice of food consumed in their homes? Could information about nutrition help convince students and / or their families to eat more fish-related dishes which are prepared in healthy ways?

[41] SCOTTISH PELAGIC SUSTAINABILITY GROUP (SPSG). Available at: <https://www.spsg.co.uk/>. Accessed on: 04.06.2021.
[42] SPSG. **The many reasons why eating mackerel and herring is so good for your health.** Available at: <https://www.spsg.co.uk/many-reasons-eating-mackerel-herring-good-health/>. Accessed on: 04.06.2021.

Obesity indicators published by the Scottish Government (SG, 2018c, p. 1-10) state the following facts: "In 2017, 65% of adults aged 16 and over were overweight, including 29% who were obese. […] In 2017, 26% of children were at risk of overweight, including 13% at risk of obesity." These figures are shocking – two out of three adults over 16 were overweight or obese in 2017. We also discover that one in four children aged 12 to 15 were already becoming overweight or obese, and that diet, sedentary behaviour and lack of physical activity were the main contributory factors. Unfortunately excess weight is frequently linked to many kinds of health problems, for example, 87% of type-2 diabetics are overweight or obese (Ibid., p. 23), also body image seems to contribute to poor mental wellbeing among young people (Ibid., p. 13).

The Scottish Minister for Public Health, Sport and Wellbeing wrote in his foreword to the government publication 'A Healthier Future: Scotland's Diet and Healthy Weight Delivery Plan' (SG, 2018a, p. 1): "We have the highest overweight and obesity levels of any UK nation - nor do we compare well with the majority of our counterparts in the developed world. This situation is unacceptable – not least because it's largely avoidable." On page 3 of the report, the challenges faced are stated in no uncertain terms:

> The impacts of poor diet and overweight are profound. They affect not only our health, but also our ability to lead happy, fulfilling lives. They have also led to increased, unsustainable demand on the NHS and other public services.
>
> The Scottish diet remains stubbornly unhealthy and we are far from meeting our dietary goals. This has a direct impact on levels of overweight and obesity – and therefore health harm – in the population.
>
> These problems start early. Overall, children in Scotland tend to consume foods and drinks high in fat and/or sugar more often than adults – an alarming finding that indicates future health problems in store. In Scotland, the rates of overweight and obesity for both children and adults are among the highest in the developed world. (Ibid., p. 3)

The report claims that half of Scotland's children eat sweets or chocolates every day and that one in three also eat crisps and drink sugary soft drinks every day. Perhaps students could check this data and discover the numbers for their school? How many students have weight-related health problems? How many students have parents or close relatives who are overweight? Which health problems are most common amongst family members who are overweight? Do students realize that health problems caused by obesity lead to increased health expenditure by the government and also economic problems for the labour market? According to the same report:

> The health harms associated with carrying excess weight are severe. Obesity is the second-biggest preventable cause of cancer, behind only smoking, and is linked to around 2,200 cases of cancer a year in Scotland. Being overweight and obese is also the most significant risk factor for developing type 2 diabetes, and can result in increased risk of other conditions including cardiovascular disease and hypertension. […]
>
> As well as health impacts, there are significant socioeconomic implications. The annual cost of treating conditions associated with being overweight and obese is estimated to range from £363 million to £600 million. The total annual cost to the Scottish economy of overweight and obesity, including labour market related costs such as lost productivity, is estimated to be between £0.9 billion and £4.6 billion. (Ibid., p. 5 - 6)

One of the problem areas which contribute to unhealthy eating is advertising. To what extent are students able to identify adverts which promote food and drink which are high in fat, salt or sugar? How many of these adverts are students exposed to during a normal day – including the journey to and from school (adverts on buses, bus shelters, walls, billboards, etc), cell phone / online use during the day, television or other activities during the evening? Do students notice a larger number of these adverts during the weekend? How often are students tempted by confectionery being offered at checkouts? What other sales pressure techniques do they observe – such as two for the price of one, or multipacks being cheaper than the same number of single items? Can students create alternative information-related adverts which describe more realistic effects on our health when we eat sweets, crisps, chocolate or too many hamburgers with fries accompanied by sugary soft drinks? Can they come up with alternative sales techniques to persuade society to eat more healthy food? How could they keep track of any positive changes promoted by their healthy advertising campaign?

Students could identify specific foods or drinks which are bad for their health and invest in research about the nutrition characteristics of the food item or food group they have selected. Then they can decide which strategies they intend to adopt in order to communicate their findings to the rest of the class, the whole school and their local community. As they work together, they can check whether they are using the learning characteristics recommended by the Partnership for 21st Century Learning, mentioned previously as P21: “five characteristics of collaborative learning groups that promote learning: positive interdependence, face-to-face interaction, individual accountability for achieving the group’s goals, use of interpersonal skills, and group evaluation of process in order to improve group effectiveness.” (PLUCKER, 2015b, p. 4) One way to stimulate discussion about how they are working together is to elect an observer for

each group, or a general observer for specific sessions. Another possibility would be to film various groups for a short period of time, then hold a whole class discussion of the learning characteristics observed. Can students propose alternative strategies which they consider more effective?

As students learn more about sales techniques, perhaps they will also become more adept at identifying different marketing tactics and will learn to look for relevant nutrition-related information. For example, strategies used to sell sweets include investing in packaging which will appeal to consumers – using holiday or seasonal themes such as Halloween, Christmas and Easter, so chocolate bars are transformed into pumpkins, Easter Bunnies or Santa Claus. Sweets are also strongly associated with the idea of 'sharing and caring' and will often be given as gifts to others. This sense of indulgence or reward can then be extended to yourself – helping to reduce the guilt, because 'we also deserve gifts'. How can students transform these marketing techniques into advertising which will promote better health options? The Scottish Government, together with other UK administrations, launched a voluntary 'Front of Pack' colour-coded nutrition labelling scheme in 2013, allowing consumers to identify whether a product contained high levels of fat, salt or sugar. However, despite the fact that approximately two-thirds of packaged foods in supermarkets display the 'Front of Pack' label, unfortunately many foods high in fat, salt and sugar do not use this label.

Another topic which students might decide to investigate in order to combat obesity is portion size. There has been a steady increase in portion size over the past 20 years or more and this can create serious health problems if we continue to eat everything on our plates in order to reduce food waste. We need to restrict our consumption to healthy portion sizes. The 'National Heart and Blood Institute' (NHBI) of the US Department of Health and Human Services published slide shows online in 2013 to demonstrate portion distortion over the previous 20 year period. The data is highly disturbing. For example, 20 years earlier, around 1993, an average US cheeseburger contained approximately 333 calories, whereas in 2013 it had grown to 590 calories; in 1993 a portion of spaghetti and meatballs consisted of 1 cup of spaghetti with sauce and 3 small meatballs, with a total of 500 calories, whereas in 2013 one portion had doubled to 2 cups of pasta with sauce and 3 large meatballs, containing a total of 1,025 calories. In 1993 a portion of French fries weighed 2.4 ounces and contained 210 calories, but in 2013 one portion of French fries weighed 6.9 ounces and contained 610 calories –

almost three times as much. We would have to walk quickly for at least one and a half hours to burn the 400 extra calories. One US portion of soda or sugary soft drink in 1993 measuring 6.5 ounces, containing 85 calories, but in 2013, a normal portion had tripled in size to around 20 ounces and contained 250 calories – three times as many as 20 years previously. In 1993, a cup of coffee with whole milk and sugar measured 8 ounces and contained 45 calories, whereas in 2013, a Mocha coffee had doubled the quantity to 16 ounces and contained 350 calories – almost 8 times as much. A five-cup serving of popcorn became an 11-cup serving, a 3 ounce serving of cheesecake became a 7 ounce serving, a 1,5 inch diameter cookie became a 3,5 inch cookie, a 2 cup stir fry became a 4½ cup stir fry.

So what are the figures in the USA at the present time? How do they compare with portion sizes in the UK and elsewhere? Have portions grown in similar ways in different parts of the world? Are they still growing? How can we reduce our portion sizes? One interesting possibility is simply to use a smaller plate – since plate sizes have also increased over the years. What other suggestions do students have? One YouTube video suggested that if you clasp your hands, this visual amount represented by your own hands held closely together should be similar to the total amount of food on your plate – but we are advised to eat this amount six times during the day at regular intervals. Is this indication correct? How can students discover trustworthy information? Do multiple sites give contradictory advice? To what extent does conflicting information motivate us to continue our investigations using more dependable, authoritative, ethical sources? What other ideas do students have for reducing the quantities of food we put on our plates? How can they obtain data to check whether schoolmates and families are in fact consuming healthier portions of food and reducing their waste over specific time periods?

Another area which could be explored with a view to curtailing obesity numbers and increasing our health and wellbeing would be to promote more active exercise. The Scottish Government produced a ‘Physical Activity Delivery Plan’ in 2018 with the title ‘A More Active Scotland’, and in the foreword, Joe Fitzpatrick, Minister for Public Health, Sport and Wellbeing, makes the following statements:

> Being physically active is one of the very best things we can do for our physical and mental health. It helps to prevent heart disease, strokes, diabetes, and a number of cancers; it plays an important part in helping us maintain a healthy weight; and reduces the risk of developing depression.

> […] Physical activity and sport have a transformative effect on communities, by providing opportunities for people to connect with their neighbourhoods and come together in shared activities which inspire and motivate. Sport and physical activity are a powerful means of addressing isolation, building community cohesion, and developing confidence. (SCOTTISH GOVERNMENT, 2018b, p. 3)

Do students agree with these statements? How physically active are they? If a group of students decide to work with this theme, is it because they are all very active or because they feel the need to become more active? How many contrasting ideas exist within each group? Ideally, each group member should feel respected and supported by his colleagues so that when every member is invited to express their specific point of view, each perspective will represent one member's individuality. Consequently, when each member gives voice to their unique thought processes, the other members of the group will be able to listen and learn from a wide range of beliefs, suggestions, theories, hypotheses, until, gradually, the group is able to bring together disparate ideas into a cohesive whole.

The outcomes which the publication 'A More Active Scotland' aspires to are as follows:

> Encourage and enable the inactive to be more active; encourage and enable the active to stay active through life; develop physical competence and confidence from the earliest age; improve our active infrastructure (people and places); support wellbeing and resilience in communities through physical activity and sport; improve opportunities to participate, progress and achieve in sport. (Ibid., p. 11)

These outcomes are very much in tune with the 'Global Physical Activity Objectives' proposed by the World Health Organization, mentioned in the same publication, which are, to promote: "Active People; Active Society; Active Environments; Active Systems." (Ibid., p. 35) Which outcomes or objectives are most important in the students' opinion and why? How would they prioritize these lists? How would they encourage the more inactive group members to become more active? What kind of activities would be more suitable for very young children or for the elderly? Could different age groups work together successfully – in what ways? Which physical activities are most popular in their community and why? Which physical activities would students like to attempt but have never had the opportunity? How could opportunities for unusual activities be created? Are the school sports facilities available for community use? How often are they used by the community? In what ways could the community benefit more profitably from these spaces? Are there barriers which prevent people from accessing opportunities to take part in sport and physical activities?

How can these barriers be overcome? For example, are there community programmes to accompany the elderly in care; are there facilities for people with disabilities; to what extent are trails or towpaths universally accessible?

How would students define the physical landscape of their community? How do the natural features combine with the man-made features? Which aspects do students pay more attention to? Where do they prefer to walk, run, cycle, swim, skate, sail, ride and why? Do they feel more relaxed, fulfilled, stimulated by different landscapes? What other aspects related to physical activities would students enjoy exploring in more depth and how would they go about it?

As students analyse the lifestyle of their own homes, and begin to relate health and wellbeing to an increase in the amount and scope of their physical activities, as well as to food choices which are beneficial instead of detrimental to their health, they may also be taking steps to improve the environment by reducing the family's food waste as well as by eating local produce which will not require long distance transport.

❁ *The Environment – Communication and Creativity*

As the previous section made very clear, overweight and obesity levels are increasing worldwide, together with the wide array of health problems and costs involved. Since the principal cause of obesity is an imbalance between energy intake and energy expenditure, the obvious methods for reducing excess weight include reducing our intake and increasing our physical activity. The Planning Institute of Australia (PIA), working in collaboration with the Australian Local Government Association and the National Heart Foundation of Australia, produced a national guide entitled *Healthy Spaces and Places* to help create sustainable communities that encourage healthy living. To answer the question: 'Why health and planning?' the guide gives the following reasons:

> Perhaps the most compelling reason for taking a deeper interest in what *Healthy Spaces and Places* has to offer comes from evidence about the human, health and financial costs of preventable disease/illness. Australia is one of the most overweight of the developed nations, with overweight and obesity affecting about one in two Australian adults and up to one in four children. […]
>
> Research shows that the built environment can have a significant impact on a person's level of physical activity. Good design and people-friendly spaces and places can promote active lifestyles by encouraging walking, cycling, public transport and active recreation. On the other hand, places designed

> around private motorised transport can limit a person's opportunities and desire to be physically active. (PIA, 2009, p. 3)

On the following page, the guide refers to European studies which affirm that people who live in areas with high levels of greenery "were more than three times as likely to be physically active and 40% less likely to be overweight or obese than those living in less aesthetically-pleasing areas". (Ibid., p. 4) These figures are confirmed by Australian examples on the same page where adults who had access to large, attractive, well-designed public open spaces were 50% more likely to undertake high levels of walking. These studies also reported that people who are more active tend to make healthier food choices and are often able to reduce mental fatigue and stress.

Scotland's State of the Environment Report (2014) also emphasizes the importance of creating sustainable and healthy places to live and recommends that an 'ecosystems' approach should be adopted in order to take into consideration key issues such as the environmental, social, and economical challenges involved. But, in order to plan for improvements to existing cities and communities, we need to analyse the infrastructure which already exists. What do students and teachers know about the local community around their school? How does our community interact with the local soil, water and air? How sustainable are local transport systems and industries? To what extent do they affect the quality of the air we breathe? What do we know about local agriculture practices? To what extent are they contributing to the pollution of our soil, air and water? How green is our local environment? How much do we know about the local ecosystem and what are we doing to improve it?

Education Scotland asks the following questions in their publication 'Opening Up Great Learning – learning for sustainability':

> How well do you know the community in which your establishment is situated? Plan regular lunch-time walks to get to know the local area – its people, greenspaces, community assets, issues, learning opportunities and biodiversity. How is Learning for Sustainability (LfS) relevant to the community? What do learners do when they are not in school? What experiences from community settings can they bring to school with them? What practical things can learners do to be active citizens and transform their communities? (EDUCATION SCOTLAND, 2015, p. 15)

Students could form small, geographically connected teams to analyse their local neighbourhoods. How many streets have conspicuous greenery? How many gardens have trees, shrubs, flowers, vegetables which are visible from the street or is greenery

hidden behind walls? How many different bird species can they identify visually and from birdsong? What kind of insects or wild animals can be seen regularly? Have trees been planted along any of the streets – do they all belong to the same species or is there a variety of different trees and shrubs? How many of the plants in the neighbourhood are the students able to name? Can they draw the leaves, flowers and fruits that they pass regularly? How many of these leaves, flowers or fruits are edible, or can be used for medicinal purposes?

How many students live in an area with no visible vegetation? What percentage of the neighbourhood has no observable greenery? Can they describe their thoughts and sensory perceptions as they walk or cycle through a built up area, and compare them with their thoughts and sensory perceptions as they walk or cycle through an area with trees, shrubs and flowers? How could they register these feelings? In what ways could they share their impressions and thoughts with a wider public? What are their proposals for improving their quality of life and community wellbeing?

Education Scotland (ES) decided to promote learning for sustainability in their publication 'Opening Up Great Learning' and they define the central concept as follows: "Learning for sustainability is about who we are and the type of communities and world we want to live in. It is about improving the quality of life and wellbeing of all. It is very much about the here and now, the present day, but also about the future." (ES, 2015, p. 2). Later on in the same publication, they explain why outdoor learning is a fundamental part of this concept:

> Outdoor learning is helping to bridge the gap between schools and the communities which they serve. Providing learners with opportunities to get to know people locally gives them a chance to participate in community transformation and to develop pride in where they live. Early learning and childcare settings take children into the community regularly to visit local parks, charity shops and recycling facilities. Older learners visit homes for the elderly to participate in intergenerational learning. Others support community allotments and garden projects. Taking learning outdoors opens up many opportunities for great learning. When this happens in conjunction with learning about issues like globalisation, interdependence or rights, it allows young people to broaden their horizons. They begin to critically explore the complexities and different levels at which issues can play out in their local and global communities. (EDUCATION SCOTLAND, 2015, p. 10)

Are there any large public spaces in the students' neighbourhood? Are they designed spaces or natural spaces? How much green or blue space do they contain? Green space refers to vegetation and blue space refers to rivers, canals, lochs or the coast. How many

exercise possibilities are contemplated as part of these public spaces? How many diverse public transport options exist nearby? What kind of shops can be found in the neighbourhood – to what extent do they advertise healthy or eco-friendly options? What suggestions do students have to improve their local space? How would they plan their ideal neighbourhood? How could they present their planning ideas to their class, the school or the community? What would be the most effective communication strategies in their opinion?

According to the Australian PIA guide *Healthy Spaces and Places*, "**Planners** are professionals who specialise in designing the communities in which we live, work and play. Balancing built and natural environments, community needs, cultural significance and economic sustainability, planners aim to improve our quality of life and create vibrant communities." (PIA, 2009, p. 8) The guide then mentions the key design principles required to plan healthy communities as follows (Ibid, p. 10): **active transport** – travel modes that involve physical activity, including the use of public transport that is accessed via walking or cycling; **aesthetics** – an attractive neighbourhood invites people to use and enjoy its public spaces and to feel safe; **connectivity** – the ease with which people can walk or cycle around a neighbourhood and between places; **environments for all people** – places that are safe and easily accessible for everyone regardless of age, ability, culture or income; **mixed density** – a mix of housing types which promotes a more diverse community and caters to various stages of life; **mixed land use** – complementary uses, such as houses, shops, schools, offices, libraries, open space and cafes are co-located to promote active transport to and between activities; **social inclusion** – providing opportunities for people to participate fully in political, cultural, civic and economic life; **supporting infrastructure** – such as footpaths, bike paths, lighting, water fountains, seating, shelter and toilets to encourage safe physical activities, public transport, social interaction and recreation; **parks and open spaces** – land reserved for passive recreation, sport and recreation, preservation of natural environments.

Which design elements do students consider to be most important? If they did a survey of their own neighbourhood, which elements are present and which are lacking? What would their priorities be in order to improve their own neighbourhood? What could they do to raise community awareness or even funding to try to revitalise their local space? Would they consider holding a public event in the community to bring the local

population together? Are there suitable places to hold different events in the area? How do event organizers communicate with the inhabitants of the neighbourhood about what is happening? Does the local community have a website? How much do students know about successful online communication? Do they understand the importance of Search Engine Optimization (SEO), character counting, the use of images, keywords, time limits, number of posts? Where can they find out more in order to broadcast their proposals as effectively as possible?

Students could form small teams, with each one organizing a specific event to improve the landscape of their neighbourhood. They could either decide to work towards separate events hosted by individual teams at specific intervals of time, or each separate project could be organized within the same theme to promote one large event.

The first step, of course, is to plan the event and in order to do this, they need to think about the main purpose of the event, the target audience, and how it should be organized. For example, one team might decide to promote an event to raise money to convert a plot of wasteland into a colourful play area, a community vegetable garden, an outdoor fitness zone for different age groups, a multi-purpose sports court, an urban orchard, a bowling green with benches, trees and gardens, a sculpture park, an obstacle course – what other ideas do students have? Perhaps they could put together a questionnaire to discover what community members would prefer? Or create an online event page which includes a voting station using the most popular suggestions from the students but including an extra box where respondents could add their own proposal? Or they could even install a voting booth at the event.

Students need not necessarily restrict the locus for the organization of ideas, group discussions, or analysis of creative proposals to the school buildings. They should also feel free to investigate, inspect and evaluate the physical environment itself. As Plucker et al., writing for P21, affirm:

> With respect to the classroom, research suggests that learning environments play at least as great a role in student creativity as students' personal characteristics (e.g., Niu, 2007; Runco, 2014). Davies et al. (2012) have, for example, identified several features of the learning environment that have been linked with creativity development, including flexible use of the physical environment, balancing structure with freedom so students have an opportunity to engage in self-directed and exploratory learning, and establishing partnerships with outside organizations, businesses, and community agencies. (PLUCKER et al., 2015a, p. 4)

Where would students hold the event, which organizations might be approached as possible associates, and what would attract community members to participate actively? Can they come up with a perfect #hashtag to promote the event? Do they know how to use it most effectively on social media channels? According to Maddy Osman, writing about the use of hashtags on the site *SproutSocial* (2017, online), "Tweets with hashtags had 2 times more engagement than those without, and 55% more Retweets" However we need to be careful about how we use hashtags, since tweets with one hashtag generate the most engagement, but engagement drops when you use more than two hashtags. (Ibid.) So clearly, hashtag users need to know how to use them most effectively. Would students consider decorating the venue in some way? Will catering be involved? If so, decorations and catering should be compatible with the proposed theme, and if students are focusing on healthy eating and waste reduction, these aspects need to be taken into consideration.

All of the suggestions we have been exploring so far involve the active use of creativity, an essential component for future education, business and a healthy environment. Are teachers and students aware of the skills which are necessary for developing creativity? In 'Creativity Across Learning', Education Scotland states that creativity skills include being:

> **Constructively inquisitive, by:** being curious; registering patterns and anomalies; making use of previous knowledge; researching productively; formulating good questions.
>
> **Open-minded, by:** using lateral thinking; using divergent thinking; hypothesising; exploring multiple viewpoints; being flexible, adaptable and functioning well with uncertainty.
>
> **Able to harness imagination, by:** exploring, synthesising and refining multiple options; generating and refining ideas; inventing.
>
> **Able to identify and solve problems, by:** understanding and defining problems; crafting, delivering and presenting solutions; demonstrating initiative, discipline, persistence and resilience; evaluating impact and success of solutions; and identifying and implementing next steps in refinement or development process. (EDUCATION SCOTLAND, 2013, p. 5)

Every planning process also involves the use of several of the creative strategies mentioned above. For example, The Australian guide *Healthy Spaces and Places* emphasizes the fact that "planning for active living calls for a commitment to applying healthy planning principles to all levels of the planning system, at every stage of the planning process and in every planning project. These principles can be applied no

matter what the scale." (PIA, 2009, p. 11) The guide then goes on to describe the six processes considered essential for creating healthier places, all of which can also be applied to group planning in general. These planning processes are: (1) investment in research to inform decisions; (2) integration by involving the community throughout the planning process; (3) distribution of responsibilities and shared ownership of the planning process; (4) deep understanding of the complex issues involved in creating healthy environments since behavioural change requires making healthy choices the easy choices; (5) the importance of partnerships which are based on shared vision and collaboration; (6) clearly articulated goals and measures to evaluate the success of the implementation process. According to the PIA guide, these six principals should help to achieve positive results by using economic, social, environmental and sustainability measures (Ibid., p. 11-16).

