CITIZEN SCIENCE

AND CURRICULUM FOR EXCELLENCE

Want to discover a new quasar in deep space, count elephants in the Serengeti National Park from the comfort of your classroom or monitor invasive species in your local park? If so, then you will be joining forces with millions of people around the world who are discovering a passion for science through citizen science activities. Read on to find out more about the exciting ways that learners and their communities can engage with science as volunteers and make a difference to their communities and world.

WHAT IS CITIZEN SCIENCE?

Citizen science involves the gathering, recording and analysis of scientific data by members of the public. This is often done in collaboration with, or under, the guidance of professional scientists. It can be undertaken by one individual or by millions of people working together towards a common goal.

The term citizen science covers a range of activities:

- Observing and monitoring – this could be gathering data to find out about wildlife populations

- Informing action – for example providing data to organisations about floods or pollution

- Promoting learning – using citizen science projects to engage learners

- Helping communities learn about their local environment through activities like 'BioBlitzes'

- Testing hypotheses – participating in science activities that answer a specific question

- Crowd-sourcing – online activities involving the gathering or analysing of data to achieve the same goal.

Citizen science gives young people and their communities the chance to get hands-on with science in an exciting and meaningful way. It provides them with opportunities to learn new skills, to discover the world around them, to engage with the scientific community and to find out how science impacts on their lives and on society.

Citizen science activities prepare young people for life in an increasingly scientific and technological world and helps them develop a curiosity and passion for science that can last a lifetime. Citizen science also challenges perceptions that science can only be done by professional scientists working in laboratories – when science should be for all!

WHY DO SCIENTISTS NEED THE PUBLIC TO GATHER DATA?

The support of large numbers of committed citizen science volunteers allows professional scientists to gather, record and analyse data on a scale that they simply could not possibly achieve on their own. For instance, over 580,000 people take part annually in the RSPB's Big Garden Birdwatch and over 850,000 people have collected environmental data for the OPAL Partnership led by Imperial College in London. Also, anglers across Scotland regularly provide information and updates to SEPA about water quality which can alert SEPA scientists to possible incidences of river pollution.

GET INVOLVED IN A BIOBLITZ!

Community BioBlitzes take place all over the country. The challenge involves recording as many bugs, beasties, birds and plants as possible before the clock runs out. These events are a great way for communities to come together and find out about wildlife in their own backyard. Naturalists and wildlife watchers also use the information collected to monitor wildlife populations across the country.

Find out about your nearest BioBlitz **www.bnhc.org.uk/BioBlitz** or organise your own **www.opalexplorenature.org/BioBlitzes**.

SCIENCES

- Sampling, identification and classification of living things

- Formulate questions and make predictions based on observations

- Collect information and data using appropriate unit and equipment, mobile devices and ICT

- Use observations and evidence to develop an informed view and present reasoned arguments about the wider world

- Collecting data about local environment and creating habitats.

NUMERACY AND MATHEMATICS

- Using counting skills when recording data

- Gather, organise and display collected information, using technologies to present and ask questions about it

- Use mental strategies when collecting data and consider inaccuracies and error

- Estimating areas outdoors and using calculations to check estimates of size

- Using tally marks for recording

- Apply understanding of probability, use this to make predictions and informed choices and assess risk.

HEALTH AND WELLBEING

- Make connections to the community

- Bring about positive change to the school and wider community

- Recognise their own skills and abilities

- Making good use of outdoor space in the school grounds and local area

- Using data collected to make informed choices.

LITERACY

- Talk about and discuss observations and relate to their own lives

- Ask questions to collect information and explain reasons for sorting

- Discuss in groups relationships between living things, behaviour and survival and human activity on environment

- Use literacy skills to navigate websites and mobile apps

- Use literacy skills when using a key to identify species

- Use social media to communicate with others and produce blogs and presentations about their findings

- Present in a variety of ways to peers, at assemblies and to the community.

SOCIAL STUDIES

- Describe the effects of weather and climate on living things

- Consider the importance of environmental management

- Compare and contrast land use of a local environment with that of a contrasting environment

- Evaluate a range of data and use it to research an environmental issue

- Develop their own balanced view of an environmental issue

- Use relevant numeracy and ICT skills to interpret data from maps.

CITIZEN SCIENCE

Early learning, ASN and primary science – Education Scotland's Sciences 3-18 Curriculum Impact Report [**http://bit.ly/sciencesimpactreport3-18**] identified the need to improve sciences provision within early learning, primary and ASN settings. Many establishments in these sectors are finding citizen science activities a great way to enhance confidence of staff in relation to the sciences and to develop engaging programmes of learning for young people.