As students learn to apply effective principles to the conservation and improvement of their local environment, interacting actively with the community which surrounds them, many social aspects of learning may improve, especially when students participate in real life activities which they perceive to be useful and culturally relevant. In general, learning becomes more meaningful when applied to real-life situations, as Education Scotland (2015) makes very clear:

> A whole school and community approach to Learning for Sustainability (LfS) develops professional practice and enables all involved to take decisions which promote a sustainable and equitable world. It is one where LfS is 'hard-wired' into the curriculum, right in the very fabric of school life, through which it reaches every learner. It also involves the local community and it harnesses the community experiences provided. (2015, p. 4)
>
> Teachers and leaders report that engaging with learning for sustainability has given them greater enjoyment of teaching, more freedom to be creative and follow their own passions. […] Great learning in LfS occurs when teachers find their own passions for learning and plan thought-provoking and innovative experiences for learners. The practitioners enter into a virtuous cycle where inspired learners inspire great practice on the part of their teachers. (2015, p. 12)

In what ways can teachers explore subjects they are passionate about in order to involve their students in innovative experiences? Personally, I have been passionate about reading and writing from a very young age. Apparently when my mother collected me after my first day at school, I complained that I had spent the whole day there and was still unable to read. A few years later, if I was late for tea, my mother would phone the library and ask the librarian to send me home. So, obviously, the local library had

already become my second home. What are some of the literacy skills we expect students to develop? Learning and Teaching Scotland (LTS) believe that students will develop and extend their literacy skills when they are given the opportunity to:

- communicate, collaborate and build relationships
- reflect on and explain […] literacy and thinking skills, using feedback to help […] improve and sensitively provide useful feedback for others
- engage with and create a wide range of texts in different media, taking advantage of the opportunities offered by ICT
- develop […] understanding of what is special, vibrant and valuable about [one's] own and other cultures and their languages
- explore the richness and diversity of language
- extend and enrich […] vocabulary through listening, talking, watching and reading. (LTS, 2009, p. 1)

Which of these aspects attract teachers more? Which aspects are students more enthusiastic about? How can they be applied to specific actions to improve the sustainability of the local community, the nation and ultimately our host planet? Throughout this section we have been discussing improvements which could be made to the landscape of our local community in order to improve our health and wellbeing and reduce negative impacts which are polluting the air, soil and water, essential elements for the continuation of our species. How can individuals affect the sustainability of the planet?

An effective first step might be to convince each student and teacher to take personal action in order to improve the sustainability of their own lives. Which single action could each individual in a school classroom change in order to improve their ecological footprint on the planet? How could reading and writing be involved in this decision? The answer is very simple – through registering and sharing. If each individual in a class (including the teacher of course) writes down their proposed eco-action on a piece of paper, and if these individual actions are gathered together on a poster which is displayed on the wall, then everyone has written at least one specific phrase and can read all of the phrases produced by the class. If each student uses their own colour choices, signs their proposed eco-action with their initials, and perhaps adds a logo design to illustrate their chosen action, then reading becomes more attractive and stimulating.

Unfortunately, as we all know, good intentions are not always long-lasting. So in order to maintain interest and a sense of commitment, perhaps an online group could be created so that individuals could share their progress and receive feedback and

encouragement when going through problematic phases when commitment to their action is low. By sharing authentic individual experiences which have common goals, the group will develop a collaborative spirit which will continue to support their sustainable actions through difficult times. And as students read messages written in different styles, focusing on a variety of aspects related to these assorted actions, they will become more aware of diverse writing choices and gradually expand their own options. Of course, as they communicate with each other by describing what they are doing, how they are feeling, and what they think about the effects of their actions, they should also be encouraged to read about specific topics which arise during these written discussions. And as they read, references to their reading may gradually be included in the group discussions, consequently broadening their experiences with an assortment of text genres.

By reading a mixture of texts related to the action they are adopting as part of their more sustainable lifestyle, students will be able to add evidence to support their own ideas and may gradually learn to select appropriate sources to meet their needs as they develop their reading range. As students read more widely, they may also adopt vocabulary and grammatical structures from their reading and use them in their writing. For this reason they should be encouraged to read a wide variety of genres to supplement their group discussions. For example, if they are discussing eco-friendly actions they are taking in order to improve their local landscape, they might decide to investigate specific data related to diverse aspects of the Scottish landscape, renowned worldwide for its beauty. They might be interested in factual texts such as the following examples taken from Scotland's State of the Environment Report (2014), which could be used as a stimulus for discussions and project work on innumerable topics. For example, students interested in economic aspects of the landscape might appreciate the following quote:

> Tourism based on Scotland's landscapes is estimated to be worth £420 million a year to our economy; around 90% of visitors rated our landscapes as a 'very important' or 'important' influence on their decision to visit. […]
>
> Landscape is an important part of Scotland's image. It helps to promote Scotland as a desirable business location, attracts inward investment and adds value to Scottish brands and products. (CRITCHLOW-WATTON et al, 2014, p. 98-99)

They might then decide to investigate specific Scottish businesses, brands and products to discover which of them are more environmentally friendly. Subsequently, they could

present their results to their local community or create a blog to join forces with other schools working on similar projects. By using their creativity to communicate with larger audiences, they will be contributing to environmental awareness on an expanding scale.

On the other hand, students more interested in the historical aspects of the landscape might become enthusiastic about Scotland's turbulent geological history as presented in a more descriptive style by Fiona Watson and Piers Dixon in their book 'A History of Scotland's Landscapes' (2018, p. 13-14):

> In the ten thousand years since the glaciers retreated at the end of the last Ice Age, Scotland has been transformed not once, but many times. […] glacial melt-waters pouring into swollen seas began to lap up the shoreline and along sea lochs and rivers – especially around 7,000 years ago when a great tsunami hit Scotland's east coast. It took another thousand years before the land finally began to outrun the sea.
>
> But then the warmer climate started to give way to wetter, windier and colder conditions. […] With the decline in temperature, as well as pressure from rising human populations and their accompanying livestock, trees began to die and not spring up again, decaying into peat. […]
>
> Peat continued to spread over succeeding millennia, […] until the scientific revolutions of the last few hundred years gave modern farmers the wherewithal to remove large swathes of it. Time and again prehistoric and even medieval communities were obliged to avoid the creeping, glutinous bogs and adapt to new conditions. And time and again, their descendants would wonder at what they found in the depths of the peat, from ancient roads to houses to ploughed fields to huge tree trunks where woods no longer existed.

Which aspects of writing do students enjoy most when they read widely? How many adjectives can they find in the above text? What effect do they have on the reading process? Perhaps students could be encouraged to describe what they see, hear, feel when they read phrases such as: "glacial melt-waters pouring into swollen seas"; or "to avoid the creeping, glutinous bogs". Can students transform these descriptive phrases into art work? Or would they enjoy producing a drama presentation or a time-lapse sculpture video of these geological processes?

There may be students who are more interested in the social aspects of Scotland's history who prefer the rousing lyrics of the popular song 'Flower of Scotland', written by The Corries in the 1960's to celebrate an important victory against England led by Robert the Bruce in 1314: *"O Flower of Scotland, when will we see your like again, that fought and died for your wee bit hill and glen […] The hills are bare now, and autumn leaves lie thick and still, oe'r land that is lost now, which those so dearly held,*

and stood against him, proud Edward's army, and sent him homeward to think again." These lyrics give more scope for the appreciation of metaphor and symbolism since the title of the song not only refers to the Scottish national emblem – the thistle, seen as a symbol of defence in the 14th century – but it also refers to the men who fought and died in the battle and who will never be seen again. The bare hills and autumn leaves emphasize the same metaphor. How would students like to translate these meanings – through poetry, drama, music? How could their work be communicated to larger audiences?

One student might decide to post a short quote from a favourite poem to illustrate a specific description of a well-known landscape, and perhaps this would stimulate other students to share their favourite verses of poetry. For example, the following lines are taken from a poem entitled 'Graduation Day', by Alan Gillis, published in the collection 'Here Comes the Night', Gallery Press, 2010: "*The bluff, heave and hill-side of Arthur's Seat turns butter-drippled green and streaked fox pelt, then glouts back to crow blue and gristle grey"*. Reading a lyrical text such as this might stimulate students to try to include more adjectives in their narrative, expository or persuasive texts or even to write descriptive poems of their own.

What do students think about the effect of renewable energy technology on the landscape? How many would enjoy the challenge of trying to describe the juxtaposition of wind farms or telecommunication masts and the natural character of rural landscape through poetry? Or would they prefer to use other text styles to help them express what they want to say? Do students find it easier to write individual texts or to collaborate and produce a group text? What are the advantages and disadvantages of each option?

When students feel secure about having permanently changed one specific action in their lives, they could write about their overall experience. While a prolonged group conversation or chat allows students to share experiences, exchange information and ideas, make relevant contributions to collaborative discussions, learn from the experiences and opinions of others, reflect on alternative solutions or points of view through reading and writing, it does not encourage the organization of longer, more complex texts. A more extended writing task is necessary for this. According to the publication 'Literacy – experiences and outcomes' produced by Learning and Teaching

Scotland for the Curriculum of Excellence, some of the desired outcomes for student writing experiences include the following:

> I enjoy creating texts of my choice and I am developing my own style. I can regularly select subject, purpose, format and resources to suit the needs of my audience. Throughout the writing process, I can review and edit my writing independently to ensure that it meets its purpose and communicates meaning clearly at first reading. I consider the impact that layout and presentation will have and can combine lettering, graphics and other features to engage my reader.
>
> I can convey information and describe events, explain processes or concepts, providing substantiating evidence, and synthesise ideas or opinions in different ways. I can persuade, argue, evaluate, explore issues or express and justify opinions within a convincing line of thought, using relevant supporting detail and/or evidence. I recognise when it is appropriate to quote from sources and when I should put points into my own words. (LEARNING & TEACHING SCOTLAND, 2009, p. 10-14)

These outcomes, naturally, do not apply exclusively to more extended texts, they can also apply to the creation of a #hashtag or an event flier, so should be developed through the writing of a wide selection of text genres. What are students' favourite text genres? Do they prefer fantasy, adventure, horror, humour, romance, song lyrics, poetry, science fiction, or other options? Perhaps each student could select a special passage from one of their favourite texts and read it to the class, then everyone can share their ideas and impressions produced by each text. This proposal could also be done online, with each student presenting their favourite passage in a creative way – perhaps reading it themselves with an accompanying sound track or a visual montage. They might also choose a passage from a film, cartoon, play, musical, advert and decide to present the same words using an alternative format. As we learn to apply creative thinking to more and more tasks in our daily lives, our critical thinking skills also improve and consequently our overall learning process will benefit enormously. Education Scotland confirms the importance of creativity for learning in general:

> There is also national and international support for the idea that developing creativity skills helps people to learn better, whatever the subject area being studied. There are clear links between this aspect of creativity and the development of critical thinking skills. A focus on creativity can make learning interesting, relevant, personal and engaging. It motivates people to find out more, to apply prior knowledge productively, analyse and synthesise information purposefully, to build confidence in personal efficacy, and to develop resilience. It has the potential to 'hook' learners into an engaging and unfolding learning story over which learners can exercise influence. Anyone who has become deeply immersed in a creative task will recognise the concept of creative 'flow', a highly rewarding state of mind which involves intense concentration, a sense of deep engagement and personal agency with a task, and an apparently seamless flow of ideas and thoughts. Creativity at

> this level is the very epitome of deep learning, one of the primary aims of Curriculum for Excellence. (EDUCATION SCOTLAND, 2013, p. 8)

Creativity, critical thinking, collaboration and communication are all fundamental skills which must be actively applied in order to motivate genuine learning. These skills should also be employed to discover eco-friendly solutions for the local, regional national and global environmental problems we are already facing as a species. Therefore everyone who is involved in the educational process at any level should consider finding out more about how each of these skills functions and how best to promote their development in strongly motivational contexts.

CHAPTER 7

THE GLOBAL ENVIRONMENT

The United Nations project, 'Back to Our Common Future' (2012), was undertaken in order to analyse global data and tendencies which would help to assess the implementation of the Agenda 21 proposals, elaborated according to the principles defined during the Earth Summit in Rio de Janeiro in 1992. The findings from this project were then used as a basis for analysis and discussion during the United Nations Conference on Sustainable Development (Rio+20) which took place in 2012. The UN project report makes the following general statement as part of the introduction:

> **The political deal that emerged from the Earth Summit in 1992 has, for various reasons, never been fulfilled**. Neither the expected outcomes – elimination of poverty, reduction in disparities in standard of living, patterns of consumption and production that are compatible with the carrying capacity of ecosystems, sustainable management of renewable resources – nor the agreed means to achieve them, have materialized. (BLANC, UN, 2012, p. ii, author's emphasis)

Subsequent pages of the same report give more specific details related to the global failure to commit to the proposals in Agenda 21:

> In the 20th century, a 4-fold increase in human numbers was accompanied by a 40-fold increase in economic output and a 16-fold increase in fossil fuel use, along with a 35-fold increase in fisheries catches and a 9-fold increase in water use. Carbon dioxide emissions increased 17 times, sulphur emissions by 13 and other pollutants by comparable amounts. Global primary energy use, carbon emissions, biodiversity loss, nutrient loadings, deforestation, global fossil water extraction are all still increasing. (Ibid., 2012, p. 3)

Based on the conclusions of this report and the discussions at the RIO+20 conference, the United Nations launched their '2030 Agenda for Sustainable Development' in 2015, defining 17 Sustainable Development Goals (SDGs) as well as 169 targets for a renewed universal agenda which would build on the previous Millennium Development Goals (MDGs). The UN defined their vision as follows:

> In these Goals and targets, we are setting out a supremely ambitious and transformational vision. We envisage a world free of poverty, hunger, disease and want, where all life can thrive. We envisage a world free of fear and violence. A world with universal literacy. A world with equitable and universal access to quality education at all levels, to health care and social protection, where physical, mental and social well-being are assured. A world where we reaffirm our commitments regarding the human right to safe drinking water and sanitation and where there is improved hygiene; and where food is sufficient, safe, affordable and nutritious. A world where

> human habitats are safe, resilient and sustainable and where there is universal access to affordable, reliable and sustainable energy. (UN, 2015, p. 7)

The UN recognizes, however, that it will be no easy task to implement the goals which they have defined. They describe the current world situation (in 2015) as follows:

> We are meeting at a time of immense challenges to sustainable development. Billions of our citizens continue to live in poverty and are denied a life of dignity. There are rising inequalities within and among countries. There are enormous disparities of opportunity, wealth and power. […] Global health threats, more frequent and intense natural disasters, spiralling conflict, […] and related humanitarian crises […] threaten to reverse much of the development progress made in recent decades. Natural resource depletion and adverse impacts of environmental degradation, including desertification, drought, land degradation, freshwater scarcity and loss of biodiversity, add to and exacerbate the list of challenges which humanity faces. […] Increases in global temperature, sea level rise, ocean acidification and other climate change impacts are seriously affecting coastal areas and low-lying coastal countries. […] The survival of many societies, and of the biological support systems of the planet, is at risk. (UN, 2015, p. 7-8)

Time is running out. The human species will have to change their habits, their mindset and their goals in order to survive. We are literally racing towards extinction. It is therefore of absolutely fundamental importance that we work towards sustainable goals in all areas of our lives – immediately. Individual actions should join together to produce positive collaborative effects in our local communities, which will then benefit local regions, countries and ultimately the planet as a whole. The United Nations is showing us the way to move forward. Agenda 2030 "is an Agenda of the people, by the people, and for the people – and this, we believe, will ensure its success. […] We can be the first generation to succeed in ending poverty; just as we may be the last to have a chance of saving the planet." (UN, 2015, p. 16)

We will explore the following themes in this chapter in order to develop suggestions which might be used to stimulate individual actions which underpin positive sustainable results for the wellbeing of our host planet and our species.

Topics: THE GLOBE ✿ *Soil* ✿ *Water* ✿ *Air* ✿ *People and the Environment*

The first goal defined by the United Nations in their Agenda 2030, published in 2015, is to eradicate poverty in all forms everywhere, and the second goal is to eliminate global hunger, which is strongly linked to poverty. According to the information published by

Hunger Notes for the World Hunger Education Service (WHES)[43], hunger is a result of chronic food shortage and when used in global terms usually refers to a life-threatening lack of food, or protein-energy malnutrition, which leads to growth failure. The United Nations Food and Agriculture Organization (FAO) estimated that about 815 million people of the 7,6 billion people in the world (10,7%) were suffering from chronic undernourishment in 2016. Africa had the highest percentage of population suffering from lack of food, but Asia had the highest number of people living with hunger.

The online publication *Hunger Notes*[44], reports that children are the most visible victims of undernutrition, and, according to the World Health Organization-UNICEF, undernutrition caused approximately 45% of all child deaths in 2011. Poverty is the principal cause of hunger, but hunger can also cause poverty. When people do not have enough to eat and lack the protein and nutrients for healthy growth, they will usually have low levels of energy and diminished mental capacity which will reduce their ability to work and to learn, consequently leading to even greater hunger.

What do students know about global hunger? How often do they feel hungry during a normal day and for how long? What is the longest amount of time they believe they would be able to support feeling hungry? Can they imagine what it would feel like to experience hunger on a permanent basis? Perhaps students could read a section from the book 'Changing the Face of Hunger' (2006) written by Tony Hall, US ambassador to the United Nations Food and Agriculture Agencies. On pages 74-89 he describes his experience of undergoing a 3-week voluntary fast. He talks about the acute pains he suffered during the first week when he had to avoid family mealtimes and drink lots of water to replace food. He noticed that his senses of smell and taste became much more acute so that he was able to smell what people had eaten and taste the difference between various water sources. However, after the first week, he didn't feel hungry any more, he said that his body just seemed to give up on the possibility of getting food, and because of these physical perceptions he felt more able to understand why starving children sometimes don't eat food when it is placed in front of them. By the third week he had very little energy and found it extremely difficult to do anything at all in the

[43] World Hunger Education Service (WHES). Available at: <https://www.worldhunger.org/about-whes-hunger-notes/>. Accessed on: 04.06.2021.
[44] 2018 World Hunger and Poverty Facts and Statistics. **WorldHunger.Org.** Available at: <https://www.worldhunger.org/world-hunger-and-poverty-facts-and-statistics/#progress>. Accessed on: 04.06.2021.

afternoons, he sensed his brain slowing down, and felt strong empathy for starving schoolchildren who tend to fall asleep in school.

This section of Tony Hall's story is made available by the online publication *Hunger Notes* which also offers several fact sheets, quizzes, pictures and stories related to hunger, such as: Facts about Famine; Hunger and Nutrition; Understanding Food Loss and Waste; Food as a Human Right; World Hunger Pictures and Stories; etc. Students could investigate topics which intrigue them, then form small groups around common interest areas to produce a variety of text genres, combinations of music and movement, or artistic installations which unite science with the arts, to raise awareness related to hunger as they learn more about key issues related to this topic. Results could be presented to the whole school, and also to the local community, or could even be documented online using imaginative posters, photography and films to communicate their thoughts and knowledge about hunger to an even wider audience. As awareness of global hunger becomes stronger, people who already have enough to eat may start to adopt healthier, more sustainable eating habits and reduce their food waste more and more.

What are the solutions for global hunger? There are many institutions involved in the battle against hunger. Perhaps students could investigate some of the strategies implemented by different organizations in order to stimulate ideas that they might enjoy applying in practice. For example, the programme *Heifer International*[45] was founded in 1944 by Dan West, a Midwestern farmer in the US. He had returned to the US after spending time as a volunteer in the Spanish Civil War where his job was to provide refugees with a single cup of milk. Coming from a farming background, he adopted the philosophy of 'teaching a man to fish' instead of simply giving him a fish to eat, and developed the idea of providing the hungry with a cow instead of a cup of milk. When the original heifer starts to produce her own calves, the family who received her, pass on the first newborn heifer to a neighbouring family in need. In this way, one initial donation can spiral outwards to impact whole communities. The key processes in this programme are: commitment, creative enhancement, collaboration, conservation and community. The organization works with small-scale farmers, providing livestock,

[45] Heifer International. **About Heifer**. Available at: <https://www.heifer.org/about-heifer/index.html>. Accessed on: 04.06.2021.

seeds for grain crops, as well as training in sustainable crop production and animal management practices.

The *Hunger Project*[46] has been working for 40 years to change how the world thinks about hunger. They train creative and self-reliant people who live in conditions of hunger and poverty and place them at the centre of their activities. These leaders take charge of their own development and create lasting change in their communities. The *Hunger Project* reaches 16 million people in more than 13,000 communities worldwide. They use a participatory approach to encourage local solutions through a community analysis of results. They start their work in each community by holding a Vision, Commitment and Action Workshop which is designed to inspire individuals to move from "I can't" to "I can" to "We can". One of the success stories on the site presents Delma Jean, a farmer from Burkina Faso, who was only able to produce 10 bags of maize per hectare of land. This meant that his family was living in poverty for many years. The *Hunger Project* gave him training on microdose technology and the production of organic manure and he was able to increase his production to 35 bags of maize per hectare. He now has surplus maize which can be sold and this has improved his family's living conditions so that he is able to send his two children to secondary school.

What do students know about 'microdose technology'? How many local farmers use organic manure? What are the positive and negative aspects of the fertilizing techniques that are currently being used locally? In what ways can the local community learn how to work collaboratively through finding out more about the techniques used by the *Hunger Project*? How does this project identify creative and self-reliant people who can be trained to become leaders in their communities? What can students learn from this project in order to use their creativity and self-confidence to encourage themselves and others to invest in successful actions which will help reduce local, regional and global food waste and hunger? We need to remember always that the less food we waste – the more there will be for those who desperately need it.

[46] The Hunger Project. **Our Work**. Available at: <https://www.thp.org/our-work/>. Accessed on: 29.05.2019.

Action Against Hunger[47] is a global, humanitarian, non-profit organization which originated in France and has almost 40 years of experience and expertise responding to emergencies caused by conflict, natural disasters and food crises. They save lives in more than 45 countries with almost 8,000 field staff assisting more than 20 million people in 2018. One of their principal objectives is to empower vulnerable communities to improve their access to food, income and markets, so they help small-scale farmers to increase production, store their crops safely and market them successfully. One of the stories on the site talks about a woman called Madina from Somali. Her husband was killed in an attack on her village and she had to flee for safety, but was only able to take part of her family with her. When they arrived at a displacement camp, her youngest son of two weeks had acute malnutrition, but when she met the team from *Action Against Hunger* in one of their Child Health Centres, she became very enthusiastic about helping young children with malnutrition, and learned to detect this condition by measuring the mid upper-arm circumference. She also started working with mother-to-mother support groups to educate women on the importance of good health and hygiene.

Sometimes when we read about actions for raising awareness related to malnutrition, we only associate these actions with starving children, but as we have learned in previous chapters, there are many children in economically privileged societies who have extremely serious health problems related to over-eating and obesity. These conditions are also a result of malnutrition – children who are not eating healthy food in healthy quantities. Furthermore, there are large numbers of children who do not lack food, who do not present symptoms of overweight, but who are not eating healthy food and may even be consuming unnecessary medication, or products with high levels of chemical additives which have negative effects on a variety of bodily functions, including neural functions. For example, high-level income countries still seem to be unaware of the dangers of High Fructose Corn Syrup (HFCS) which is being added to more and more of the ready-made food and drink products all over the world. According to Lowette et al.:

> The consumption of fructose has increased tremendously over the last five decades, which is to a large extent due to the development of high-fructose corn syrup (HFCS), a commercial sugar additive that contains high amounts

[47] Action Against Hunger. **About**. Available at: <https://www.actionagainsthunger.org/about>. Accessed on: 04.06.2021.

> of free fructose. HFCS is often added to processed food and beverages partly because it is a powerful sweetener but even more so because the production is cheap. Although fructose in combination with fiber, vitamins, and minerals, as present in fruits, is a healthy source of energy, isolated fructose, in processed food products, has been associated with several health disorders such as insulin resistance and hypertension. Apart from its metabolic consequences, a growing body of literature suggests that free fructose can also affect neuronal systems. (LOWETTE, et al., 2015, p. 1)

The article cites several studies which indicate that a high intake of fructose can lead to a reduction in brain function, memory, learning and the formation of brain neurons, and may also cause high blood pressure and arterial dysfunction. It is therefore extremely important that everyone who is involved in the provision of food, especially food for developing children, should be aware of the positive and negative aspects of the food that is being provided.

Do students know which foods and beverages contain large amounts of high fructose corn syrup? Perhaps each student could make a list of their favourite foods and drinks, then small groups could try to discover the positive and negative aspects of specific items based on the analysis of products which students have in common. The challenge might then be to discover healthier options for any items which present high levels of HFCS. The results could be shared with the whole school, as well as the local community, in order to promote healthy options for healthy growth and development. Societies which are economically privileged should not be raising children who are suffering from malnutrition, this situation requires urgent changes.

Another organization, *Food for the Hungry*[48] (FH), recognizes that poverty is complex and ever-changing and they work towards a world without poverty through intentional and purposeful community development by creating a foundation for resilience and self-sufficiency. Their goal is to accompany communities in such a way that they are able to thrive once the FH representatives leave. They enter a community to listen and learn in order to understand their challenges. Then they develop a plan of action together with community members and serve as mentors as the community implements solutions. When the community has developed a sense of project ownership and independence, FH staff will celebrate the community's success and leave. This approach allows them

[48] Food for the Hungry. **Our Approach**. Available at: <https://www.fh.org/our-work/our-approach/>. Accessed on: 04.06.2021.

to partner with local leaders to develop transformative solutions, which are both sustainable and implemented at the hands of the communities themselves.

Students could explore different online sites to discover what various groups of people are already doing to help reduce hunger and poverty around the globe. Then they could form teams in order to promote effective action themselves. What do they know about hungry children around the world? How much do they know about the places where they live and the conflicts which have placed many of them in the terrible conditions in which they find themselves? What do they know about the local food culture in some of the regions most affected by poverty and hunger? Which aspects of these hungry children's lives disturb them most strongly and why? Which images or videos inspire them most and why? Let's create relevant innovative proposals and put them into action as quickly as possible in order to collaborate with the United Nations goals for 2030.

The UN defined several targets to accompany each of the 17 Sustainability Development Goals and I have selected one of the targets to accompany SDG 2.

> **Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture**
>
> 2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed. (UN, 2015, p. 19-20)

This UN target for ending hunger, improving nutrition and promoting sustainable agriculture focuses on the importance of maintaining a variety of seeds, plants and domesticated animals in order to guarantee food sources for humanity, and it also emphasizes the importance of combining genetic resources and traditional knowledge. There are fascinating links between the traditional knowledge held by indigenous peoples around the world and scientific knowledge currently being produced related to genetic resources. The problem is that most indigenous peoples all over the world are living in poverty, although many of them continue to protect large areas of biological diversity – the source of genetic resources. The Indigenous Peoples Major Group for Sustainable Development (IPMG-SD) produced a Global Report on the Situation of Lands, Territories and Resources of Indigenous Peoples in 2019 which describes their current situation as follows:

> Indigenous peoples are at the frontlines of the global crises of poverty and marginalization, climate change impacts, biodiversity and cultural diversity loss.
>
> In all global regions, they are among the most economically and socially deprived populations and politically marginalized in the countries where they live. Climate change impacts such as extreme weather events, drought, melting ice, sea water rise and species shifts are seriously impacting indigenous territories and ecosystems in the Arctic, Pacific, tropical forests, drylands and mountains, increasing the vulnerability of indigenous peoples.
>
> Nonetheless, indigenous peoples secure most of the remaining biological and cultural diversity on Earth, being custodians of important ecosystems and species and cultural landscapes. Their lands and waters are major contributors to ecosystem and social resilience at this time of rapid global change.
>
> Surviving at the frontlines of the social and ecological crises, **indigenous peoples are also uniquely placed as central contributors to contemporary solutions and vital actors in the global transformation agenda on sustainable development, biodiversity conservation and climate change mitigation and adaptation**. (IPMG-SD, 2019, p. 59, my emphasis)

What do students know about indigenous peoples around the world? My father was fascinated by the indigenous peoples of North America. Although his family had lived for generations in the small town of Lockerbie in South-West Scotland, he was an avid member of the Boy Scout movement for most of his life, and when he was a young teenager, he was given the opportunity to participate in a World Jamboree. He met scouts from all over the globe and became fascinated with world cultures, especially indigenous cultures which were more closely related to nature conservation – another of his passions. He carved Pueblo Kachina dolls for us as children as well as producing hand-beaded necklaces in the Navajo style. With my mother helping on the sewing machine, he also produced a full size tipi, embellished with Native American symbology, which he would use at various community events, or when visiting schools, to tell Native Indian stories to young children. And when he took up pottery, he decorated everything he produced with different Native American designs and symbols, frequently favouring traditional Hopi designs. He also had an extensive collection of books, focusing principally on the indigenous cultures of North America. But when I moved to Brazil, he expanded his reading to include indigenous groups from Brazil, and was overjoyed when my daughter became best friends with a young Guarani girl who was studying with her, and he often accompanied us when we visited the indigenous settlement where she lived. A few years later, my daughter chose a Guarani celebration song to accompany her when she received her graduation diploma.

What do students know about different indigenous groups and what would they like to learn about them?

> Indigenous peoples are identified as custodians of many of the world's most biologically diverse areas and verifiably hold a wealth of traditional knowledge, innovations and practices on ecosystem management and technologies, traditional health systems and medicinal plants; agricultural production and food systems, local crops and seeds.
>
> While these realities are increasingly recognized among mainstream sectors, indigenous peoples seldom share in the benefits of the commercialization of their knowledge. Indigenous peoples, including indigenous women, have a proven track record of responsible management of natural resources in forests, deserts, tundra, and small islands. **Their contributions to sustainable development should not only be recognized and respected, but whenever possible, celebrated as models of good practices that have a huge potential to benefit all mankind.** (IPMG, ac. 2015, p. 4, my emphasis)

Several of the quotes above have mentioned the importance of maintaining biodiversity because genetic uniformity is frequently the primary cause of famine. According to Hope Shand, writing for the Food and Agriculture Organization of the United Nations:

> Industrialized agriculture favours genetic uniformity. Typically, vast areas are planted to a single, high-yielding variety – a practice known as monoculture – using expensive inputs such as irrigation, fertilizer and pesticides to maximize production. In the process, not only traditional crop varieties, but long-established farming ecosystems are obliterated. Genetic uniformity invites disaster because it makes a crop vulnerable to attack – a pest or disease that strikes one plant quickly spreads throughout the crop. (SHAND, FAO, 1993, Chpt. 3, online)

What do students know about the biodiversity of the foods they like to eat? Are they aware that there are more than 4,000 varieties of potatoes; 1,000 varieties of banana; an estimated 40,000 varieties of beans; 120,000 varieties of wheat; and 200,000 varieties of rice – each with their unique characteristics? For example, specific varieties of potato present a considerable range of selected nutrients. Studies in the FAO/INFOODS database show that "in the case of potatoes, which comprise several species and varieties/cultivars, the protein content varies from 0.3 to 11.6 grams per 100 grams, iron content varies from 0.1 to 35.5 mg per 100 grams, and vitamin C content varies from 0.3 to 33.8 mg per 100 grams." (RAWAL et al., 2019, p. 36)

Unfortunately, the world is losing an enormous amount of biodiversity. For example, Kathrin Strohm (2013) estimates that there are more than 30,000 varieties of apple which grow all over the world, but less than 40 varieties are produced and traded commercially. The National Biodiversity Network reports that there are around 5,000

varieties grown in the UK, although most supermarkets only stock about eight varieties of apple. This means that lesser known varieties may not be planted in sufficient numbers in order to survive. If students explore the online site 'People's Trust for Endangered Species', there is a *Fruit Finder*[49] search tool which can help readers discover information about different varieties of fruit. So when I looked for apple varieties in Scotland, 46 varieties appeared with a marvellous selection of names such as: Thorle Pippin; Red Sudeley; Lass o' Gowrie; Green Kilpandy Pippin; and the Coul Blush – none of which I was familiar with.

Students could try to find out more about the origin of these wonderful names. How many of these apples have students heard of? Can they describe the different tastes of the varieties they have eaten? To what extent are students able to identify apple varieties according to their taste and texture? Which are their favourite apple varieties and why? What do they know about the history and geography of apples? They might even be stimulated to write poetry, songs or scientific reports about the unique qualities of their favourite apple. Or they could discover the sources for unusual varieties and gather together to plant a variety of genetically distinct apple trees in the community to promote fruit diversity and food security.

"While more than 6,000 plant species have been cultivated for food, fewer than 200 make substantial contributions to global food output, with only nine accounting for 66% of total crop production in 2014. [sugar cane, maize, rice, wheat, potatoes, soybeans, oil-palm fruit, sugar beet and cassava]" (FAO, 2019, p. 114) According to M. Rai (2003), there is archaeological evidence that rice was already being cultivated in India between 1500-1000 BC:

> With its long history of cultivation and selection under diverse environments, rice acquired wide adaptability enabling it to grow in a range of environments, from deep water to swamps, irrigated and wetland conditions, as well as on dry hill slopes. Probably far more than any other crop, rice can grow under diverse geographical, climatic and cultural conditions.
>
> The quality preferences of rice consumers have resulted in a wide diversity of varieties specific to different localities. Although the exact diversity cannot be gauged, it is estimated to be around 140,000 different genotypes. (RAI, 2003, online)

[49] Fruit Finder. **People's Trust for Endangered Species**. Available at: <https://ptes.org/campaigns/traditional-orchard-project/fruitfinder/>. Accessed on: 04.06.2021.

Rice breeding in India started at the beginning of the twentieth century and by 1960 there were 69 research stations in the country which had developed 430 improved varieties. High yield was the most important objective in all breeding programmes as well as early maturity and resistance to pests.

How often do students eat rice and what are their favourite rice dishes? How many different varieties of rice have they tried? Do they know where each variety originated? Which source of carbohydrate do they eat more frequently and why? How often do they eat rice, pasta, bread or potatoes? Perhaps students could form groups around their favourite source of carbs and discover more about their history and development? What do they know about the history of the potato? Do they know that more than 2,800 different types of potato originated in Peru?

Sarah Anstett writes about the Potato Park (*Parque de la Papa*), located in the Cusco region of Peru, and points out that it is "one of the world's few biological reserves operated by local indigenous populations […] mixing old knowledge with new technology to protect crops against climate change." (2015, online) The Park is an Indigenous biocultural territory comprising six Quechua communities who are dedicated to protecting their land, culture and local native potato varieties. Amanda Stephenson provides more information:

> The area is a government-recognized park where 1,400 varieties of potato are grown. These varieties were compiled through local gathering, donations from the International Center for the Potato (ICP), the town of Ayacutro, and members of a native potato network. The Park is run by its members, who have made strides in biodiversity conservation. (STEPHENSON, 2012, online)

Potatoes have traditionally been cultivated using the tubers, but ICP has been working with the local indigenous communities to produce seeds from different varieties of potatoes. The ICP first learn what they can from the Quechua farmers, then apply scientific techniques while preserving traditional farming methods. By working closely together, they are learning which seeds are most appropriate for planting at different altitudes, in different soils and at different times of the year. This collaboration is helping to guarantee that native varieties will continue to be cultivated for generations to come. The Quechua farmers consider themselves to be the 'Guardians of the Potato'. (Ibid., 2012, online)

How many different varieties of potato have students eaten? Which specific varieties do their families use for particular dishes? Do they know that some wild potatoes contain toxic compounds to defend themselves against attacks from fungi, bacteria and predators? In the Andes wild relatives of the llama lick clay before eating poisonous plants, because the toxins stick to the clay and pass through the digestive system without harming the animals. Similarly, indigenous peoples from the mountains would dip wild potatoes in gravy made of clay and water. How many native recipes for potatoes can students discover? Have they seen pictures of the huge variety of potatoes produced in the Andes? If they explore images for Peruvian potato varieties, students may be motivated to produce works of art related to the history of this fascinating food source. They can then mount a compelling exhibition combining all disciplines to raise awareness of the necessity to promote biodiversity while it still exists.

There are approximately 370 million Indigenous Peoples worldwide in over 90 countries, and according to the World Bank (2019): "While Indigenous Peoples own, occupy, or use a quarter of the world's surface area, they safeguard 80% of the world's remaining biodiversity. They hold vital ancestral knowledge and expertise on how to adapt, mitigate, and reduce climate and disaster risks." In the same article, the World Bank expresses their concern about the recognition of Indigenous Peoples' rights, especially as related to secure land tenure.

> Much of the land occupied by Indigenous Peoples is under indigenous customary ownership, and yet many governments recognize only a fraction of this land as formally or legally belonging to Indigenous Peoples. Insecure land tenure is a driver of conflict, environmental degradation, and weak economic and social development. This threatens cultural survival and vital knowledge systems – both of which contribute to ecological integrity, biodiversity and environmental health upon which we all depend. (WORLD BANK, 2019, online)

Since indigenous peoples are "custodians of important ecosystems, species and cultural landscapes, and their lands and waters are major contributors to ecosystem and social resilience at this time of rapid global change" as mentioned above, it is extremely important that they should continue to maintain the "ecological integrity, biodiversity and environmental health upon which we all depend." But, one of the main problems which threaten the biodiversity of the planet is the invasion and abuse of indigenous territories. In order to legalize their historical rights, or customary ownership, the land needs to be surveyed and mapped and many indigenous groups and support

organizations are promoting community participatory mapping and land demarcation as fundamental tools to strengthen community governance over their territories and resources (IPMG, 2019, p. 64). The IPMG offer several examples of successful participatory mapping projects:

> 145 indigenous communities have used participatory 3-dimensional modeling (P3DM) to delineate the boundaries of their domain and to define their own management zones, generate their own spatial information, and present their unique perspective on their ancestral lands. In a lobby against Sagittarius Mining Inc. (SMI) operations in the B'laan ancestral domain in South Cotabato, indigenous communities used P3DM successfully to generate critical data to counter SMI experts' arguments in the review of the company's environmental impact assessment.
>
> In Thailand where indigenous communities mostly live in protected forests and are vulnerable to being evicted, the indigenous peoples used P3DM to negotiate with subdistrict and forest officials for possible collaborative management of the forests so they can continue to occupy and use their lands which have become protected areas. (IPMG, 2019, p. 65)
>
> In Burma indigenous communities are mapping their ancestral territories in Shan, Chin, Karen and Karenni states with the help of civil society organizations such as POINT, KARUNA, and Chin Human Rights Organization. Besides being a useful tool for advocacy and to reclaim their lands, the process of inclusive and rights-based approaches to community mapping has been empowering to the indigenous communities in many ways: 1) it creates unity among the community behind territorial defense, 2) it enables intergenerational transfer of knowledge about their territory and 3) though territorial demarcation may sometimes lead to conflicts, in most cases it helps to find a lasting solution to existing boundary conflicts. (Ibid., p. 66)

What do students know about 3-dimensional modelling? Are they able to map the local community using 3-dimensional tools? Could they remodel 3D maps of the local community using creative proposals to improve any of the United Nations Sustainability Development Goals? Which goals would they focus on to improve local soil use? What lessons can we learn from Indigenous soil management which can be applied to our local communities? How strongly united are our own local communities? To what extent does the community join forces to promote the UN sustainability goals? What kinds of knowledge are transmitted from one generation to another in our local communities? To what extent are different generations able to listen and learn from each other? Can community conflicts be resolved by coming together for a common cause? What can students suggest as effective strategies to unite the community more strongly in order to achieve the Sustainability Development Goals?

Eva Perroni, in an article published on the site *Resilience*, suggests several indigenous farming practices which could be used to guarantee biodiversity and enhance food security, one of them being agroforestry.

> Agroforestry involves the deliberate maintenance and planting of trees to develop a microclimate that protects crops against extremes. Blending agricultural with forestry techniques, this farming system helps to control temperature, sunlight exposure, and susceptibility to wind, hail, and rain. This system provides a diversified range of products such as food, fodder, firewood, timber, and medicine while improving soil quality, reducing erosion, and storing carbon. (PERRONI, 2017, online)

How could this indigenous practice be used in Scotland or elsewhere in the world? What ideas do students have? There are several different kinds of forests in Scotland, including more recently planted commercial forests which don't necessarily contain the biodiversity of older woodlands. Perhaps students could help create partnerships between local communities and those responsible for local forests with a view to planting, caring for, and harvesting some of the traditional woodland plants and fruits which would increase local biodiversity and expand the uses of forest areas. For example, by adding edible fungi, blueberries, brambles, raspberries, and a variety of medicinal plants, the flowers and fruits will entice more bees, insects, birds and small animals into the forests, which will help improve the quality of the soil and consequently support tree growth more successfully. What other ideas do students have to increase the biodiversity of local forests? How might they use forest cover to protect crops?

Do students know that wild coffee originally grew in the forested highlands of Ethiopia under tall, shady trees? Coffee beans mature more slowly in the shade, which enhances the flavour of the coffee, and shade-grown coffee is often organically grown since chemical fertilizers and pesticides are not necessary. The leaves which fall from the surrounding trees mulch the soil, which helps to retain moisture, and the large variety of birds which are attracted to the diversity of habitats provide insect control. How can students promote shade-growing coffee consumption? The most obvious strategy is to restrict our buying to appropriately farmed products. As consumer awareness of sustainable agricultural practices increases, production may follow demand. So how can we increase consumer awareness of sustainable farming practices? Students can form teams around their favourite food products produced in different places around the world, then investigate the farming practices used to produce the items they have

chosen. They could then compare the farming practices used by different companies and present their results using a variety of strategies to convince their classmates, families, and the local community to buy more sustainable and ecologically sound products.

Another traditional farming practice which promotes sustainable soil structure is to use crop rotation, which is not the usual practice adopted by industrial agriculture practitioners who tend to prefer monoculture.

> The principles of crop rotation have been successfully used for thousands of years in agriculture and are still used today. Crop rotation is the practice of growing different crops on the same land so that no bed or plot sees the same crop in successive seasons. It is a practice designed to preserve the productive capacity of the soil, minimize pests and diseases, reduce chemical use, and manage nutrient requirements, all of which help to maximize yield. The practice of crop rotation builds better soil structure and increases the ability to store carbon on farms. (PERRONI, 2017, online)

How many local farmers use crop rotation? Perhaps students could map the local community or region and register which farmers use crop rotation and which farmers don't. Can students come up with creative strategies to convince industrial farmers who don't use crop rotation to consider this possibility? It might also be interesting for students to invite at least one local farmer who does use crop rotation, together with one who doesn't, to talk to the class about the reasons for their choices. Which arguments are more convincing and why? What kind of information do students feel they need to know more about and where can they find it? When different sources give contradictory facts, what do students do? How do they check the reliability of their sources?

Other traditional farming techniques include mixed or inter-cropping, which is a system whereby farmers plant at least 2 crops at the same time, for example planting fruit trees together with one or more short term crops. The polyculture system is an expanded version of mixed cropping, where many plants of different species are grown in the same area – in a similar way to nature. By increasing plant diversity, diet diversity is maintained in local communities. Moreover, a greater variety of insects are attracted which can help minimize pests, reduce the growth of weeds and increase soil organic matter. The polyculture system therefore promotes a much stronger, healthier ecosystem than the monoculture system, which is very susceptible to attacks from pests and disease. How many local farmers use the polyculture system? How many students have a polyculture system in their gardens to produce different vegetables or fruits in the same plot of land? How many wasteland areas or community-owned plots are there near

the school which could be used to develop polyculture vegetable, fruit or mixed produce gardens? Let's get involved actively and apply traditional farming techniques in our community.

It is important to remind ourselves that: "Despite a wealth of more than 50,000 edible plants in the world, well over half of our food now comes from only three plants (rice, corn, wheat), making the world's food supply highly vulnerable to biological diseases that would affect one of those." (BLANC, UN, 2012, p. 17) The Global Crop Diversity Trust (or Crop Trust), which is related to the International Treaty on Plant Genetic Resources for Food and Agriculture (FAO), defines the six key areas where crop diversity is essential, as follows: to ensure food security; guarantee adaptation to climate change; reduce environmental degradation; reduce poverty; and ensure sustainable agriculture.[50]

Fortunately, several favourable trends were already being identified in 2016, both on the ground and in policy. First, recognition of and respect for traditional knowledge and customary sustainable use was increasing. Second, real progress was being made in bringing traditional and scientific knowledge together on the ground to improve natural resource management, partly through the use of innovative technologies. In addition, there was an improved flow of information between local and global networks. (IPMG, 2019, p. 66) It is therefore of fundamental importance that students should be able to compare traditional farming practices with current scientific knowledge in such a way that they are able to understand that both fields of knowledge are necessary in order to sustain and improve global biodiversity and develop sustainable farming practices which will guarantee sufficient, nutritious food for every single human being on the planet.

However, one more particularly relevant factor needs to be taken into consideration when analysing food production and consumption in general. According to the United Nations (2012), "Food is becoming disconnected from nutrition."

> There are now as many clinically overweight people in the world as undernourished. Epidemiological data already points to considerable societal and economic costs of the rapid rise of the clinically obese in many industrial economies. Given these realities, we must recognize that we are often aiming at the wrong goal. *Agriculture policy concentrates mostly on production and trade and is divorced from the even more vital purpose of good nutrition.*

[50] CROP TRUST. **Crop Diversity: Why it Matters** – the six key areas where crop diversity is essential. Available at: <https://www.croptrust.org/our-mission/crop-diversity-why-it-matters/>. Accessed on: 04.06.2021.