Relevance and motivation – citizen science allows learners to connect their learning to exciting real-life situations on their own doorstep or at the other side of the world. It also provides them with an opportunity to take action and develop new skills in meaningful situations which can lead to increased motivation for learning and therefore achievement.

Learning for sustainability – Learning for sustainability [**http://bit.ly/lfsonline**], which includes global citizenship, sustainable development education and outdoor learning, is an entitlement for all learners and is embedded within the GTCS Professional Standards for education practitioners. Citizen science offers an excellent way to embed learning for sustainability within the sciences curriculum.

Promoting STEM approaches – don't be fooled by the name! Citizen science should probably be referred to as citizen STEM as it also supports learning in technologies, mathematics and numeracy as well as the sciences and offers a natural opportunity for interdisciplinary learning across the STEM subjects (sciences, technologies, engineering and mathematics). STEM learning has been identified as a priority by the Scottish Government.

Gender in STEM – research [**http://bit.ly/STEMgenderbalance**] shows that girls tend to be attracted to a more humanistic and values-based approach to science. Citizen science provides a relevant context to engage learners in finding out about and caring for the world around them, and as such, may be useful in engaging more girls in STEM subjects.

Parental engagement and awareness of careers – there is a great need to attract more young people into careers in science and STEM but negative perceptions of STEM from parents and wider society can be a barrier. Citizen science provides lots of exciting opportunities for people of all generations to come together to learn about the relevance of science to our communities and world and tackle these perceptions.
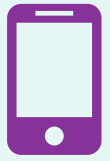
COMMUNITY BIO-LABS

Bio-labs have been set up across the world and allow enthusiastic citizen scientists to carry out innovative bioscience projects.

- Community bio-lab in London: **http://biohackspace.org/**

- Find out how New York high school students discovered cheaper substitute fish used in sushi restaurants using DNA barcoding: **http://bit.ly/1rU1FVz**

CITIZEN SCIENCE GOES DIGITAL

MOBILE APPS

There are a range of apps available for mobile devices, phones and tablets that can be used as part of a citizen science approach.

Websites, smart phones and mobile apps make it easier than ever for individuals to participate in surveys and collect citizen science data. Many mobile devices contain high quality cameras and in-built GPS receivers that allow photos and other data to be easily collected, tagged to specific locations and uploaded so it can be shared with professional scientists.

Websites such as Project Noah (**www.projectnoah.org**) and iSpot (**www.ispotnature.org**) allow members of the public to upload images of wildlife for others to identify, meaning help and advice is only a click away.

Organisations can also upload many images as part of citizen science projects for the public to sort through. This can help them classify thousands of images in a short space of time. For example, Galaxy Zoo (**www.galaxyzoo.org**) has used this method for over 50 million classifications of stars and galaxies and Cancer Research UK use the 'cell slider' site to classify cancer cells for research purposes (**www.cellslider.net**).

Scotland's Environment web
Scotland's Environment Web contains resources across a range of topics, including a list of useful mobile apps:
http://www.environment.scotland.gov.uk/get-learning/

iRecord Ladybird
Help map species of ladybird within the UK:
www.ladybird-survey.org/recording.aspx

PlantTracker
Identify and record non-native invasive species: http://planttracker.org.uk

Air Quality in Scotland
Keep informed about latest and forecast air pollution in your region:
http://www.scottishairquality.co.uk/stay-informed/apps

iGeology
Take a geological map of Britain with you wherever you go to help you learn about the rocks beneath your feet:
https://www.bgs.ac.uk/igeology/

iRecord Butterflies
Identify the butterflies that you see and use your sightings to protect butterflies:
http://naturelocator.org/irecord-butterflies.html

myVolcano
Share your photographs and descriptions of volcanic hazards, as well as collecting samples and measurements of volcanic ash fall: www.bgs.ac.uk/myVolcano

Great British Bee Count
Join the Great British Bee Count to help build a nationwide picture of bees' health:
http://greatbritishbeecount.co.uk

mySoil
Access to a comprehensive European soil properties map within a single app:
www.bgs.ac.uk/mysoil

BirdTrack
Collect casual records of birds on your mobile phone:
http://bit.ly/BirdTrack

Cancer Research UK
Games and apps to help analyse cancer data to allow more treatments to be developed:
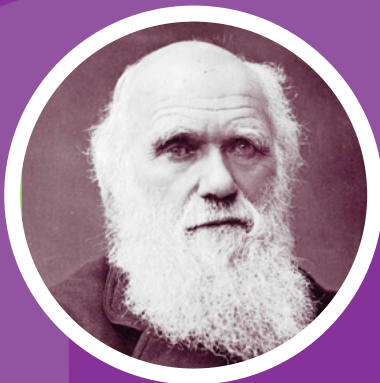http://bit.ly/CancerResearchApps

EVOLUTION OF CITIZEN SCIENCE

In China, both citizens and officials have been tracking outbreaks of locusts for at least 3500 years.