> Investing to fill the global "pipelines" with more food would appear to be a pointless strategy. *Rather than simply "more" production, we must also consider what would be "better" production and better food systems.* Besides its production function, agriculture needs to integrate other vital functions of ecosystem management as central features of its development. Multi-functional agroecology is a necessary working strategy, not an option. According to many experts, our objectives should be:
>
> a) better access since there are more than 4000 kcal per person per day available in the global food system already.
>
> b) more nutrition or healthy food.
>
> c) fostering efficient agro-ecological landscapes that reduce risks. (BLANC, UN, 2012, p. 23, my emphasis)

We already have enough food production to feed everyone on the planet – but too many people are eating more than their 'fair share', and too many people are wasting the food they buy. We are also consuming more and more 'unhealthy' food and beverages with very little nutritious value and a growing percentage of excess salt, fat and sugar, as well as a surfeit of chemical additives, which are destroying our health. The recommended daily intake of calories for adults is around 2000 for women and 2500 for men, depending on age and size. The global food system already provides more than 4000 calories per person per day, therefore it is not necessary to produce more food. We must concentrate instead on producing less waste and eating recommended amounts of healthy food.

Do students know how many calories they consume each day? How healthy do they think their diet is? What could they change in order to be eating more nutritious meals? Do they know that at least half of their 'plate' should be full of vegetables and fruits of various colours for every meal? Harvard Medical School (2013) tells us to: "Add colour to your diet for good nutrition – choose at least one vegetable from each of five colour groups to get a wide range of healthy nutrients." Potatoes are not included as a vegetable option since they are considered to be one of the carbohydrate options, and should be eaten with their skins in order to include a little fibre. The preferred carbohydrate options should be whole grains and should only make up one quarter of your plate, so brown bread, rice and pasta are much healthier than white processed grains which have negative effects on blood sugar and insulin. Protein then makes up the final quarter of your plate, preferably fish, chicken, beans or nuts rather than red meat or processed meats such as bacon and sausages. Of course plate size and food preparation are also important factors to take into consideration – it is much healthier to boil vegetables for a short time in lightly salted water than deep fry them.

Throughout this section we have been focusing on connections between soil and the production of food, but soil has a fascinating array of functions which can also be explored in order to appreciate its crucial significance for life on earth. We have already discussed several possibilities in previous chapters, but the Soil Science Society of America (SSSA) maintains a captivating site which includes many teaching ideas for different ages and abilities. They define the ecosystem services of soil as follows:

> Soil is the link between the air, water, rocks, and organisms, and is responsible for many different functions in the natural world that we call ecosystem services. These soil functions include: air quality and composition, temperature regulation, carbon and nutrient cycling, water cycling and quality, natural "waste" (decomposition) treatment and recycling, and habitat for most living things and their food. We could not survive without these soil functions. (SOIL SCIENCE SOCIETY OF AMERICA, online.)

The SSSA also produced short, monthly videos[51] during 2015 to celebrate the International Year of the Soil. These videos last 2-3 minutes and cover topics such as: Soils sustain life; Soils clean and capture water; Soils are living; Soils support health; Soils, culture and people, amongst others. This site also offers a broad selection of teaching ideas.[52] For example, one of the lessons inside the Scoop Teacher's Guide has the title 'Soil is NOT Dirt' which provides information and activities about the importance of soils for the human world, history and housing. They explore connections between soils and music by asking students to think of songs about soils, food and farming. Amongst others, they have a love song from scientists about erosion; a country song from Brad Paisley called 'Two feet of top soil'; and a folk song by Woodie Guthrie called 'Dust Bowl Blues' with a video showing film of the dust bowl disaster which affected the American and Canadian prairies in the 1930s. How many other songs can students think of related to soil and soil use?

The site also suggests that students could try to find soils which vary in colour and texture to produce art work, or diverse types of clay to mould a selection of shapes, plates and pots before drying them or firing the results in a kiln to produce pottery and ceramics. Students are encouraged to investigate online games such as 'Building a Sod House' offered by the Smithsonian Museum or 'Making Bricks' available on the Kids

[51] SSSA. **Celebrating 2015 – International Year of Soils**. IYS Videos. Available at: <https://www.soils.org/iys/monthly-videos>. Accessed on: 04.06.2021.
[52] SSSA. **K-12 Soil Science Teacher Resources**. Available at: <https://www.soils4teachers.org/lessons-and-activities>. Accessed on: 04.06.2021.

Zone at Colonial Williamsburg.[53] In addition, they are also asked to think about what soil means to different professions – such as an archaeologist, a farmer, an engineer, a potter, an ecologist.

The fundamental teaching-learning strategies involved in the suggestions given so far should ideally focus on the stimulation of deep thinking and analysis and not simply on the accumulation of facts or routines. Project proposals are more challenging and inspirational when they are open-ended and thought-provoking. Therefore when students are stimulated to explore topics which motivate them, they will usually invest more effort to construct investigative techniques which will lead them towards their goals. They will also learn more successfully if concepts are strongly connected to actions, especially those which can promote positive results in the students' lives and their local environment. As students work collaboratively towards the sustainability development goals by investigating self-elected topics in innumerable ways which bring together several content areas, they will automatically develop a conscientious awareness of the fundamental importance of maintaining healthy soil to sustain the biodiversity of life on Earth.

❁ *Water*

One of the United Nations Sustainability Development Goals (SDGs) related to the conservation of water is SDG 6, and I have also selected three of the targets which accompany this goal as references for discussion:

> **Goal 6. Ensure availability and sustainable management of water and sanitation for all**
>
> 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
>
> 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
>
> 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (UNITED NATIONS, 2015, p. 22-23)

In order to track developments towards the attainment of the above goals, UN-Water

[53] Colonial Williamsburg. **Brick Making Game**. Available at: <https://www.history.org/kids/games/brickmaker.cfm>. Accessed on: 31.05.2019.

Members and Partners produced a Synthesis Report on Water and Sanitation in 2018. On the first page of the Executive Summary for the report, the following situation was described:

> Water-related ecosystems and the environment have always provided natural sites for human settlements and civilizations, bringing benefits such as transportation, natural purification, irrigation, flood protection and habitats for biodiversity. However, population growth, agricultural intensification, urbanization, industrial production and pollution, and climate change are beginning to overwhelm and undermine nature's ability to provide key functions and services. Estimates suggest that if the natural environment continues to be degraded and unsustainable pressures put on global water resources, 45 per cent of the global gross domestic product, 52 per cent of the world's population and 40 per cent of global grain production will be put at risk by 2050. Poor and marginalized populations will be disproportionately affected, further exacerbating rising inequalities. (UN-WATER, 2018a, p. 10)

This Synthesis Report points to several very serious problems which must be overcome in order for the United Nations to be able to analyse progress towards SDG targets – one of them is a lack of comparable data. Less than half of the Member States of the UN have monitoring and reporting systems in place which can generate sufficient data to enable comparisons to be made. Data collection is therefore still a work in progress. UN-Water also produced a brief 2-page summary with some of the most important data from the original report and several highlights from this summary are presented below:

> **Billions of people still lack safe water, sanitation and handwashing facilities:** 844 million lack basic water services, 2.1 billion lack safely managed drinking water, 4.5 billion lack access to safely managed sanitation and 892 million still practice open defecation. Only 27 per cent of the population in least developed countries has access to soap and water for handwashing on premises.
>
> **Water pollution is worsening:** Increasing wastewater in many parts of the world is profoundly affecting the quality and amount of water available to meet human needs and sustain ecosystems.
>
> **Agriculture places enormous stress on water, but could be part of a water-saving solution:** The agriculture sector accounts for nearly 70 per cent of global freshwater withdrawals. […] saving just a fraction of agricultural withdrawals would significantly alleviate water stress in other sectors.
>
> **Ecosystems and their services are in continuous decline:** The world has lost 70 per cent of its natural wetlands over the last century, with profound impacts on economic development and social and environmental stability. (UN-WATER 2018b, p. 1)

Which aspect of this report do students find most shocking? At the time of writing this paragraph, the current world population was already more than 7,7 billion. This means that more than half of the world population do not have access to safe sanitation and

slightly less than a third do not have access to safe drinking water. What actions can be taken in order to promote further progress in this area?

The United Nations SDG Action Awards "recognize individuals, organizations, governments and private sector leaders who are advancing the global movement for the Sustainable Development Goals in the most transformative, impactful and innovative way."[54] The finalists for the 2019 SDG Action Awards illustrate some of the strategies which are being used to promote awareness and more sustainable ways of living around the world. For example, there are finalists who are referred to as 'visualizers'. They create art projects which draw attention to serious global problems in order to highlight the importance of the SDGs in the hope that they can influence policy makers as well as the general public, so that individuals, communities and public leaders will all contribute to a more sustainable global environment. How many students would like to become 'visualizers'? They could search for ideas and images online which inspire them to create a variety of art projects to raise awareness of water-related problems locally and around the globe.

There is also a group of 'storytellers' who demonstrate connections between different sustainability goals as they recount moving human stories from a wide range of diverse cultures. For example, the entry 'The Owners of Water'[55] from Lima, Peru, reveals the inequality in both access and distribution of water within indigenous communities. This project analysed almost half a million water use rights granted in Peru during the last 50 years and tells stories about the conflict over this resource, demonstrating that many authorizations were given to copper extraction companies in the southern regions of Peru without previous studies of impacts on the local indigenous communities, violating their rights which resulted in the loss of communal water resources.

Perhaps non-indigenous communities need to learn about environmental conservation from indigenous communities around the world. For example, the Sahel in North Africa, a climate-based region which stretches from the Atlantic to the Red Sea, with the Sahara desert to the north and the savannah plains to the south, is a semiarid region

[54] UN SDG ACTION AWARDS. **Unveiling the 21 Finalists of the 2019 SDG Action Awards**. Available at: <https://medium.com/@UNSDGAction/unveiling-the-21-finalists-of-the-2019-un-sdg-action-awards-83c7ee5ca9c3?sk=3057c87bb86030fb0e77450cf0201e7d>. Accessed on: 04.06.2021.

[55] UN SDG ACTION AWARDS. '**The Owners of Water**' - a project by Ojo Público. SDG Action Awards Initiative 2019. Available at: <https://sdgactionawards.org/initiative/2326>. Accessed on: 04.06.2021.

with an average rainfall between 12 to 20 inches per year. This region has experienced severe droughts for hundreds of years with at least one megadrought which lasted 250 years, from 1450 to 1700. According to Ickowicz, et al., (2012), many different ethnic groups use a variety of herd, pasture, and water management practices, adapting their production systems and way of life to cope with water scarcity and uncertainty. Cropping systems are used in association with livestock activities in the south while livestock mobility in the north is a strategy which helps nomadic herders to cope with resource uncertainty in space and time. Many of the practices adopted in this region contribute to biodiversity maintenance, water cycle enhancement and carbon sequestration in rangelands where grazing pressure is moderate. The Indigenous Peoples Major Group (IPMG) tells us fascinating stories about sustainable resource management in the Sahel:

> Water is life for the diverse indigenous peoples living in the Sahel region and is at the center of social, cultural, economic, animal and botanical activity. Local indigenous techniques adapted to the local carrying capacity have been used successfully for countless generations to conserve and protect the soil and water. For example, Mossi farmers in Burkina Faso build rock bunds and stone terraces. The Dogan of Mali construct a basin system in the fields, which is effective in conserving rainfall. The Hausa in Niger's Ader Doutchi Maggia use rock bunds and construct small weirs using sticks, grain stalks and earth to divert flood water over their fields. Farmers in the Yatenga region of Burkino Faso use a water harvesting technique called *zay*, which conserves and slows down excess runoff with the use of rock bunds. This system is used to help rehabilitate degraded, barren and crusted soils. (IPMG, 2019, p. 60)

What do students know about these indigenous peoples? How much do they know about *rock bunds,* or the *zay* water harvesting technique? Where can they find reliable information? What do they know about the living conditions of these ethnic groups? What can we learn from their conservation practices? In what ways could these indigenous techniques be adapted to different environments? Many of these ethnic groups have suffered, and still suffer, from lack of water – what can we learn from their stories? Perhaps students could investigate different indigenous groups in the Sahel and tell their stories to local communities? What are some of the stories that students are already familiar with related to water shortage, water pollution, the abuse of water supplies, disasters caused by excess water or the lack of water? How would they like to tell their stories – through song, theatre, puppetry, film, poetry, mime, dance, or in a story circle? How could their stories lead to positive actions, as well as heightened

awareness, to help those who are suffering from lack of clean water or from water-related calamities?

The SDG Action Awards also include a group of 'mobilizers' who make their voices heard in order to promote collective action towards a variety of solutions for each of the SDGs, as well as a group of 'Includers' who make sure that excluded groups are in fact included in discussions and decision-making in their community and at all levels. How could students mobilize their community in favour of global actions towards sustainable water use? Which excluded groups do students empathize with most? Who are the people who suffer most from lack of clean water and sanitation? What can students find out about them and how can these people be helped? In what ways can local and global communities be mobilized to take positive action to solve problems related to water sustainability? In what ways can online communication be used most efficiently to promote effective actions which contribute towards the attainment of the SDG goals?

Another category of the SDG Awards includes the 'creatives', because they use artistic expression to stimulate SDG action and awareness. For example, one of the finalist projects is by Grammy Award winner Ricky Kej, from Bangalore, India, who produced a collection of children's songs called 'My Earth Songs', based on the needs of the planet and the actions that must be taken to ensure a more sustainable planet for their future. The songs are free and were officially launched on World Children's Day in November 2018. One of his songs focuses on the conservation of water and is called 'In the Summer'. It has a simple chorus which is easy for children to remember: "*In the Summer, we all love water, In the Summer there's not a lot, In the Summer, save the water, In the Summer, save every drop*."[56] Another song which emphasizes the incredible diversity to be found in the oceans of the world is called 'In the Water World' where the chorus says: *"There's underwater mountains, underwater caves in the waterworld, There's so many colours, so many creatures in the waterworld."*[57]

Students could form small teams to write a selection of songs to promote a stronger awareness of the need for sustainable actions related to water conservation and use. Then they could give a concert to the local community, or post their songs online to

[56] KEJ, R.; D'CRUZ, D.; PARK, L. **In the Summer**. My Earth Songs: Children's Songs for a Brighter Future. My Earth Songs Email. 5 Apr, 2019. Available at: <https://www.youtube.com/watch?v=qRpmTT_WbTE>. Accessed on: 10.06.2019.
[57] KEJ, R.; D'CRUZ, D.; PARK, L. **In the Waterworld**. My Earth Songs. Available at: <https://www.youtube.com/watch?v=l778nBBJWfU>. Accessed on: 18.06.2019.

reach wider audiences who might be encouraged to take personal as well as collective action in favour of water conservation.

Ricky Kej also performed the concert *BreatheLife*[58] at the United Nations headquarters in Geneva in 2018 for the World Health Organization conference on Global Air Pollution – a fascinating concert, well worth watching and listening to. And I would also highly recommend his music video 'Cauvery – in search of the waters'[59], which tells the story of the River Kaveri or Cauvery in the south of India. The river originates in the foothills of the Western Ghats and flows south and east to empty into the Bay of Bengal through two main outlets, forming one of the most fertile regions in the country. The song is sung in Kannada, one of the many languages of India, and according to *T-Series Kannada*, India's top music label, can be translated as follows:

> The river feeds us without complaining, bathes us in her beauty, provides us with warmth, and soothes our troubled minds with that gentle flow. The waters falling over verdant hillsides and the serene mirror-like surface alike touch a chord in each one of us as she flows on, ever-giving, everlasting!
>
> We worship her and call her 'Mother'. And yet we destroy her, steal from her, and pollute her existence with our greed. We take everything from her; she is the mother we pretend to love.

This video gives us a captivating insight into Indian culture but also emphasizes the key significance of water as an essential resource for life on Earth. The video starts with scenes which emphasize what happens when there is a lack of water, showing extensive images of desert-like soil, it then shifts to forest-covered hills in the rainy season giving birth to many river systems. As the river grows, links are made to agriculture and transport, but strong associations are maintained to the interconnectedness of natural life, with strong, healthy trees, bushes and plants of all kinds growing along the river banks while birds and animals nest, graze and feed by the waterside. Immense waterfalls illustrate the enormous force of water, while slow-moving waters over the plains provide inspiration and spirituality for human contemplation, as well as the mud necessary to produce images and statues to honour the creation and preservation of the universe. As the river reaches urban landscapes, degradation and pollution become more evident, together with the myriad uses of water, and images vary from a lone fisherman on his boat to a massive hydro-electric dam, before the river joins with the sea.

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[58] KEJ, Ricky. **BreatheLife**: One Song. United Nations, Geneva, 2018. Available at: <https://www.youtube.com/watch?v=exO9p1VZ0lI>. Accessed on: 04.06.2021.
[59] KEJ, Ricky. **Cauvery – in search of the waters**. T-Series Kannada, 2 Nov, 2017. Available at: <https://www.youtube.com/watch?v=MyzO9o7gUog>. Accessed on: 04.06.2021.

Which aspects of this video excite students most? How many inspirational videos can students discover, or produce themselves, which link water to the necessity for sustainable management, using high levels of artistic creativity?

Students could select important rivers from different countries around the world and try to find out as much information as possible about issues which inspire them as they make explicit connections to one of the UN Sustainable Development Goals (SDGs). For example, one team might choose to work with the Amazon which originates in the Andes mountains of Peru and passes through Bolivia, Venezuela, Colombia, Ecuador and Brazil on its 4,000 mile long journey to the Atlantic Ocean. The gene pool of the Amazon rainforest has been estimated as containing around two-thirds of known organisms in the world, but due to serious environmental problems caused by continued deforestation throughout the Amazon basin, strong links can be made to SDG 15 - *Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*.

If students select a variety of major rivers around the globe, teams can investigate countless topics related to cultural diversity, the expressive arts, history, geography, science, language, maths and will also become more aware of the interconnectivity between these areas of knowledge. Investigations of this nature can also help them to develop more responsible attitudes towards other people and cultures and stimulate them to promote effective actions both locally and globally.

The last group of finalists for the SDG Action Awards are referred to as the 'Connectors' since they create networks to generate transformational change in favour of the SDGs. For example, a project launched by IBM using Blockchain Technology entitled: 'Tackling Ocean Plastic and Global Poverty' is described as follows:

> IBM played the Connector role in work with The Plastic Bank which mobilizes recycling entrepreneurs from amongst the world's poorest communities to clean up plastic waste in exchange for digital currency which they can use for life-changing goods and services; and advance circular economy – all backed by IBM Blockchain technology. The initiative incentivizes participants (individuals, etc.) to collect plastic waste which would otherwise be discarded due to its lack of value perceived by commercial recyclers. Under this initiative, the flow of discarded plastic to the ocean is interrupted, collectors earn a predictable income, and the plastic returns to commerce as a socially responsible material corporations can purchase to use in their products. […] The initiative piloted in 2014 in Haiti. Today, it has 32 operating locations in Haiti and 27 locations in the

> Philippines, with additional locations being planned to open in Indonesia during 2019. […] This initiative is transforming people's livelihoods by giving them access to decent work and regular source of income while preventing ocean plastic pollution. Since 2014, over 2,000 collectors have returned more than 3 million kilograms of plastic waste to the recycling loop through this platform. Through its technology IBM connects the private sector, communities, government institutions and NGOs to collaborate for a global cause.[60]

This connection between technology, NGOs, government, communities and the private sector is helping some of the world's poorest people to clean up some of the pernicious plastic pollution which is degrading water supplies and oceans all over the world. How clean are local water sources? How effective is plastic recycling in the students' community? What connections need to be made locally in order to improve these areas? To what extent can local collaborative networks contribute to global sustainability issues related to clean water and plastic recycling?

As the project above makes clear, attempts are being made to prevent plastic from reaching the ocean. But unfortunately the ocean is already suffering enormously from plastic pollution as well as pollution from many other sources. The United Nations specifically elected SDG 14 to focus on the sustainable use of the planet's oceans. I have also selected three of the targets which accompany this goal as a basis for discussion.

> **Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development**
>
> 14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
>
> 14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
>
> 14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics. (UNITED NATIONS, 2015, p. 28)

According to the Centre for Biological Diversity, "Plastic accumulating in our oceans and on our beaches has become a global crisis. Billions of pounds of plastic can be found in swirling convergences that make up about 40% of the world's ocean surfaces.

[60] SDG ACTION AWARDS. **Tackling Ocean Plastic and Global Poverty with IBM Blockchain Technology**. Available at: <https://sdgactionawards.org/initiative/1294>. Accessed on: 04.06.2021.

At current rates plastic is expected to outweigh all the fish in the sea by 2050."[61] According to this site, more plastic was produced during the first decade of this century than all of the plastic produced throughout history before the year 2000. The site also mentions the Great Pacific Garbage Patch – between California and Hawaii – which is the largest accumulation of plastic in the world. According to the Ocean Cleanup Foundation, who published an informative video in 2018, entitled 'The Great Pacific Garbage Patch Explained'[62], the Garbage Patch measures 1.6 million km^2 – three times the size of France. It contains 1.8 trillion pieces of plastic, 250 pieces for every human being in the world.

Students could look for more updated information about this Garbage Patch to see if it has expanded even more or whether society has managed to reduce or recycle some of the plastic which has gathered there. What are the most recent technological proposals related to plastic recycling? To what extent has plastic been replaced by more sustainable biodegradable materials? Students could compare plastic waste disposal data over the past 10-20 years to discover whether trends indicate tendencies in the direction of improved sustainability or whether more drastic action needs to be taken as quickly as possible in order to combat even more negative tendencies. Which organizations are working towards ocean sustainability? In what ways can students contribute towards their actions?

The group Ocean Unite was founded in 2015 "to unify and mobilize impactful voices at key moments that matter to drive positive Ocean conservation action."[63] This group "works collaboratively to ensure the Ocean is on a pathway to recovery." They make connections, propose and implement innovative solutions, and help solve some of the most pressing environmental problems by coordinating high impact actions.

The site offers many discussion points in the section 'Key Issues' under general titles such as 'Healthy Ocean, Healthy Climate'; 'Marine Reserves'; 'The High Seas'; 'Overfishing'; as well as 'Ocean SDG' and 'Marine Plastic Pollution'. The introductory

[61] CENTER FOR BIOLOGICAL DIVERSITY. **Ocean Plastics Pollution**: A global tragedy for our oceans and sea life. Available at: <https://www.biologicaldiversity.org/campaigns/ocean_plastics/>. Accessed on: 04.06.2021.
[62] OCEAN CLEANUP. **The Great Pacific Garbage Patch Explained**. Available at: <https://www.youtube.com/watch?v=0EyaTqezSzs>. Accessed on: 04.06.2021.
[63] OCEAN UNITE. Available at: < https://www.oceanunite.org/about/>. Accessed on: 04.06.2021.

paragraph which presents the topic Marine Plastic Pollution, emphasizes the following problems:

> We are turning our beautiful Ocean into a plastic soup. About 8 million tonnes of plastic enters the sea every year, and at this rate we face a future with more plastic in the Ocean than fish by 2050. Our plastic addiction and waste mismanagement is condemning countless marine birds and animals to death by entanglement or poisoning, and even leading to chemical contamination of the fish we eat. The vast swirls of plastic rubbish visible on the sea surface – horrifying as they are – represent just the tip of the iceberg. What lies beneath are the masses of microbeads and broken-down particles of plastic that are easily ingested by sea creatures, and impossible to remove. The urgently needed solution calls for a combination of enhanced awareness, reduced plastic use, and massively improved waste management. The most effective way to have less plastic in the Ocean is to use less plastic in the first place. (OCEAN UNITE[64], 2018, online)

What do students think about the information presented by Ocean Unite? How can they promote the reduction of plastic use in their family, their community and around the world? How effective is plastic recycling within their family and their local community? Can any of the local recycling practices be expanded or adapted to benefit other communities around the world? Perhaps the local community could form partnerships with other communities – both far and near – to share their problems, ideas and proposed solution strategies?

On the same page, Ocean Unite offers many talking points, together with references and consequences, on topics such as the following: Americans use 500 million plastic straws every single day; plastic material does not biodegrade, but breaks down into tiny particles which can be eaten by small marine animals and enter the food chain; microplastics from synthetic fabrics washed in washing machines are the most common form of microplastic in the Ocean; the plastic debris floating on the surface accounts for only 5% of all plastic trash dumped into the sea; and many others. Which topics interest the students most? Perhaps they could promote community debates on specific topics and create theatrical presentations, musicals, storyboards, posters and films to convince the community that urgent action needs to be taken to reduce the plastic pollution of the world's oceans.

The site also discusses what needs to be done in order to solve these problems, starting, of course, with each individual assuming responsibility for limiting personal plastic use

[64] OCEAN UNITE. Marine Plastic Pollution. **Key Issues**. Available at: <http://oceanunite.wpengine.com/issues/marine-plastic-pollution/>. Accessed on: 16.06.2019.

and recycling whenever possible. They also emphasize that "We must transition away from a linear (make, use, dispose) economy towards a circular economy where resources, such as plastics, are used, recovered and reused over and over again, instead of heading directly to the landfill or the Ocean." (Ibid, 2018, online)

Ocean Unite also has a resources page which offers many recent articles from a variety of sources as well as a number of fascinating videos. One of the videos is a 1 min. video by Richard Branson, about why 'The Ocean is Everybody's Business'[65], where we discover that 50% of the Earth's oxygen is produced by the oceans, that the ocean is home to more than 80% of life on the planet, and absorbs more than 25% of all CO2 emissions. It also provides the livelihood for more than 3 billion people around the world – almost half of the present world population – bringing us back to the SDG targets 14.2 and 14.4 which point to the necessity of regulating and managing overfishing, destructive fishing and illegal fishing in order to restore fish stocks and re-establish a healthy ocean environment which is able to produce a sustainable yield.

In the previous section, when discussing soil, we already made the point that sustainable practices are often exemplified by indigenous peoples around the world and also that many successful partnerships are being consolidated between indigenous groups and scientific organizations working towards sustainable environmental management. The Indigenous Peoples Major Group (IPMG) gives the following example related to the ocean:

> The most effective approach to environmental management is a combination of customary practices and traditional knowledge with scientific methods of assessment and monitoring of environmental sustainability. This has proven to yield successful results, for example in the village of Ucunivanua in Venata, Fiji. After implementing scientific monitoring of fish and bivalves in the village coastal area and adjusting harvesting when counts were low, the women who are the gatherers of the bivalves are able to collect twice as many oysters in the same amount of time, compared to before the monitoring began. This demonstrable benefit has ensured that the environmental monitoring program continues. (IPMG, 2019, p. 67)

Have students ever harvested bivalves? And did they prepare and eat their catch? How many different bivalves have they eaten? Are students aware that the Natural History

[65] BRANSON, Richard. Why the Ocean is Everybody's Business. **Ocean Unite**. Available at: <https://www.youtube.com/watch?v=FhWT2xylTos>. Accessed on: 04.06.2021.

Museum of Wales[66] has registered 380 different species of bivalves which can be found in British waters to a depth of 5000m? Which do they prefer – scallops, oysters, mussels, razorfish, cockles? What are their favourite bivalve recipes? What do they do with the shells after eating the contents? The shells are made from 95-99% calcium carbonate which is mined from limestone as one of the most heavily exploited minerals on the planet, used for example to produce cement or to whiten paper. Surely these shells could be valued and used as part of a more sustainable circular economy? For example, according to Morris (2019, online), shell powder can be used as a source of calcium supplement for livestock and for poultry, as well as a liming agent in agriculture to reduce soil acidity and improve fertility levels. It also has potential as an environmentally friendly ingredient for road grit which could be used for de-icing road surfaces or as part of a biofilter drainage layer for green roofing structures which would contribute towards the neutralisation of acid rain. However, the best use for waste bivalve shells may actually be to return them to their natural environment in order to restore overfished and declining shellfish reefs, by creating suitable settlements for larvae. Which shellfish related topics arouse the students' curiosity and how can they find out more? What actions can be taken locally to improve the global situation of shellfish consumption?

What else can be done to protect and restore marine and coastal ecosystems as well as to control overfishing, illegal and destructive fishing? The Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) published an article on their site entitled 'A brief history of indigenous fishing', which starts off with the following words:

> For Aboriginal and Torres Strait Islander peoples, fishing is as natural and as necessary as breathing. It forms part of the deep cultural and spiritual connection many communities have with their waters and marine resources, whether saltwater or freshwater. Fishing is a matter of cultural practice, and is informed by traditional knowledge. (AIATSIS, ac 2017, online)

Unfortunately their traditions have been challenged over the years and many communities have been denied access to their traditional waters, but they have recently been taking steps to negotiate their rights by making sure that their voices and values are being included in water management planning where possible. In July 2015

[66] NATURAL HISTORY MUSEUM – WALES. **Marine Bivalve Shells of the British Isles**. Available at: <https://naturalhistory.museumwales.ac.uk/britishbivalves/>. Accessed on: 17.06.2019.

AIATSIS carried out a collaborative project on Indigenous values in fisheries in northeast Arnhem Land, the South Coast of New South Wales and the Far West Coast of South Australia to document the cultural and socio-economic value of Indigenous customary fishing in the belief that:

> An increased understanding of the values Aboriginal and Torres Strait Islander people place on customary fishing will ensure that policy-makers involved in fisheries management planning are able to better appreciate why these values should be taken into account when negotiating catch allocations and access to waters. It will also increase the likelihood of collaborative – not combative – approaches to fisheries research and management of aquatic resources. (AIATSIS, ac. 2017, online)

Despite the variety of cultural, social and economic contexts of each region investigated, the project was able to identify several strongly held values which were common to all communities involved: fishing is a central part of people's lives and cultures; it is one of the main ways of passing knowledge and culture to future generations; it helps maintain people's connection to their country; it allows people with low incomes to provide their family with a healthy diet; it is rarely done alone and is therefore an important bonding activity for family and community; fishing implies sharing your catch, which can provide a safety net for vulnerable community members; and also only taking what you need and preserving resources for future generations (Ibid., online). The AIATSIS article includes a poignant example which should encourage readers to respect the values held by different cultures:

> Sue Haseldine [a *Kookatha/Mirning woman*] wants to start a cultural eco-tourism business which would teach people respect for the land and the sea. These programs would not only provide employment, they would provide new opportunities for Aboriginal people to explain to outsiders the sacredness of their connection to sea country and the importance of respecting the cultural rules of fishing.
>
> She says: *"Fishing is actually sacred to us; it's really part of our culture. So if people want to go fishing and if they want to do it our way, then they'll learn the sacredness. You never take more than you need, for a start."*
>
> This rule is widespread, and often accompanies two others: don't take undersized or pregnant fish and don't overfish. When fish are allowed to breed and grow, their populations are both sustainable and can sustain a community when taken at the right time. (AIATSIS, ac. 2017, online)

According to the Food and Agriculture Organization (2018b, p. xiii), "Nature-based tourism is growing three times faster than the tourism industry as a whole and now accounts for approximately 20% of the global market." So Sue Haseldine seems to be making excellent plans for the future. However, future plans related to tourism may

have to take into consideration the possibilities of pandemics similar to the COVID19 pandemic of 2019-21. What do students think about these indigenous cultural values and plans for the future? How could they be adopted or adapted during a pandemic situation? Which values can be applied to their own community? Which values need to be developed more strongly in their local community and around the world and how might students motivate global communities to develop these important sustainable principles and codes of behaviour? How much do they know about different indigenous cultures in Australia and the Torres Strait Islands? Do they know that the Aboriginal Peoples of Australia have been living there for 50,000 years and are one of the oldest living populations in the world? Are they familiar with their history, their art work, their music, their stories and songs? How much do they know about the different kinds of environment which they inhabit? What else would they like to discover about these fascinating cultures?

As students explore the applicability of indigenous value systems, perhaps they will develop a sense of the fundamental importance of water for life systems on Earth. Water is the major component of the human body, the water cycle reminds us of the cycle of life and the life cycle of all our creations and products. Water stabilizes temperatures around the globe, it cushions earthquakes and softens the soil, it is used to transport nutrients and wastes, plant sap, as well as electrical charges in the brain through blood circulation. Water provides a home for more life forms than live on land and most forms of life are wholly dependent on it for survival. (HORSPOOL, 2018, online)

As we become more conscious of the myriad roles that water plays in our lives, we may develop a more profound respect for water in general which will help us to become aware of the absolute necessity to conserve this precious resource which is crucial for the survival of innumerable forms of life on the planet.

Air

In the preface to the report 'Ambient air pollution: a global assessment of exposure and burden of disease', published by the World Health Organization (WHO) in 2016, Dr. Maria Nara[67], makes the following statements:

[67] Director of Public Health, Environmental and Social Determinants of Health for the World Health Organization at this time.

> To date, air pollution – both ambient (outdoor) and household (indoor) – is the biggest environmental risk to health, carrying responsibility for about one in every nine deaths annually. Ambient (outdoor) air pollution alone kills around 3 million people each year, mainly from noncommunicable diseases. Only one person in ten lives in a city that complies with the WHO *Air quality guidelines*. Air pollution continues to rise at an alarming rate, and affects economies and people's quality of life; it is a public health emergency. […]
>
> Air pollution has also been identified as a global health priority in the sustainable development agenda. WHO has responsibility for stewarding three air pollution-related indicators for monitoring progress against the Sustainable Development Goals (SDGs): in health (Goal 3), in cities (Goal 11) and in energy (Goal 7). (WHO, 2016, p. 11)

This WHO report limited their analysis specifically to the effects of ambient (outdoor) air pollution from particulate matter (PM) which refers to a mixture of solid particles and liquid droplets found in the air: PM_{10} refers to particles smaller than 10 micrometres which can be inhaled and $PM_{2.5}$ to particles smaller than 2.5 micrometres. As a size reference, a single human hair measures around 70 micrometres in diameter.[68]

The non-communicable diseases caused by outdoor pollution mentioned above include acute respiratory infections, lung cancer, chronic pulmonary diseases, stroke and ischaemic heart disease. However, the report also registers a total of 85 million people living with disabilities, or disability-adjusted life years (DALYs), caused by particulate matter air pollution. (WHO, 2016, p. 47) The report points to the lack of comparable data in many countries and emphasizes the fact that several other diseases are associated with air pollution but were not included in this particular assessment, nor did the report analyse the effects of other air pollutants. Nevertheless, given the limitations of the WHO report, it is clearly the case that air pollution is a serious global problem which needs to be addressed in order to guarantee healthier living conditions in the future, since "about 90% of people breathe air that does not comply with the WHO Air Quality Guidelines." (Ibid., p. 49) The final recommendation highlighted by the report is the necessity to strengthen the capacities of cities to monitor their air quality using standardized methods, reliable and good quality instrumentation, and sustainable structures since, without comparable data, the proposal of effective solutions becomes extremely complex.

Although the United Nations did not identify an explicit SDG exclusively related to air pollution, several of the SDGs have strong connections to the overall goal of improving

[68] EPA (US Environmental Protection Agency). **Particulate Matter (PM) Basics**. Available at: <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>. Accessed on: 04.06.2021.

air quality around the world. The three sustainable development goals referred to by Nara are specified below, together with one of their targets, to facilitate discussion:

> **Goal 3. Ensure healthy lives and promote well-being for all at all ages:** Target 3.9 – By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination (UNITED NATIONS 2015, p. 20)
>
> **Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all:** Target 7.a – By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology. (Ibid., p. 23)
>
> **Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable:** Target 11.6 – By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management. (Ibid., p. 26)

What do students know about their local levels of air pollution? Do they know how it is being measured and which air pollutants are being measured? As I was writing this section, I explored the site *Air Quality in Scotland* which provides an interactive map with specific information about current air pollution levels for different places, with level 1 as the lowest level possible, indicating very clean air, and level 10 as the most highly polluted air.[69] The town of Dumfries, near Lockerbie where I was born and raised, was classified as low level 1, whereas Eskdalemuir, also close to my home town, was again classified as low, with level 1 for nitrogen dioxide levels, but level 3 for ozone levels. I then checked Edinburgh, which registered as low level 1 in Musselburgh, but low level 2 in Leith specifically for particulate matter, while nitrogen dioxide was low level 1. The highest level registered on the whole map of Scotland was low level 3 for Fort William, where ozone was registered as level 3 but nitrogen dioxide as low level 1. These figures indicate a very positive result for Scotland during June 2019.

What do students know about ozone? When found in the upper atmosphere or stratosphere, it is considered to be 'good' ozone because it protects the Earth's surface from dangerous ultraviolet light. But when it is found in the lowest layer of the atmosphere it is usually man-made and can be the result of air pollution from

[69] AIR QUALITY SCOTLAND. **Latest pollution map.** All data cited was last updated on 20.06.2019. Available at: <http://www.scottishairquality.scot/latest/> Accessed on: 04.06.2021.

combustion engines or power plants, automobile exhaust and industrial emissions.[70] We may therefore think it strange to find slightly higher levels in Eskdalemuir and Fort William which both registered a maximum of low level 2 ozone in one or two locations compared to Edinburgh and Glasgow, which registered low level 1 overall. Eskdalemuir has a population of 265 (2001) and is surrounded by forestry plantations and moorlands used for sheep grazing, whereas Fort William has a population of almost 10,500 (2011), the second largest settlement in the Highlands, and is located along the shore of Loch Linnhe, with the famous Glen Coe to the south and Ben Nevis to the east. So, neither of these locations is densely urban, although Fort William does attract a considerable number of tourists, who bring their exhaust fumes with them. However, we need to remember that ozone pollution produced in urban areas can be carried by prevailing winds to rural areas, so it might be difficult to work out possible sources. What are the probable causes for the small increase of ozone in the places mentioned above? To what extent do ozone levels change during the course of a day, or during a monthly or annual cycle? What other topics related to air pollution would students have fun investigating?

How do the ozone measurements for Scotland mentioned above compare with contemporary measurements of the same places and how do they compare with data from different countries? Students must remember that even if their national levels of air pollution are relatively low, the winds of the world do not recognize political borders. Therefore, as air pollution builds up in neighbouring countries, and often faraway countries, accumulated pollutants will be dispersed and blown far and wide, affecting others who have managed to maintain low levels locally or even nationally. Air pollution is truly a global problem, as is marine pollution, and solutions require global collaboration. What can students do to reduce air pollution in countries that are suffering more strongly from this problem? Perhaps they could join up with schools in countries which are more profoundly affected by air pollution and work together with their partners to boost awareness campaigns and assorted positive actions which would help mitigate some of the challenges they face.

[70] FREUDENRICH, Craig. How Ozone Pollution Works. How Stuff Works – Green Science. Available at: <https://science.howstuffworks.com/environmental/green-science/ozone-pollution.htm>. Accessed on: 04.06,2021.

What are the main sources of air pollution around the world? According to the US Environmental Protection Agency[71], carbon dioxide emissions from fossil fuels and industrial processes accounted for 65% of global greenhouse gas (GHG) emissions in 2010, while another 11% of carbon dioxide emissions were produced by deforestation, land clearing and soil degradation. Methane, produced by agricultural activities, waste management, energy use and biomass burning, accounted for 16% of the total. Nitrous oxide, produced by agricultural activities such as fertilizer use represented 6%, and fluorinated gases, such as HFCs, involved in industrial processes, refrigeration, as well as a variety of consumer products, accounted for the remaining 2%. Since we have already examined some of the environmental problems caused by transport in previous chapters, we will focus on other sources of air pollution in the present chapter.

The Climate and Clean Air Coalition (CCAC), which works in partnership with the World Health Organization and the United Nations Environment Programme, included several possible solutions for air pollution mitigation in their Annual Report for 2017-2018. "The Climate and Clean Air Coalition is a voluntary partnership of governments, intergovernmental organizations, businesses, scientific institutions and civil society organizations working across the world to deliver rapid and multiple benefits for air quality and the climate." (CCAC, 2018, p. 6) One of the 'key impacts on the ground' included in the report informs us that more than 4,300 brick-making kilns were improved in Bangladesh, Brazil, Columbia, India, Mexico, Nepal, Pakistan and Peru. "New kiln technologies increased net income by $11.32 million and reduced black carbon emissions in Brazil, Columbia, Mexico and Peru." (Ibid., p. 11)

What do students know about traditional brick-making kilns? What are the main differences between traditional kilns and the recently improved zig-zag kilns? What are the latest contemporary solutions? What do they know about the history of brickmaking in general? The site *BrickArchitecture* has a historical section which affirms that "Man has used brick for building purposes for thousands of years. Bricks date back to 7000 BC, which makes them one of the oldest known building materials. They were discovered in southern Turkey at the site of an ancient settlement near the city of

[71] EPA (Environmental Protection Agency). **Global Greenhouse Gas Emissions Data**. IPCC 2014. Available at: <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data#Sector>. Accessed on: 04.06.2021.

Jericho."[72] *BrickArchitecture* also tells us that the first bricks were made in places with a warm climate so that mud bricks could be dried in the sun, then with the invention of kilns around 3,500 BC, bricks could be made in cooler climates. The Romans preferred to make their bricks in the spring and used them to build walls, forts, aqueducts and other public and private buildings throughout the Roman Empire. Moses Jenkins, writing about traditional Scottish brickwork, affirms that brickwork died out in Scotland after the Roman occupation and only started up again during the 17th century, becoming increasingly important during the Industrial Revolution.

> Until the mid-19th century all bricks produced in Scotland would have been moulded by hand and fired in small, intermittent kilns which could hold around 30,000 bricks. Traditional brick making by hand was a seasonal occupation: autumn was for excavating the clay; the winter frost was utilised to help break up the raw material; spring through to summer saw brick moulding, drying and firing. The clay for manufacturing these bricks came from fairly shallow surface deposits. Such small scale production allowed regular firings of special batches, giving the capacity to produce tiles as well as bricks, something which was economically beneficial to rural brickworks in particular. Temperatures in these kilns could also be controlled with great accuracy. For this reason these small intermittent kilns continued to be used up until the end of the 20th century. (JENKINS, 2014, p. 4)

How does Scottish brickmaking compare with brickmaking in other parts of the world? What do students know about the science, maths, economics, history, geography or cultural aspects of brickmaking? The site *brickarchitechture* has a section which offers a multitude of modern architectural project designs from around the world as well as a section with inspirational images of older buildings and structures made of bricks, such as the Fortress Ark, Silk Road, Bukhara, Uzbekistan in Asia; an old aqueduct named El Puente del Aguila in Nerja, Andalusia, Spain; the house of Nicolas Copernicus in Torun, Poland; details from the Pomposa Abbey in Codigoro, Emilia Romagna, Italy; and the dome of an ancient mosque in Shiraz, Iran, amongst many others.

Students could form teams around a favourite image of a brick construction and try to discover as much as they can about the techniques used to produce the building, the size of the building, the number of bricks that were used, how the bricks were made, the means of transport involved, the environmental effects of the construction process, the geographical aspects of the area, health issues related to the construction process, the social structure of the local population, their belief systems, the purpose of the building

[72] BRICKARCHITECTURE. **The History of Bricks and Brickmaking**. Available at: <https://brickarchitecture.com/about-brick/why-brick/the-history-of-bricks-brickmaking>. Accessed on: 04.06.2021.

at the time of construction and whether it was repurposed in later years, the cultural impacts of the building, as well as any other ramifications of their research. They could reproduce the building as a 3D model using recycled materials, adding their own ideas to improve the environmental repercussions. What other suggestions do students have?

Another key impact story presented by the CCAC Report, which illustrated positive actions towards the reduction of air pollution, describes a demonstration project which was adopted by a supermarket chain in Chile. It was so successful that 6 more chains joined the same project, "adopting transcritical CO2 technology as an alternative to HFCs. The new technology emits about 6,000 times less CO2 over its lifetime." (CCAC, 2018, p. 12) This was an extremely important step for Chile since CCAC had previously discovered that, according to their HFC inventory, Chile's commercial refrigeration sector was the country's largest source of HFC emissions. (Ibid, p. 34) What do students know about HFCs and the merits of CO2 technology? The Environmental Investigation Agency (EIA) informs us that "CO2 is a natural, energy-efficient climate-friendly refrigerant with a global warming potential of 1." Whereas,

> HFCs or hydrofluorocarbons, are super greenhouse gases, manufactured for use in refrigeration, air conditioning, foam blowing, aerosols, fire protection and solvents. HFCs unlike most other greenhouse gases are not waste products but are intentionally produced. HFCs were developed as alternatives to ozone depleting substances that are being phased-out under the Montreal Protocol. Unfortunately, HFCs have a global warming potential 1000 to 3000 times that of CO2, and their use has increased from almost nothing in 1990 to 1,100 million tonnes of CO2e in 2010. […] If left unchecked, these emissions will increase to 7-19% of all greenhouse gas emissions by 2050 and off-set most if not all mitigation actions pledged by countries to date. (EIA, online)

Where can HFCs be found in students' lives? Probably in their refrigerators and freezers; in air conditioning appliances in their homes and vehicles; in aerosol propellants used for personal care products such as deodorants, antiperspirants, hair mousse, or household products such as insecticides, textile/fabric care or air fresheners; as well as in medical applications. So, perhaps family members can look for more eco-friendly options for products which contain HFCs, especially when they are renewing refrigeration appliances or vehicles.

One other less familiar cause of air pollution mentioned in the CCAC report is the production of methane during traditional rice farming in Asia. Traditionally, rice paddies are kept continuously flooded. Because of this, "the warm waterlogged soil provides ideal conditions for microbes that produce methane as they breakdown and

decay any flooded organic matter. Rice cultivation is responsible for 10% of all agricultural greenhouse gas emissions globally." (CCAC, 2018, p. 9) However, the International Rice Research Institute (IRRI) has been implementing a CCAC Agriculture Initiative since 2014 to help reduce greenhouse gas emissions from rice production.