French winemakers have been recording data about grape harvests for almost 700 years and passing the records down through the generations.

Charles Darwin collected evidence from hundreds of keen enthusiasts across the world. Gardeners, diplomats abroad, army officers and naturalists provided Darwin with observations on plants, animals and peoples of the world.

Mary Anning (1799-1847) was not trained as a scientist, but her finds changed science. She found fossils of prehistoric animals on the south coast of England and her fossil-hunting helped change the way people thought about prehistoric history of the Earth.

CITIZEN SCIENCE NOW

Hackathons allow scientists, computer programmers and others to collaborate intensively on a problem and find a software solution

Digital weather stations allow schools to collect and share meteorological data:
www.metoffice.gov.uk/learning

Collecting data using mobile phones and tablets (including cosmic ray data):
http://bit.ly/SciAmCosmicRays

Well-established citizen science projects such as the RSPB Big Garden Birdwatch continue to engage the public with their local environment and collecting data:
http://bit.ly/BigGardenBirdwatch

RESOURCES

Sign up to Education Scotland's **STEM e-bulletin** for monthly updates of all the current issues, news and information about science, technology, engineering and maths: **http://bit.ly/STEMeBulletin**

Visit our **STEM Central in Motion blog** for comprehensive updates and the latest and best information: **http://bit.ly/BlogSTEM**

Visit our **sciences hub page** for more information about sciences within Curriculum for Excellence: **www.educationscotland.gov.uk/sciences**

Network, share and collaborate with teachers from around Scotland on our **Glow sciences community** and download from or contribute to the bank of more than 4000 classroom resources: **http://bit.ly/scienceshome** Glow login required.

Our **STEM Central** website provides high-quality resources, teaching ideas, videos and interactive activities to develop learning experiences relating to sciences, technologies, engineering and mathematics (STEM): **www.educationscotland. gov.uk/stemcentral**

Scotland's Environment Web contains resources across a range of topics: www.environment.scotland.gov.uk/get-learning/

The Froglife website provides resources, games and curricular links related to amphibians and reptiles: www.froglife.org

Zooniverse contains a range of citizen science projects ranging from classifying new galaxies and looking at explosions on the Sun to helping historians understand the lives of ancient Greeks: www.zooniverse.org

Biological Recording in Scotland promotes the gathering of wildlife data in Scotland: www.brisc.org.uk

The UK Met Office Weather Observation website allows anyone to submit their own weather data: http://wow.metoffice.gov.uk/

The Conservation Volunteers work with communities to conserve green spaces across the country, encouraging communities to get involved with citizen science projects: www.tcv.org.uk/scotland/discover/scotland-counts

OPAL provide resources and surveys for citizen science projects from earthworm surveys to looking at water samples from local ponds: www.opalexplorenature.org/

The John Muir Award is an environmental award scheme focused on wild places. It encourages awareness and responsibility for the natural environment: www.johnmuiraward.org

Foldit is an innovative computer game enabling anyone to contribute to important scientific research about how proteins fold: http://fold.it/portal/info/science

CITIZEN SCIENCE IN THE FUTURE…

Emerging technologies will further open up science and scientific data to members of the public, making it more accessible and democratic. Online gaming is playing an increasingly important role in engaging non-traditional audiences and social networking also provides a method of sharing information and expanding the reach of scientific projects.

STIRLING HIGH SCHOOL – JOHN MUIR AWARD AND CITIZEN SCIENCE

Young people at Stirling High School have chosen an option based around the John Muir Award. The aim of this option is to use wild places within the school grounds and further afield to support learning and give learners the opportunity to appreciate and protect nature.

"Citizen science fits in really well with the John Muir Award. Surveying nature is a great way to increase the pupils' knowledge and awareness of their wild place, and of course your results can be used to help look after it. Everyone got involved with surveying trees in and around our school grounds – it was fun and you don't need a high level of experience. The pupils and I have really enjoyed our experience while working towards the award."

Teacher from Stirling High School

REFLECTIVE QUESTIONS

- How can citizen science support programmes in your school such as Eco-Schools Scotland, John Muir Award, and The Duke of Edinburgh's Award?

- How could citizen science activities make learning in science more relevant and engaging for learners?

- What resources and community partners exist in your local areas to support citizen science?

- How can citizen science promote development of skills across the curriculum and also awareness of careers?

- How can citizen science enhance parental engagement?

- In what ways can citizen science help ensure that all learners receive their entitlement to learning for sustainability?