> In Viet Nam and Bangladesh IRRI introduced Alternate Wetting and Drying (AWD) rice cultivation as an effective alternative to traditional paddy rice farming. This planting method has the potential to reduce paddy rice emissions by half. Instead of keeping their fields continuously flooded, farmers drain rice paddies two to three times during the growing season. This limits the amount of methane that is produced, does not compromise yield, and saves money for farmers, as it requires a third less water. (CCAC, 2018, p. 9)

Nevertheless, despite the fact that positive changes are taking place in different parts of the world, the steady growth of population and industry means that "Despite successes, global methane emissions are expected to rise by more than 35% (from 2000 levels) by 2030 with 90% of total man-made emissions coming from three sectors, agriculture (40%), oil, gas and coal (35%) and waste (20%)." (Ibid., p. 17) This signifies that sustainable practices must be drastically intensified worldwide if we hope to reach the sustainability goals defined by the United Nations.

How can students discover more information about local levels of methane emission? In the UK, the main man-made source is from rotting rubbish in landfills, although a considerable amount is also produced through agricultural practices involving livestock, especially from manure management. What do students need to know in order to promote effective actions which will result in lowering the local levels of methane production? How many local farms breed cows, pigs, sheep or poultry? How do they manage the manure produced by their livestock? In what ways could current practices be improved in order to reduce the emission of methane? What do students need to know in order to analyse the effectiveness of suggested improvements? What actions could be taken in order to promote positive changes and how can students monitor the progress being made?

If students are already aware that food decomposition is the main source of methane in landfills, then one of the most effective actions is simply to reduce individual, family, school and community food waste, so that less organic material is sent to landfills in the first place. When students invest in effective local actions, they can write about them

and illustrate their stories using the expressive arts in a variety of ways then communicate their results to global communities online. What other actions can students think of which would contribute towards healthier air quality?

The *BreatheLife* network includes representatives from the World Health Organization, the United Nations Environment Programme, the Climate and Clean Air Coalition, as well as the World Bank, and its purpose is to "combine public health and climate change expertise with guidance on implementing solutions to air pollution in support of global development goals."[73] Their principal strategies for implementing change are as follows:

> **Connect cities:** Provide a platform for cities to share best practices and demonstrate progress in their journey to meeting WHO air quality targets by 2030.
>
> **Increase monitoring:** Work with municipalities to expand monitoring efforts that can keep citizens informed and facilitate more sustainable urban development.
>
> **Accelerate solutions**: Build demand for new solutions that are working and support municipalities in effectively implementing them in their own cities.
>
> **Empower individuals**: Educate people about the burden air pollution poses to our health and our climate and provide meaningful ways to take action both locally and globally. (BREATHELIFE, online)

Clearly the four Cs mentioned in earlier chapters must be activated in order for the above strategies to become effective: Communication, Collaboration, Critical Thinking and Creativity. Communication is indispensable if cities are to be connected to promote efficient collaboration, and critical thinking is necessary in order to analyse available data so that creative solutions can be generated through multiple forms of collaboration. Some of the individual actions suggested by the *BreatheLife* campaign are listed below:

> **Manage waste:** Minimize emissions from your waste – compost food and garden items, recycle non-organic trash if available, reuse grocery bags and dispose of remaining trash by local collection. Never burn trash as this contributes directly to air pollution.
>
> **Cook and heat clean:** Check efficiency ratings for home heating systems and cookstoves to use models that save money and protect health.
>
> **Move mindfully:** Use public transportation, cycling or walking to get around. Consider low or no emission vehicles if a car is necessary.
>
> **Conserve energy:** Turn off lights and electronics not in use. […] Rooftop thermal solar systems may be an option for many to generate hot water affordably and photovoltaic systems can be a clean and healthy source of power.

[73] BREATHELIFE. **About Our Global Campaign**. Available at: < https://breathelife2030.org/about/>. Accessed on: 04.06.2021.

> **Call for change:** Call on local leaders to adopt national air quality standards that meet WHO guidelines. Support policies that strengthen emissions standards and provide incentives for purchase of cleaner vehicles, low-energy appliances and energy-efficient housing. (BREATHELIFE, online)[74]

What other proposals can students come up with to motivate people to change their lifestyle in order to reduce air pollution and appreciate clean air? If students are asked to brainstorm the word 'air', what do they come up with? Wind – clouds – rainbows – planes – kites – wind power – windmills – wind instruments – music – sounds – communication – songs – birds – bees …, etc., etc. Air is an essential element for an enormous percentage of life on earth as well as for all of the activities we undertake throughout the day. Students could make a list of their most recent activities and try to make connections with the air that surrounds us.

How often have students flown kites or model aeroplanes and have they made these kites or planes themselves? How often have they seen anyone paragliding, hang gliding, or hot air ballooning? To what extent do they understand the science involved in these activities? How many students have watched the film 'The Boy who Harnessed the Wind'[75]? It tells the extremely moving story of a young schoolboy in Malawi who manages to save his community from drought by building a makeshift windmill from components rescued from the local junkyard to power an electric water-pump. How many air-related projects would students be able to produce from local waste? Perhaps they could hold an arts-based science fair to raise local awareness of the importance of clean air around the globe?

What are some of the students' air-related hobbies? How many students are interested in bird watching? How many different bird songs can they recognize or reproduce? Do they know that if they slow down some of the birdsongs produced by small birds, which sound like a series of 'chirrups', they will be able to hear a more melodious version of the same song? Do they understand why this happens? Have they observed the different flight patterns of various species? To what extent are they able to associate the mechanics of bird flight with the variations in wing structure? Do they know that bird flight is one of the most complex forms of locomotion in the animal kingdom? How many different birds have they watched while they take off, hover, defend their nest,

[74] BREATHELIFE. **Actions for Individuals**. Available at: <https://breathelife2030.org/solutions/actions-for-individuals/>. Accessed on: 04.06.2021.
[75] 'The Boy who Harnessed the Wind', written and directed by Chiwetel Ejiofor in 2019.

pick up food, and land? How many different wing shapes are students able to draw? Have they seen any groups of birds flying in a coordinated formation? In what ways do the flight formations relate to successful aerodynamic principles?

What are the aerodynamic principles involved in our own breathing? Apart from requiring air to breathe in order to do anything at all, how does our breathing change when we are eating, swimming, chasing a ball or when we are sitting in a vehicle or riding a bicycle? Why do these changes occur and what is happening to our bodies and our air supply during diverse activities? How does communication change when we speak normally compared to when we try to speak underwater or when we use the air we have breathed in from a balloon? How can we explain these changes? When we tell secrets to our friends, shout in anger, or sing our favourite song, we are using the air in different ways, just as air is being used in specific ways when we play a variety of musical instruments. Students could compare instruments from unrelated cultures and discover more about the contribution of the air to the sounds produced. For example, if students listen to the Scottish bagpipes, the Aboriginal didgeridoo or the Chinese sheng instrument, how would they describe the characteristics they have in common, and how would they describe the characteristics which make them unique? Which wind instruments from around the world fascinate students enough to motivate them to find out more about their origins and the cultures who play them? What emotions do they experience as they listen to a variety of instruments from disparate cultures? Which instruments and music styles stimulate feelings of empathy with cultures we know very little about? Why might this happen? What do world cultures have in common and how can we join together to protect the planet which provides us with life?

Current levels of air pollution are essentially caused by increasing urbanization and industrialization. Historically, the burning of solid fuels in the household for eating and cooking purposes was a common ancient practice when the world population was very small. In modern times, however, the monumental growth in world population, combined with accelerated industrial expansion around the globe, has multiplied the negative effects of air pollution intensely and the highest levels of air pollution are found in large cities around the globe:

> Although cities cover less than 3% of the global terrestrial surface, they account for 78% of carbon emissions, 60% of residential water use and 76% of wood used for industrial purposes (Grim *et al*., 2008). In 2016 over 54%

> of the world population lived in cities, a figure which is expected to rise to 60% by 2030 (FAO, 2018, p.39).

Interestingly, the FAO report 'The State of the World's Forests' quoted above, points out that urban forests and trees can provide many sociocultural and environmental benefits, including the maintenance of local biodiversity conservation and natural eco-systems.

> Urban forests and trees can contribute to the protection of cities' local cultural and natural heritage by enhancing communities' sense of place, providing settings for recreational and physical activities, increasing aesthetic appreciation of the surrounding environment, inspiring artistic expression, and fostering local tourism. Urban forests and trees also have a religious value in some cultures. (Ibid. p. 42)

Students might be interested to check out the online site *Treepedia*, maintained by the World Economic Forum (WEF) in partnership with MIT's Senseable Lab, which offers interactive maps showing the density of greenery in cities around the world, focusing on street view images and not including parks. In an article by Leanna Garfield, published by the WEF in 2018, we can discover which cities had the most street trees at that time. Top of the list was Tampa, Florida, with 36,1% canopy coverage, then Singapore with 29,3%, Oslo, with 28.8%, then Vancouver and Sidney, both with 25,9%. How many cities have been included in this list at the present time? What other information is available on the site *Treepedia?* What kinds of information would students like to see on this site and why? Where can they find the information that is lacking and what do they intend to do with it? In what ways can information stimulate positive environmental changes? What do students enjoy most about urban green spaces? What could be done to increase the canopy cover of local cities and towns?

One interesting topic explored by FAO was to analyse the contribution of trees, forests, gardens, parks and human-nature relationships to urban UNESCO World Heritage Sites (WHS). They analysed WHS selection criteria, site descriptions and management information and discovered that natural elements were in fact valued and were often considered to be one of the key components of the site.

> As examples, tree cover was assessed at three urban World Heritage Sites (WHS): Carlton Gardens in Australia, the Historic Centre of Olinda in Brazil, and Caserta Palace, Italy. Tree cover was found to be 65% at Carlton Gardens and 63% at the Royal Palace of Caserta. In its description of the site, UNESCO states that the monumental Caserta complex is "exceptional for the way in which it brings together a magnificent palace with its park and

> gardens, as well as natural woodland". Meanwhile, in the Historic Centre of Olinda, Brazil, tree cover was almost 70% (FAO, 2018, p.42)

Have students visited any World Heritage Sites? In 2019 there were six of them in Scotland: The Roman Antonine Wall; the Heart of Neolithic Orkney, including Skara Brae, the Stones of Stenness and the Ring of Brodgar; New Lanark, a restored 18th century cotton mill village on the River Clyde; the Forth Bridge which links Edinburgh and the Lothians to Fife and the Highlands; the medieval Old Town and the 18th century New Town of Edinburgh; the St. Kilda islands and sea stacks which host the largest colony of seabirds in Europe, unique sheep populations and remains of 4,000 years of human habitation. What impressed students most about any of the Heritage sites they visited? How did they respond to the natural elements of the sites? What connections did they make between the natural elements and the man-made elements? To what extent did the man-made elements affect the natural elements at the time of their constructions? How have these relationships changed over time?

Nature Conservancy (NC) is a global environmental non-profit organization working in more than 72 countries across 6 continents to create a world where people and nature can thrive. Their mission is to "conserve the land and waters on which all life depends. Our vision is a world where the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfil our needs and enrich our lives."[76] Since environmental predictions believe that we are entering the urban era and that by 2050 the vast majority of humanity will be living in cities, Nature Conservancy decided to conduct a global survey of 245 cities around the world to discover whether nature could contribute to a healthier urban environment. They released their report in 2016 with the title 'Planting Healthy Air: a global analysis of the role of urban trees in addressing particulate matter pollution and extreme heat.' They explain their reasoning as follows:

> Cities globally face many environmental challenges, from protecting their drinking water supply to managing their wastewater to building enough parks and street trees to satisfy the needs of their residents. Some of these challenges are idiosyncratic, and some are universal challenges facing all cities. One of the biggest challenges facing cities globally is keeping their air healthy. (NATURE CONSERVANCY, 2016, p. 9)

Since the most damaging pollutant in most cities at the present time is particulate matter (PM), and since energy production and consumption will increase with a growing

[76] NATURE CONSERVANCY. **Who we are**. Available at: < https://www.nature.org/en-us/about-us/who-we-are/>. Accessed on: 04.06.2021.

population, Nature Conservancy elected PM pollution as their focus. They also decided to investigate the effects of rising temperatures in urban environments due to the recent increase in heat waves, droughts and wildfires around the globe, all of which can contribute to increased levels of PM pollution as well as negative impacts on human health, as reported by the WHO report discussed earlier in this section. Nature Conservancy explain the strategies they adopted:

> We collected geospatial information on forest and land cover, $PM_{2.5}$ pollutant concentration, and population density for 245 cities, and then used established relationships in the literature to estimate the scope of current and future trees to make urban air healthier. These 245 cities currently house around 910 million people, or about a quarter of the world's urban population. (NC, 2016, p. 30)
>
> Increasingly, cities are beginning to recognize that nature can be part of the solution to problems of air pollution and excess heat. […] Nature benefits urban dwellers in many ways, and these benefits are often called *ecosystem services* - the components of nature, directly enjoyed, consumed, or used to yield human well-being. (Ibid., p. 21)

Although the Nature Conservancy study focused on the planting of trees as a strategy to reduce heat and air pollution, there are many more benefits to be gained through associated ecosystem services, such as: aesthetic benefits, recreation, physical and mental health benefits, spiritual value and sense of place, noise reduction, biodiversity, erosion prevention, storm water mitigation, reduction of flood risk, coastal protection, air purification (particulates, ozone), shade and heat mitigation. Of course trees also capture carbon as they grow, as well as reducing the electricity used for cooling purposes, therefore there are many environmental benefits to be gained from planting trees.

How do trees and other vegetation remove particle matter from the atmosphere? The Nature Conservancy report explains:

> PM is removed by plants through a process known as dry deposition. Dry deposition is when particles in the atmosphere deposit themselves on a surface, decreasing the atmospheric concentration of PM. Much of the fine fraction ($PM_{2.5}$) becomes permanently incorporated into leaf wax or cuticle, while a portion of the coarse fraction is resuspended as a function of wind speed. The remainder of the coarse fraction is eventually washed off to the ground by precipitation. (NC, 2016, p. 24)

Based on the above explanation, it is clear that a greater leaf area will increase the PM absorption, so when selecting tree species for planting, we should consider the size of the surface area as well as the density of the leaves in the canopy, in addition to the

texture of the leaves, since rough or waxy surfaces absorb more PM. Other factors that should be considered include factors such as: whether the tree is deciduous or evergreen, since deciduous trees lose their leaves in winter; how much shade is being provided; whether sufficient water is available for planting and upkeep; and whether the selected tree varieties are appropriate for the climate and are sufficiently hardy so that minimum maintenance is required.

One other component mentioned in the report which requires constant vigilance, is the fact that "26% of cities had a decline in forest cover over the period from 2000 to 2010, whereas only 16% of cities had an increase in forest cover over this time period. If this trend continues, there will be fewer trees in cities precisely when there are more of us in cities who need the services trees can provide." (NC, 2016, p. 53) This decline in urban forest cover follows the global deforestation trend which is explicitly related to SDG 15.

> **Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss:** Target 15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. (UN, 2015, p. 29)

According to Frances Seymour (2018, online), writing for the World Resources Institute: "Last year was the second-highest on record for tree cover loss, down just slightly from 2016. The tropics lost an area of forest the size of Vietnam in just the last two years." Nevertheless, despite the continued global trend to cut down forests, we should also pay attention to the efforts being made by indigenous groups worldwide to reverse this trend:

> CIFOR (Center for International Forestry Research) reports that community forestry is highly effective and that "the world's best-kept forest and ecosystems tend to be in indigenous peoples' territories." Analysis of 73 case studies in the tropics found that annual deforestation rates are significantly lower in community-managed forests than in strict protected forests. The findings also underscore that greater rule-making autonomy at the local level is associated with better forest management and livelihood benefits. A study on forest loss by the World Bank Independent Evaluation Group comes to similar conclusions about the effectiveness of community-managed forests, in particular forest areas managed and controlled by indigenous peoples. (FOREST PEOPLES PROGRAM, IPMG, 2018, p. 11)

It therefore seems to be the case that we should continue to learn from indigenous practices. However we also need to support the legalization of their rights so that indigenous communities have more autonomy to control their forest sustainability

management practices. Indigenous Peoples and Local Communities (IPLCs) are particularly well suited to manage local ecosystems because they not only have an intimate knowledge of their lands and resources, they also have a vested interest in maintaining a resilient ecosystem on which their livelihood depends. What can we learn from them? According to Reyes-Garcia et al, many researchers have registered traditional practices whereby "IPLC manage, adapt and restore the land on which their livelihood depends, sometimes creating new types of highly biodiverse ecosystems." (2019, p. 2). For example, the IPLC were considered to be "key participants in several country-scale forest restoration efforts in Asia, especially China and Vietnam." (Ibid.) The authors give examples of some of the strategies used:

> Examples of traditional practices contributing to maintaining and restoring ecosystems include (1) anthropogenic burning purposively altering spatial and temporal aspects of habitat heterogeneity to create diversity; (2) waste deposition practices resulting in soil carbon enrichment; (3) rotational swidden cultivation systems able to maintain forest cover and plant diversity; (4) interplanting useful plants in native forests thereby increasing forest diversity. (REYES-GARCIE et al., 2019, p.2)
>
> Other Indigenous and Local Knowledge (ILK)-based land management practices (e.g. rotational farming, agroforestry, improved crop-fallow systems, hedgerows, grazing enclosures) have also effectively enhanced carbon sequestration, prevented environmental degradation, and combatted desertification. (Ibid., p. 3)

Furthermore, this article by Reyes-Garcia et al. emphasizes the importance of inclusion and collaboration as fundamental aspects for the success of projects involving the participation of IPLC representatives. "Projects that actively involve IPLC in co-designing restoration activities affecting their territories are reported as successful in that they build partnerships (e.g. for co-management) and address value conflicts over resources." (Ibid). So once again, we discover that true collaboration and respect for all of the individuals involved in group efforts are necessary components for success.

What can we do to reverse the global trend of deforestation? How many students have already planted trees, and where did they plant them? To what extent did they follow up the development of the trees they planted? What were their reasons for planting the trees? How did they feel when they discovered that trees were able to absorb pollutants from the atmosphere? What is their relationship with trees? As you might recall from my introduction, I have a very strong, personal relationship with trees – I feel very calm and protected when I am around large trees and am fascinated by the variety of shapes, textures, smells, colours at different seasons. Do students have a favourite tree in their

garden, local park, on their way to school? Which aspects of the tree do they admire most? Would they prefer to represent their special tree visually, musically, through dance or using words? Which species would they choose to plant locally and why? How would they work out the average area of the leaves for the species they have selected or the total area of the tree canopy?

Perhaps students could collaborate with an urban school in another country where heat and pollution levels are higher in order to launch a campaign for tree-planting near their partner-school? If they decide to do this, they would need to find out which trees would be more appropriate, whether there is enough water available for them to grow successfully and many other details related to the local culture of their partners. Which software tools are available to help work out the most appropriate species for the location being considered? In the publication 'State of the World's Forests' (2018) the Food and Agriculture Organization (FAO) of the United Nations recommends the tool *i-Tree Eco* which cross-references the structure of a given tree system with local hourly air pollution and meteorological information.

> Users just need to collect and enter standard information on the trees (such as species, diameter, health condition) and the programme will provide estimates (by species composition, size class and/or land use) on the benefits and related monetary value they provide and will continue to provide in the future in terms of air pollution removal (and associated benefits for human health), carbon storage and sequestration, energy saving, rainfall interception and avoided runoff. (FAO, 2018, p. 41)

Which are the most appropriate tools currently available for students' needs? To what extent do they intend to take into consideration the preferences of the population who will benefit from their tree-planting project?

Another strategy which is being adopted by different countries to cool down summer temperatures, reduce energy use, and help manage storm water is to build green roofs by planting vegetation on the roof. The city of Athens in Greece has completed the construction of green roofs on 13 primary and kindergarten schools – making the buildings much more attractive as well. The city of Paris in France, on the other hand, decided to invest in vertical gardens called *"Des jardins sur les murs"*. Nevertheless, according to the Guinness Book of Records, the largest vertical garden in the world is the *Tree House* in Singapore, completed in 2013. Which city currently holds this record? The *Tree House* also contains sustainable technologies which include heat-reducing windows and motion sensors that automatically activate lights. Have students

seen images of this building? Do students prefer green roofs or green walls? How many local roofs or walls would benefit from 'greening'? Perhaps they could start with one of the school walls and have a design competition to decide which plants would be most successful? What other ideas do students have for increasing green areas around the school?

The Nature Conservancy report suggests that priority buildings for 'greening' should be schools and hospitals, because the inhabitants of these buildings include the most vulnerable sectors of the population. Are there any hospitals, day care centres, or kindergartens near the students' school? How 'green' is the surrounding area? How many different proposals can students come up with to improve the quality of the air in the vicinity of these buildings? Which suggestions are most appropriate? How will students manage to raise the necessary funding or expertise? In the final paragraph of the Nature Conservancy report we are reminded that planting trees is only one of the options for improving air pollution.

> In conclusion, tree planting constitutes a part of a cost-effective portfolio of interventions aimed at controlling particulate matter pollution and mitigating high temperatures in cities. While trees cannot and should not replace other strategies to make air healthier, trees can be used in conjunction with these other strategies to help clean and cool the air. Moreover, trees provide a multitude of other benefits beyond healthier air. In the right spot, trees can both help make our air healthier and our cities more verdant and livable. They are an important way that we can make our coming urban world – the cities in which most of us will live – resilient, livable, and thriving. (NATURE CONSERVANCY, 2016, p. 95)

It is therefore extremely important to continue to plant trees and conserve forests worldwide, but we also need to put into practice other fundamental lifestyle actions which have already been mentioned in order to reduce our contribution to air pollution. We need to conserve energy at all times; look for sustainable labels whenever we are buying something; use public transportation, carpools, bikes and walk whenever possible; use eco-friendly products; avoid burning leaves, trash and other materials, opting to mulch or compost leaves and appropriate food waste when possible, amongst many other sustainable actions. Global sustainability is only possible through creative, collaborative individual and group actions.

❁ *People and the Environment*

Throughout this book I have emphasized the undeniable necessity for individual and collaborative changes to our way of living and to our way of thinking. As human beings, we need to recognize our responsibility for the all-encompassing devastation that we have inflicted upon our host planet Earth, and it is up to us to save our planet and ourselves by restoring as much of the damage as possible in order to guarantee the sustainable continuation of the human race. The United Nations made the following statement in 2015 as part of their introduction to the proposed 17 Sustainable Development Goals:

> All countries and all stakeholders, acting in collaborative partnership, will implement this plan. We are resolved to free the human race from the tyranny of poverty and want and to heal and secure our planet. We are determined to take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path. As we embark on this collective journey, we pledge that no one will be left behind. (UN, 2015, p. 5)

Nonetheless, in order to take transformative steps towards collaborative sustainability, appropriate and effective steps can only be taken based on reliable data, as the UN points out in the same document. "Quality, accessible, timely and reliable disaggregated data will be needed to help with the measurement of progress and to ensure that no one is left behind." (Ibid., p. 15)

In order to take bold steps forward we should also be aware of the steps which brought us to the place where we are currently standing. How much do students know about the history of mankind and our influence on the wellbeing of our host planet? Can they make a timeline based on some of the human activities throughout history which have strongly influenced the paths our species has taken? Which *homo sapiens*-related events or trends have caused most damage to our planet so far? What do students think should happen in the near future to guarantee a healthier planet for their children?

How many students have heard of the term 'Anthropocene'? This name has been proposed by a group of scientists to define the current geological age during which human activity has been the dominant influence on climate and the environment. However, the International Union of Geological Sciences has not yet taken a final decision as to whether to adopt the name, nor how to define the period referred to, since there is considerable debate about when this period can be said to have started. Some scientists proposed a start-date at around 1780 marking the beginning of the Industrial

Revolution, but others have suggested earlier dates around 12,000 BCE with the introduction of the Agricultural Revolution.

The first appearance of the genus Homo (*homo habilis* – sometimes referred to as *Handy Man*) was around 2 and a half million years ago in Eastern and Southern Africa, surviving until 1.4 million years ago. *Homo habilis* was the first stone tool maker and was followed by several other species, including *homo erectus* around 2 million years ago, who survived until around 145,000 years ago, nine times as long as our own species so far. They were the first early humans to make hearths and to care for the old and weak. Neanderthal man (*homo neanderthalensis*) lived in the glacial regions of Europe and parts of Asia between 400,000 – 40,000 years ago. Their bodies seem to have developed in order to conserve heat, with shorter limbs and broad noses for warming cold air, and they also wore clothing for warmth.[77] The species *homo floresiensis* lived in Indonesia between 95,000 – 17,000 and is the smallest known group in the genus *Homo,* sometimes given the nickname 'hobbit'. They may have decreased in size due to lack of resources on the islands where they were living. This process has been observed in other mammals and is referred to as island dwarfing. Evidently, the genus *Homo* was able to adapt to very different geographical contexts and conditions, and as Potts and Sloan observe:

> Although all earlier hominins are now extinct, many of their adaptations for survival – an appetite for a varied diet, making tools to gather food, caring for each other, and using fire for heat and cooking—make up the foundation of our modern survival mechanisms and are among the defining characteristics of our species. (POTTS; SLOAN, 2010, p. 46)

However, when *homo sapiens,* who had been living in Africa since about 200,000 BCE, initiated migrations out of Africa, the population started spreading and growing in different parts of the globe. We arrived in the Middle East about 100,000 years ago and reached Asia about 70,000 years ago, despite extreme climate changes which may have reduced the population to around 10,000 adults. Then different groups arrived in Oceania 50,000 years ago, Europe, 40,000 years ago, and the Americas about 15,000 years ago. According to the timeline presented by the site *Anthropocene*[78], "humans played a profound role due to overhunting between 50,000 – 10,000 years ago, thus

[77] Much of the information in this section has been obtained from the Smithsonian National Museum of Natural History.
[78] ANTHROPOCENE. **Anthropocene Timeline.** Available at: <http://www.anthropocene.info/anthropocene-timeline.php>. Accessed on: 04.06.2021.

contributing to the Megafauna Extinction." North America lost 72% of its large mammals, South America 83% and Australia 88% by about 11,000 years ago. So this period definitely seems to be a strong starting point for negative effects on the environment caused by human activity.

More information provided by the site *Anthropocene* follows. The year 11,700 BCE marks the beginning of the geological period called the Holocene which has had an extremely stable climate so far, but is now being threatened by human activity. Around this period humans invented farming more or less simultaneously in Southwest Asia, South America and North China, which subsequently began to impact ecosystems and biodiversity. Goats, sheep and cattle were also being domesticated around this time and deforestation practices expanded from around 8,500 years ago as farming became more widespread. Around 7,500 years ago a very large settlement was already thriving in Southern Anatolia, Turkey – possibly one of the first cities. By 6,500 years ago, rice cultivation was already beginning to affect the atmosphere due to the production of methane. Later on, the wheel was invented in Mesopotamia around 3,500 years ago, initially in order to expand the production of pottery.

Nevertheless, despite various migrations in different directions and all the cultural advances mentioned so far, Kaneda and Haub (2018), writing for the Population Reference Bureau, estimate that, around 8,000 BCE, at the time when agriculture was becoming more common around the world, the total world population was around 5 million. This global total is considerably smaller than the population of many modern cities, since Shanghai was attributed with around 24 million in 2017, Tokyo and Moscow with more than 13 million each, São Paulo with 12 million, Delhi with 11 million, Mexico City and London with almost 9 million each, New York with more than 8 million, etc. It is manifestly the case that the effect on the global environment of a total population of 5 million inhabitants would be minimal.

Nevertheless, by 2,000 years ago, the soils of the Earth were beginning to show evidence of human activity through large amounts of residual phosphorous from fertilizers. By the late 18th century, growing concentrations of carbon dioxide and methane could be found in pockets of air trapped in polar ice. Then the Atomic Age started on July 16th, 1945, when the first atomic bomb was exploded. According to Kylie Lemon, writing for the site *Sciencing:*

> When an atomic or nuclear bomb detonates, the 1 megaton blast kills or poisons everything within a two-mile radius. The accident at the Chernobyl power plant in 1986 and the bombs dropped on Hiroshima and Nagasaki in 1945 provide insight into the short and long-term effects of radiation and thermonuclear detonation on the environment. Radioactive particles can travel from the site of an atomic bomb explosion and contaminate the land and water for miles. Genetic mutations and disease in the generations of plants, animals and humans following contamination also occurs. Contamination remains for decades. (LEMON, 2018, online)

Between the Trinity nuclear test in 1945 and the Partial Test Ban Treaty of 1963 almost 500 nuclear tests were carried out. Although this partial treaty banned nuclear testing underwater, in the atmosphere and in outer space, it did not ban underground testing and more than 1,300 nuclear tests were carried out underground between 1964 and 1996. In 1996, the Comprehensive Nuclear-Test-Ban Treaty, which includes a ban on underground testing as well, was adopted by the United Nations General Assembly. Unfortunately it is not yet being enforced since eight specific states did not ratify the treaty. According to Daryl Kimball, Director of the Arms Control Association, "The treaty cannot enter into force until it is ratified by 44 specific nations, eight of which have yet to do so: China, India, Pakistan, North Korea, Israel, Iran, Egypt, and the United States." (February, 2019, online[79]) And even if the treaty is ratified, there is still a large number of nuclear weapons around the world.

Kristensen and Korda, writing for the Federation of American Scientists in May 2019, make the following disturbing statements:

> The number of nuclear weapons in the world has declined significantly since the Cold War: down from a peak of approximately 70,300 in 1986 to an estimated 13,890 in early-2019. […] Globally, the number of nuclear weapons is declining, but the pace of reduction is slowing compared with the past 25 years. The United States, Russia, and the United Kingdom are reducing their overall warhead inventories, France and Israel have relatively stable inventories, while China, Pakistan, India, and North Korea are increasing their warhead inventories. All the nuclear weapon states continue to modernize their remaining nuclear forces, adding new types, increasing the role they serve, and appear committed to retaining nuclear weapons for the indefinite future. […] In addition to the roughly 3,800 warheads in the military stockpile, approximately 2,385 retired warheads are awaiting dismantlement. (KRISTENSEN; KORDA, 2019, online)

Despite the fact that many of these weapons are said to be in storage, in reserve, or in the process of being dismantled, their very existence can be a threat to the environment

[79] KIMBALL, Daryl. Comprehensive Test Ban Treaty at a Glance. **Arms Control Association**. Available at: <https://www.armscontrol.org/factsheets/test-ban-treaty-at-a-glance>. Accessed on: 26.06.2019.

since the process of dismantlement and storage can increase the risk of radiation accidents and environmental pollution.

> Ironically, research into the radiation released into the atmosphere – and from there into the soil, water, plants, and animals, including humans – during the 1950s reign of [nuclear weapon testing] fallout provided the basis for our understanding of pathways of persistent chemicals in the environment. Historian Laura A. Bruno writes: "As a result of fallout, scientists learned that pollutants could travel over long periods and distances, and that they could be accumulated in a reservoir in organic matter. This research revealed how interconnected different ecosystems are and led to the view that our global environment cannot tolerate endless pollutants." […] The awareness that radioactive poisons in the atmosphere ended up in all living things became the basis for the environmental movement. (WILLIS, 2018, online)

What is the current situation as regards the existence of nuclear weapons? Have all states now signed and ratified the Comprehensive Nuclear-Test-Ban Treaty? What steps are being taken to guarantee the safe dismantlement of existing nuclear weapons? What actions can students, families, local communities, countries, take in order to reduce worldwide aggression? To what extent are human beings able to work together to build a peace-loving planet where everyone can thrive and enjoy their lives to the full? What are the students' thoughts on this extremely sensitive topic and what proposals might they put forward to guarantee a safer environment for all?

The last 60 years have frequently been referred to as 'The Great Acceleration' due to the unprecedented rates of environmental destruction and pollution caused by human beings all over the world. Today, 1st July 2019, world population passed 7,7 billion[80]; in 2017 atmospheric carbon dioxide reached more than 405 parts per million (ppm), the highest previous level being 300ppm during a warm interglacial period about 300,000 years ago; and in 2015 the United Nations defined the Sustainable Development Goals in an attempt to control humanity's downhill race to extinction. Perhaps we are moving towards a governing system which aims to promote global collaboration rather than the current state of competition between countries. The United Nations makes the following statement in the introduction to the sustainable development goals:

> We pledge to foster inter-cultural understanding, tolerance, mutual respect and an ethic of global citizenship and shared responsibility. We acknowledge the natural and cultural diversity of the world and recognize that all cultures and civilizations can contribute to, and are crucial enablers of, sustainable development. (UN, 2015, p. 13)

[80] Current World Population. Available at: <https://www.worldometers.info/world-population/>. Accessed on: 04.06.2021.

The necessity of promoting "understanding, tolerance and mutual respect" is naturally one of the basic requirements for effective collaboration. Unfortunately these qualities seem to be lacking in many aspects of contemporary society around the world, for example as related to gender equality, which is the focus of SDG 5, as well as the central themes underlined by SDG Goals 10 and 16:

> **Goal 10. Reduce inequality within and among countries:** Target 10.2 – By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status (UN, 2015, p. 25)
>
> **Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels:** Target 16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels (Ibid., p. 30)

Can students think of any examples of gender inequality as part of their own lives? Have there been any instances of gender inequality in the local community? To what extent have these examples been solved? What lessons can be learned from these illustrations? What other problems exist locally which demonstrate the need for inclusion and justice for all? How many local instances have there been where people have felt excluded because of their age, sex, disability, ethnicity, religion or economic status? What happened? What do students think should have happened?

To what extent can local decision-making be considered inclusive, participatory and representative? Are there any groups who believe they have not been included in any recent local discussions or decisions? How are decisions taken in local schools? To what extent do students feel their opinions have been taken into consideration during processes of school decision-making? How would students choose to express their feelings or reactions to these different questions?

Students could investigate different sites to discover more explicit information about the concept of exclusion, then explore online groups involved in promoting solutions. In the discussion paper "What does it mean to leave no one behind?), The United Nations Development Programme (UNDP) emphasizes the fact that "Establishing a shared understanding of what it means to leave no one behind is an essential first step to formulating an appropriate response." (2018, p. 9) And in the Executive Summary of the same paper, they explain the five key factors involved as follows:

> ***Who is being left behind and why: Five key factors***
>
> People get left behind when they lack the choices and opportunities to participate in and benefit from development progress. All persons living in extreme poverty can thus be considered 'left behind', as can those who endure disadvantages or deprivations that limit their choices and opportunities relative to others in society.
>
> This paper asserts that to understand who is being left behind and why, and to shape effective responses, five key factors should be assessed:
>
> **1. Discrimination**: What biases, exclusion or mistreatment do people face based on one or more aspect of their identity (ascribed or assumed […]?
>
> **2. Geography:** Who endures isolation, vulnerability, missing or inferior public services, transportation, internet or other infrastructure gaps due to their place of residence?
>
> **3. Governance:** […] Who is affected by inequitable, inadequate or unjust laws, policies, processes or budgets? Who is less or unable to gain influence or participate meaningfully in the decisions that impact them?
>
> **4. Socio-economic status:** Who faces deprivation or disadvantages in terms of income, life expectancy and educational attainment? Who has less chances to […] benefit from quality health care, clean water, sanitation, energy, social protection and financial services?
>
> **5. Shocks and fragility:** Who is more exposed and/or vulnerable to setbacks due to the impacts of climate change, natural hazards, violence, conflict, displacement, health emergencies, economic downturns, price or other shocks? (UNDP, 2018, p. 3-4)

Can students identify local members of their community who may be feeling excluded due to any of the above factors? Can they identify different groups around the world who are suffering from a combination of different factors which result in lack of choices and opportunities to improve their lives? Which of these key factors would students find most difficult to live with and why? What are some of the possible solutions for some of the problems identified? Which solutions do not require monetary investment? Which solutions could be carried out personally by groups of students working together with local members of the community? The UNDP paper emphasizes the fact that "Social exclusion is a multidimensional phenomenon not limited to material deprivation […] Accordingly, social inclusion processes involve more than improving access to economic resources." (Ibid., p. 17)

In order to produce this paper, the UNDP analysed several successful attempts to implement some of the SDGs around the world in order to discover which strategies were proving to be more effective, and they identified three "mutually reinforcing levers" which they consider to be necessary: *examine, empower, enact.* (Ibid., p. 21) The first step inevitably involves examining trustworthy "disaggregated and people driven data and information." When they refer to people driven data, this means that

'objective' numerical data is not enough, subjective judgements and perceptions should also be investigated in order to promote greater understanding of the situations involved. The second 'lever' refers to empowerment – "civic engagement and voice".

> To achieve the SDGs, the people that are being left behind must be full, equal agents of sustainable development. Urgent action is needed to enable and empower them, including by ensuring their meaningful participation in decision making and establishing safe and inclusive mechanisms for their civic engagement. (UNDP, 2018, p. 4)

The third lever refers to the necessity for action: "*Enact* policies, laws, reforms, interventions to confront the drivers that leave people behind across SDGs: Duty-bearers and rights-holders will both need to shape, deliver and improve policies aimed at curbing inequalities and upholding minimum standards of well-being." (Ibid., p. 5)

Therefore, if students hope to help individuals, or groups of people, who have been left behind in some sense, they first need to gather accurate and convincing information about the situation. Then they need to consider how best to guarantee that the needs of these people can be successfully communicated to relevant authorities who are able to act in their favour for their voices to be heard. When authorities have been persuaded to listen to the voices of the disadvantaged, appropriate policies and interventions can then be put into action.

> Given the urgency of achieving the SDGs, no country can afford to do one at a time. Integrated approaches are needed to move all three "levers" forward simultaneously by improving what is known about who is left behind, where they are and why; empowering marginalized populations to act and claim their rights; and building the capacity of governments to adopt equity-focused and rights-based SDG targets, policies and budgets which are inclusive and accountable. (UNDP, 2018, p. 21)

To what extent do all members of the students' extended family and local community have access to resources, goods, services and opportunities? What are some of the difficulties faced by people who live in isolated areas, mobile families, people in prisons, institutions, hospitals, single-parent households, homes headed by older people with young children, large households with foster children or unrelated orphaned children, children cared for by neighbours? Does everyone participate fully in economic, social, political and cultural activities and enjoy a normal standard of living? What do students consider to be a 'normal' standard of living for themselves? How much variation is there within each classroom? If students work out what a normal

standard of living entails for their classroom, how would they compare their 'normal' reference with families living in very different conditions in various places around the world? What changes would students be prepared to make in their own lives in order to guarantee improved living standards for families who have much lower living standards?

According to the United Nations, social inclusion necessitates taking active steps to facilitate social inclusion. "As a political response to the exclusion challenge, social inclusion is thus a more deliberate process of encompassing and welcoming all persons and embracing greater equality and tolerance." (UN, 2016, p. 20) How do students react to the idea of treating people in underprivileged situations as equals and welcoming them into a more tolerant, fair-minded society? The United Nations believes that, "Success in [leaving no one behind] will require that people of good will support the efforts of excluded communities and people to be included. It also will require personal bravery and persistence as the process typically involves deep social change. But it is the right thing to do." (Ibid., p. 31)

The United Nations Relief and Work Agency (UNRWA) has 691 schools for Palestine refugees in the Near East where they create safe learning environments where students are encouraged to investigate different aspects of human rights and tolerance by participating in activities specifically designed for this purpose. Students are taught to appreciate diversity, listen to each other consciously and to resolve conflicts using dialogue instead of violence. Empathy and critical thinking abilities are considered to be essential. "Role-playing and group games help students to learn about and critically reflect on sensitive social issues, such as gender roles and discrimination in all its forms." (UN, 2016, p. 135) Each school has a school parliament where elected members actively promote

> […] the inclusion and empowerment of young people, by mediating grievances between faculty and students, or forming support groups for peers at risk of dropping out of school or succumbing to early marriage. School parliaments have also resulted in greater participation in community life of people with disabilities; they are nurturing the civic spirit of inclusion and participation of children in decision-making both in school and in their community.
>
> Internal evaluations show that students who are exposed to human rights education tend to support gender equality, value diversity and take action to end bullying and violence inside and outside of school. Heba abu Laban, a 13-year-old member of her school parliament in Gaza, commented: "I have learned a lot about diversity and human rights. Now I know that people have

> different religions or colours, but while we all have the right to be different, we need to be treated equally."
>
> When exclusion and lack of awareness of rights reinforce each other, human rights education in schools presents a special opportunity to break this cycle. Moreover, promoting attitudes of inclusion, tolerance, peaceful resolution of conflict and respect for diversity among children and youth, helps embed these values more broadly. (Ibid)

How many students have a parliament system operating in their schools or have visited schools which have democratically elected parliaments? What are the positive and negative aspects of parliament-run schools? How many students would like to experiment some kind of democratic system like the one described above in their own schools and how would they start the discussion with their colleagues and teachers?

What do students know about the Scottish charity *Children's Parliament*? The General Teaching Council for Scotland provides the following information:

> Children's Parliament is Scotland's Centre for Excellence for Children's Rights and Participation. We give children the opportunity to voice their ideas, thoughts and feelings so that their concerns and opinions can be listened to and included in our social and political landscape.
>
> Firstly, we work directly with children in projects, consultations and programmes which allow them to develop the skills, knowledge, behaviours and values necessary to engage in civic life. We focus on the development of positive, respectful relationships and safe, supportive environments where all children can flourish.
>
> Children do not become responsible citizens because we tell them they have responsibilities; they become responsible citizens through experiencing a rights-based approach and understanding how this connects to other areas of their lives. (GTS - General Teaching Council for Scotland, online)

Children's Parliament also works with adults, including caregivers, government officials, teachers and other professionals "to raise awareness of children's rights and to equip them with the knowledge and skills to replicate a rights-based approach in their own settings." (Ibid, online) It is immensely important to give children as many opportunities to voice their own thoughts and exchange ideas with others in safe environments, where they learn to respect ideas and opinions which are unlike their own, and where their voices are respected by those who are listening to them, since communication in mutually respectful environments will build the foundation for strong partnerships.

The organization *Children's Parliament* (CP) also works with Universities involved with teacher training where CP children are often invited to engage with trainee teachers

to share ideas related to children's rights and active participation. Towards the end of a discussion session, children suggest some of their 'tips' for future teachers:

> The Top Tips from children usually include the following: Listen to your pupils and try to understand where they are coming from; Try teaching in different ways and use technology in your lessons; Get to know your pupils; Let us have an opinion – and don't judge us or punish us if we say something you don't like; Always think on the positive side of us; Let us be children; Be patient – strict but not too strict; Be my equal. (GTCS., online)

How many of these tips strike a chord with readers? How are these tips applied in the family environment, in school or in the community? Which tips are easier to apply and which ones require long-term investment? Which tips demand structural or administrative reorganization and which ones necessitate mental readjustments? As we listen attentively, and make serious attempts to understand what students of all ages are trying to say to us, we demonstrate our respect for them. Obviously – respect does not entail agreement. But the ability to listen respectfully to ideas and opinions which are different from our own, promotes the growth of mutual respect – an essential step towards successful collaboration which is indispensable for our species to survive, thrive and move forward.

The site *ChildrensParliament* lists the specific values which they practice and encourage:

> *Honesty*: We are truthful and open to the views and experiences of others; *Respect*: Both for the views of others and that no-one should ever feel small or stupid; *Diversity*: We are different and we are equal; *Empathy*: We can understand others by putting ourselves in their shoes; *Participation*: It is everyone's right to have their say and to take part; *Social Justice*: We must do what we can to make the world a better place for ourselves and for others. *Action*: If something is wrong we should try to change it.[81]

These values are very similar to those promoted by the United Nations, and in fact representatives from the *Children's Parliament* attended the UN event 'Under the Same Sky', which is "an international constellation of projects exploring children's rights and the environment"[82]. A group of CP children presented the Scottish project *Streets Ahead Tranent*. There were five other contributions – from Australia, Brazil, Mozambique,

[81] CHILDREN'S PARLIAMENT. **About Us.** Available at: <https://www.childrensparliament.org.uk/about-us/>. Accessed on: 04.06.2021.
[82] CHILDREN'S PARLIAMENT. **Under the Same Sky** – Children's Parliament at the United Nations. Available at: <https://www.childrensparliament.org.uk/our-work/past-work/under-the-same-sky/>. Accessed on: 04.06.2021.

Palestine and Zimbabwe. All projects were featured at the United Nations Convention on the Rights of the Child – Day of General Discussion, in September, 2016. It is definitely worth investigating visuals and reports related to children's contributions to the solving of local and global problems, such as the videos currently available on the page referenced above, so that we can learn from previous experiences in order to formulate appropriate proposals which may contribute towards current challenges.

The project *Streets Ahead Tranent* came about as part of the *Year of Innovation, Architecture and Design 2016*. The idea was to explore children's views and experiences of their local community and built environment, past, present and future, examining how various factors relate to children's rights and wellbeing.

> 250 children from several primaries participated in whole class workshops with a strong emphasis on creativity through an intergenerational and heritage theme. These workshops included inputs from local community members, urban designers, historians and wildlife rangers.
>
> Following nine workshops, a small group of 16 children from across the five schools engaged in an intensive creative process that included visits to historical sites, […] and working with artists, drama facilitators and local professionals to create a mural reflecting the views of all 250 children who took part. […]
>
> *Streets Ahead Tranent* demonstrates the possibilities for how children's voices can be included in local and global dialogue […]. Children's voices should have a ripple effect, influencing life in those spheres closest to them as well as the wider discussions of national and global significance.[83]

What do students think about their local built environment? What changes would they like to make in order to transform their local community into a more sustainable environment based on children's rights and wellbeing? How many innovative creative ideas can students come up with, such as the 'walking hotel in the shape of a monster with trees growing out of it in all directions' included in the Tranent mural? Adults should remember that very often the apparently crazy ideas produced by young children often contain the seeds of future inventions. What have students done in their own lives recently which can be said to have made a positive difference in the world? How often do students feel that adults are truly listening to what they have to say? What suggestions do they have for genuine, respectful, student-adult collaboration to become more frequent?

[83] CHILDREN'S PARLIAMENT. **Streets Ahead Tranent**. Available at: <https://www.childrensparliament.org.uk/our-work/streetsaheadtranent/>, Accessed on: 04.06.2021.

Many similar examples of children representing their local communities, as well as their countries, and sharing their ideas with international groups can be found online. For example, in 2014 a group of Scottish students participated in a Commonwealth Games Challenge where they reworked the UN Millennium Development Goals and performed them as a rap. These students made connections with students from several other countries and discovered that they had many values and aspirations in common: "learners came to appreciate the need for mutual respect and solidarity. Making contact with children in other countries increased their empathy and helped develop their communication skills. It also motivated them to raise awareness and take action in their local community." (EDUCATION SCOTLAND, 2015, p. 8) These different experiences illustrate that SDG 4 is certainly being contemplated and put into action in a variety of ways around the world.

> **Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all**
>
> 4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development (UN, 2015, p. 21)

The examples related to the *Children's Parliament* in Scotland refer to a charity organization which provides valid experiences for the children involved. However, it is also important for students to experience living within a democratic system on a daily basis at school and I would like to develop this idea further.

I already mentioned the United Nations Relief and Works Agency (UNRWA) which promotes Human Rights, Conflict Resolution and Tolerance Education for refugees in almost 700 schools in Palestine. Each of their schools is run by an elected parliament, and in 2015 they published a 'Good Practices Booklet' which contains several examples of successful practices as well as ideas, tools and guidelines to help school parliaments function as effectively as possible. For example, a group of around 200 students wanted to help local farmers pick their olives. This activity helped strengthen links between the students and the community, and the students learned about the harvesting process and the importance of olive farming in Palestinian culture, as well as the importance of volunteering. Some of the farmers observed that "it was an activity that helped students

recognize the importance of volunteering as a key aspect of being a good citizen." (UNRWA, 2015, p. 6)

Have students ever volunteered to help with different activities in the community? What did they do and how did they feel about helping out? Would they be prepared to do more to help others in need? In what ways could a school parliament motivate students to actively participate in the cultural life of the community? If students are interested in volunteering, perhaps the school parliament could conduct surveys to identify local organizations or groups in need and find out how students would like to help and what they are interested in learning about. Parliament members could then try to match up the various needs in the community with the interests of the student volunteers. The organizations or groups in need could also be invited to the school to tell students more about the work they are doing and the different kinds of help required. What other proposals do students have?

Another successful practice promoted by one of the UNRWA school parliaments involved inviting children from a Centre for Rehabilitation of People with Disabilities to visit their school and participate in various activities. Members of the school parliament worked together with specialists from the rehabilitation centre to devise appropriate activities for their visitors, focusing specifically on children and young people with intellectual disabilities. Parliament members also talked to the families involved to help them accept that this would be a positive experience for their disabled children. Both the administrators of the school and the Centre appreciated the leadership shown by parliament members who created stronger ties between the school and the community. The activities focused on the inclusion of people with disabilities, and students who participated said that the experience taught them "to accept and appreciate differences". (Ibid., p. 10) One of the families also made the following comment: "We felt that people cared about our children. We rarely see schools showing interest in children with special needs. Seeing the School Parliament girls play, sing and dance with our children was great! We saw our children laugh from the bottom of their hearts." (Ibid.) And one of the school students described the experience as follows:

> "This initiative impacted us psychologically and emotionally. We rarely interact with people with special needs and their families. We felt it was our duty to give moral support to 'both children and their parents.' Meeting with specialists at the Centre raised our awareness of different intellectual disabilities and ways to deal with them. We passed this knowledge on to other students at school. We are carrying on with this initiative which has

become a main component of the School Parliament annual plan." (UNWRA, 2015, p. 11)

How many students know families who have children or young people with additional support needs? To what extent are they able to attend school? In what ways has the school already been adapted to cater for these children? Could a school parliament help promote more effective inclusion of these children? How frequently have they interacted with these children and their families? What have they learned from these interactions? How much do young people without additional support needs know about the various problems faced by children with these additional support needs? How many school activities are planned to guarantee the participation of all children? Perhaps parliament members could consult with organizations responsible for these students to discover how to integrate such children more fully?

Other UNWRA schools focused on cleaning up their local environment. Initially, they placed suggestion boxes around the school grounds and this encouraged many students to submit their ideas as well as participate in various projects. The school parliament then analysed the most popular ideas, as well as the feasibility of putting them into action. Consequently, they decided to work with environmental clean-up since this proposal could include several different activities which would increase the general awareness of environmental problems, as well as actions which would contribute to waste reduction. For example, they promoted an environmental clean-up drawing competition with winners being displayed around the school; experts were invited to talk about the importance of planting trees in the vicinity of the school; the school radio and school workshops were used to educate students about the importance of maintaining a clean environment; students were encouraged to take home any waste from their lunchboxes; a recycling exhibition was held where students displayed art projects produced from recycled materials; and students also participated in a paper-recycling project with a local organization, amongst other schemes. This project was considered good practice "because it gives all students the opportunity to participate by means of the Suggestion Box. Once the idea is selected, the different activities involve many stakeholders: students, parents, the community and experts who can help with the tree planting." (Ibid., p. 19)

Which activities have students already participated in related to cleaning up the environment? What are their suggestions to improve the activities that they have already

tried? How many enjoyable and creative proposals can they come up with for the near future? Perhaps each class could present their ideas to the school parliament and the parliament members can try to work out how best to include the most popular suggestions. In what other ways could the school parliament contribute to successful projects which bring together different groups in the local community and beyond? Which necessary actions are students most concerned about related to environmental conservation practices? In what ways can school parliaments help organize priorities and motivate local, regional and global actions which will contribute to effective solutions? For example SDG 12 stipulates several absolutely essential targets which must be achieved in order to guarantee a sustainable future for the present generation of students and their children:

> **Goal 12. Ensure sustainable consumption and production patterns**:
>
> 12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses
>
> 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
>
> 12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse (BLANC, UN 2015, p. 27)

We have discussed several of these areas in other sections of this book, but we need creative solutions and radical behavioural changes in order to reach these targets. To what extent have students already changed any of their waste-production habits? How successful have they been – are they able to chart explicit positive changes? Which of the above areas motivate students most strongly to continue investing in positive changes that they have already initiated?

Happily, the UN report includes positive as well as negative information, and when children from different countries are asked what kind of future they would like to see for the world in 2050, "they often include wishes for a harmonious and peaceful world and sustainable, pleasant, and healthy local communities." (Ibid., p. 9) These wishes should inspire us all with profound hopes for the future, since a strong desire for peace, harmony and sustainable environments will surely compel the youth of today to make every effort possible to bring about this vision for their children. But how can teachers, families and communities in general help students realize their dreams for a

harmonious, sustainable future based on global cultural understanding and collaboration?

Project Zero (PZ) at the Harvard Graduate School of Education is "an intellectual wellspring, nourishing inquiry into the complexity of human potentials – intelligence, understanding, thinking, creativity, cross-disciplinary and cross-cultural thinking, ethics – and exploring sustainable ways to support them across multiple and diverse contexts." Project Zero develops research and activities in a variety of topics[84] such as Arts & Aesthetics, Thinking & Understanding, Collaboration & Group Learning, and Learning Environments. The two topics which we will explore more fully here are Interdisciplinary Studies together with Global & Cultural Understanding.

> Every generation confronts the challenge of discerning what capacities and dispositions are the most important to nurture among its young people at a given moment in time. Today, profound economic, digital, demographic, and environmental forces are shaping people's lives on the planet, thereby making the promotion of cultural and global understanding a priority. Our contemporary context requires us to examine how (1) young people can develop the capacity to understand themselves as well as people living in contexts that are different to their own; (2) [how] teachers and learning environments can foster learners' dispositions to make sense of the global issues of our times and take action toward societal wellbeing and sustainability; and (3) [how] such capacities are both supported and hindered in today's digital landscapes. (PROJECT ZERO, online.[85])

The PZ site offers many resources including books, articles and toolkits, such as the 'Good Collaboration Toolkit', which is designed "to help individuals develop, nurture and reflect on good collaborations."[86] This toolkit identifies 8 essential 'ELEMENTS' of Good Collaboration:

> ***E****xcellently Executed* (not haphazard or amateurish in process);
> ***L****eadership Driven* (not without a vision, but not leader-dominated or unnecessarily hierarchical);
> ***E****ngaging for Participants* (not without meaning, not narrowly-focused);
> ***M****ission Focused* (not all over the map, not with contradictory goals);
> ***E****thically Oriented* (not self-serving, based on power, or exhibiting "compromised work");
> ***N****urtured Continuously* (not neglected or left to whim);
> ***T****ime Well Spent* (not time wasted, not reliant on impulse or rigid routine);
> ***S****olution Inspired* (not aimless or without a specific goal or product). (Ibid)

[84] PROJECT ZERO. **Subject Topics**. Harvard Graduate School of Education. Available at: <http://www.pz.harvard.edu/topics>. Accessed on: 04.06.2021.
[85] PROJECT ZERO. **Global & Cultural Understanding**. Available at: <http://www.pz.harvard.edu/topics/global-cultural-understanding>. Accessed on: 04.06.2021.
[86] PROJECT ZERO. **The Good Collaboration Toolkit**. Available at: <http://www.pz.harvard.edu/resources/the-good-collaboration-toolkit>. Accessed on: 04.06.2021.

The toolkit makes connections between the above elements and some of the problems which can arise during collaborative projects. For example, if the outcome of a specific project has not been considered in sufficient detail, this would be related to the element 'Solution Inspired' since collaborative projects need to guarantee a focus on solutions, products or outcomes, therefore a balance has to be maintained between 'process' and 'product'. By clicking on the element 'Solution Inspired', we are taken to a follow-up page which contains illustrative narratives and activities which can be utilized to help group members explore solutions and focus more on the desired goal or product. For example, one of the activities asks the group to produce a 'Word Cloud'. As group members discuss the words they want to include and the relative font sizes which should be used to indicate the degree of importance attributed to each word, they will be sharing creative ideas and taking collaborative decisions in order to produce a final outcome which satisfies all members.

One fascinating collection of PZ projects is referred to as 'Interdisciplinary & Global Studies' and is described as follows:

> Interdisciplinary and Global Studies (Id-Global) is an ensemble of research projects designed to inform scholars and educators interested in preparing youth to understand pressing global issues of our times through interdisciplinary work and to participate in these issues as responsible global citizens. The Id-Global Project seeks to:
>
> 1) Understand and foster quality interdisciplinary research and education among scholars, teachers and youth,
>
> 2) Understand and nurture the development of global competence among leaders, teachers and youth, and
>
> 3) Create fertile environments for dialog about the purpose of education in the twenty first century and the responsibilities of professionals in our field.
>
> We understand that the most pressing issues of our times, from climate change to mass migration, from global health to the digital revolution, cannot be fully addressed through a single disciplinary or cultural perspective. We must bring together insights from the natural and social sciences, the arts, engineering and the humanities to produce explanations, create products, ask new questions, and find solutions to these contemporary issues. We see the purpose of education as nurturing individual human potential and promoting societal growth and well-being. We contribute to these aims by conducting basic research, developing usable frameworks, and creating practical tools that educators can use to inform their work. (PROJECT ZERO, online[87])

As I hope to have shown throughout the book, complex issues cannot be explored fully within a single discipline area. However, I also believe that when apparently simple

[87] PROJECT ZERO. **Interdisciplinary & Global Studies**. Available at: <http://www.pz.harvard.edu/projects/interdisciplinary-global-studies>. Accessed on: 04.06.2021.

issues are investigated through interdisciplinary studies, they become much more engaging and will often be found to be more complex than they may have appeared initially. When we combine an interdisciplinary approach to teaching with a strong focus on developing global competence, we will be preparing our students to better comprehend complex global issues and hopefully to act in ways that contribute towards the solution of global problems.

Veronica Boix-Mansilla is a principal investigator and lecturer in education at Project Zero, and in her article 'How to be a Global Thinker', she defines several global thinking dispositions which she has observed during her research into global competence and how they can best be nurtured in our schools. She believes that it is absolutely necessary to develop long-lasting forms of learning, or thinking dispositions, instead of helping students acquire large quantities of knowledge which seem to evaporate very quickly. These thinking dispositions can only be acquired when they are seen to be valued and are consistently put into practice through active participation and collaboration in the classroom on a permanent basis. Boix-Mansilla describes the following essential global thinking dispositions in her article:

> Thinking dispositions include (1) the *ability* to perform certain kinds of thinking, such as close observation, making connections, and reasoning with evidence, (2) the *sensitivity* to recognize occasions for using such ability, and (3) an ongoing *inclination* to do so (Perkins, et al., 2000). Looking at global competence through a thinking dispositions lens, I propose that we cultivate the following global thinking dispositions in students:
>
> ▪ *A disposition to inquire about the world* (for example, engaging with questions of significance, exploring local-global connections, and seeking information beyond familiar environments).
>
> ▪ *A disposition to understand multiple perspectives – others' and their own* (for example, considering cultural contexts, resisting stereotypes, and valuing our shared human dignity, especially as students interact with others whose paths differ greatly from their own).
>
> ▪ *A disposition toward respectful dialogue* (communicating across differences appropriately, listening generously, and sharing courageously).
>
> ▪ *A disposition toward taking responsible action* (being inclined to see and frame opportunities to improve conditions, collaborating with others, and mobilizing themselves to act). (BOIX-MANSILLA, 2016, p. 2)

The above thinking dispositions can also be linked to the four Cs: Collaboration, Communication, Creativity and Critical Thinking. For example, when we are encouraging students to make close observations, search for and analyse relevant data, put forward reasons or arguments based on specific evidence, they are using their critical thinking abilities. When students are stimulated to appreciate different points of

view and communicate with others through respectful dialogue, they are communicating in a collaborative fashion. And when they feel motivated to take responsible actions and mobilize others to join them in order to benefit those in need, they will require a combination of creativity, critical thinking, communication and collaboration.

However, when teachers decide to promote 'global' thinking dispositions, they must create opportunities for students to investigate global issues, "take multiple perspectives, engage in respectful dialogue, and take responsible action as a routine and integral part of life in the classroom." (Ibid., p. 3) To help teachers develop these global thinking dispositions in their classrooms, Boix-Mansilla, together with other researchers at Project Zero, developed several Global Thinking Routines which can be used regularly in the classroom to help reinforce the proposed dispositions. One of the thinking routines proposed by the author is called 'The 3 Ys'. When a new topic is introduced in a classroom, or when it arises through student discussion, everyone is asked to apply the '3 Ys' routine to think about: *1. Why might this [topic, question] matter to me? 2. Why might it matter to people around me [family, friends, city, nation]? 3. Why might it matter to the world?* The first question helps to stimulate students' intrinsic motivation, while the following questions invite students to make local, then global connections.

For example, if students are discussing the exponential growth in consumption in general terms, the problem will become much more realistic, or close to home, if they ask themselves how they would feel personally about scaling down their intake of hamburgers, French fries and soda. In other words, a specific concrete example is often more effective than an abstract generalization. Fast food is often comfort food, which is very difficult to give up, but if they also consider the positive health benefits that would ensue if they decide to eat healthier, more sustainable options, they will be considering positive and negative aspects which affect them personally. At that point, if they consider how this decision would affect the family, they might realise that if the whole family decides to reduce their intake of fast food, they may be able to support each other as they plan alternative healthier meals together and perhaps start exercising more as a group as they find higher levels of energy.

Before long, students might consider that if the family was able to reduce their fast food consumption successfully, they could also try to influence their extended family,

neighbours and friends, thus creating a more widespread support group within the community. Consequently, as they reduce their consumption of meat and dairy products, as well as reducing direct or indirect healthcare costs, they may realize that their group efforts are in fact producing positive effects on the global environment, since meat and dairy farms are amongst the most important factors influencing global land use changes, including deforestation, as well as being responsible for a considerable percentage of water consumption and methane emissions. Consequently, the impersonal, arid facts related to the global effects of their initial individual decision become much more meaningful as they make strong connections between individual decisions and consequences, through family and community decisions and consequences, to global decisions and consequences.

Another global thinking routine proposed by Boix-Mansilla is called 'How Else & Why' and is described below:

> How Else & Why – seeks to nurture students' disposition toward thoughtful communication, encouraging them to recognize that they have communication choices and to consider how they may interact respectfully across cultures and situations. Such an ability is crucial for global-ready citizens, who will need to adjust the way they express themselves to deal with complex cultural, social, and linguistic situations. In this routine, students move through multiple reflective iterations of a particular claim (a comment, story, or question):
>
> 1. *What I want to say is ...* (The student makes a statement).
> 2. *How else can I say this? And why?*
> 3. *How else can I say this? And why?*
>
> At each turn the same student considers intention, audience, and situation to reframe his or her language, tone, body language, and use of various technologies and media. The question repeats through as many iterations as appropriate, inviting the student to reflect about his or her choices in communication […] "Remember – our goal is not to vent, but to learn through dialogue with others." (BOIX-MANSILLA, 2016 p. 4)

In my experience, students are rarely encouraged to rewrite, reframe, reconsider what they wish to say, and are hardly ever stimulated to consider their intentions, their audience or the specific context in any depth. But this very simple technique which urges students to express an initial thought in several different ways, analysing why they are making the specific changes each time, is guaranteed to add considerable depth to their thinking processes. And as the globe shrinks and inter-cultural communication becomes more common, future citizens of the world will need to analyse their intentions

as they pertain to a wide panorama of cultural contexts and adapt the ways they express themselves according to the characteristics of each situation.

> Global Thinking Routines capture key forms of thinking embodied in global competence. They are open-ended, assuming no right or wrong answers. They are simple in design, which makes them useful for teachers of varied levels of expertise, yet cognitively sophisticated, providing extensive room for growth and refinement. When teachers make these routines habitual practices – part of "the way we do things here" – they pave the way for the kind of learning we need to prepare our youth for our interdependent world. (BOIX-MANSILLA, 2016, p.5)

To guarantee the continuity of the human race, we must develop genuine mutual respect for all citizens and cultures around the globe. But we must also recognize our responsibilities towards the protection of all other species which still exist on our host planet, since we are all interdependent and interconnected, even though we still do not comprehend fully the countless forms and ways of being which represent life on Earth. We must also assume responsibility for working tirelessly towards restoring a healthier environment for future generations – the air, soil and water of our planet are suffering desperately from human abuse and mismanagement. The future of our species and our host planet depends on the youth of today if there is to be a tomorrow. Therefore the teachers of today need to think very seriously about the global tools, dispositions and behaviours which are necessary not only for the development and future wellbeing of our students, but for the cultivation of creative solutions and forward thinking; efficient analysis and innovative critical thinking; respectful, attentive and appropriate communication; and productive, authentic collaboration skills.

The power of individual actions has been mentioned several times throughout this book, but these actions have required effort, they have been made publicly, and have been sustained over time, gradually inspiring others to take similar sustained actions in such a way that the original individual action stimulates collective action. As the collective group expands, and stronger coalitions are formed between diverse groups who have been fighting for the solution of a variety of environmental and social issues, meaningful change through national and international campaigns becomes possible. Consumer action is a strong tool, but drastic industrial reform and social transformation are imperative. Pervasive systemic behaviour patterns cannot be altered by individuals choosing to eat less meat, recycle their clothing or take a 5-minute shower. But, when individual actions spiral outwards through local communities and government lobbying,

systemic shifts in societal norms and wide-ranging changes of policy do become possible.

Committed individuals who belong to small local groups can produce positive global impacts – let's get started!

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APPENDICES

APPENDIX 1

Oak Story – July *by Claire Hewitt*

LONG AGO there was an Acorn. The tiniest Acorn you have ever seen. There it was hanging from the branch of a mighty Oak Tree, hiding amongst the green, green leaves.

One day the sky began to darken. Thunder roared and boomed like a great drum over the hills and a fiery fork of lightning struck the great tree. It quivered and it shook from its strong roots to the tips of its branches but the wee acorn hung on. The wind blew and blew and shook the branches hard and finally the acorn could hold on no longer and fell 'plop' to the ground!

There it lay along with many of its brothers and sisters and the acorn wondered what to do. "Wait. Have patience." said the wise Old Oak, "and you will see what you will see."

And so the little Acorn watched and waited just as she had been told.

One day she saw a pig with the curliest tail snuffling around with its soft pink nose along the ground, and snaffling up the tasty acorn feast. But just as it got so close she could feel its whiskers on her shell, the pig grunted and squealed and ran down the hill.

And little Acorn waited. And little Acorn watched. She saw two children carrying baskets of willow and filling them with fairy acorn cups. Around and around the tree they danced and played. Little Acorn so wanted one of those wee hands to pick her up and carry her away, but as the sun began to set the children wandered homewards leaving her all alone.

"Now what?" she exclaimed impatiently.

"Just wait and watch and you will see what you will see!" said Grandfather Oak.

And so she waited and she watched as the fiery leaves from Grandfather Tree fell all about her.

She saw three red squirrels leaping this way and that. When they came to the Old Oak, down the trunk they skitter-scampered, gathering and hiding their winter stores whilst nibbling a tasty treat in their paws.

And little Acorn watched and little Acorn waited just as she had been told as the Winter awoke and snow began to fall. Crows gathered in her Grandfather's branches keeping her awake most of the short days with their cackling and crawking, but rest came through the long cold nights as she slept in the arms of Grandfather Oak, snuggled in the cosy leaves under the sky's snowy blanket.

The soft rays of the Spring Sun tickled her and she stretched her rooty toes down into the ground. And there she waited and she watched as the seasons passed and the world turned and the rain rained and the sun shone and wind whirled and burled all around.

Until one fine sunny summer's day Grandfather Oak said, "See Little Acorn what you have become." And she looked down to the river below and saw a great Oak with acorns on its boughs and whispered, "Is that me?"

"Oh yes." said the wind "You are a fine strong tree!"

She saw her arms reaching high into the sky and sheltering the earth below. She felt the birds hopping and nesting about her, singing their bonnie wee songs as the sun rose and set. And she heard the Owls calling to one another as Mother Moon spun her gold threads about her. And she was happy she had listened to her wise old Grandfather and waited and watched for now she could see what she'd waited to be —

A shelter, a feast, A fine Gathering tree,
Blessing, strength and long life,
To you and to me.