STEM Hubs in School

St Margaret's Primary, Falkirk

This case study will be of interest to practitioners and members of senior leadership teams in primary schools.

Rationale

St Margaret's Primary School committed to focus upon STEM in its school improvement plan with the following goals:

- build capacity in staff and parents by modelling effective practice and promoting family learning
- enhance engagement through STEM learning experiences and support efforts in raising attainment
- embed STEM into our planning and delivery of IDL
- motivate children with a wide range of learning needs and abilities by providing a variety of stimulating STEM opportunities
- enable children to explore a wide range of skills through STEM learning and develop their capabilities in identifying skills they have used and how they could transfer them elsewhere
- ensure children gain knowledge of STEM career opportunities and the importance of STEM in our rapidly-changing world

The plan stated that the school wanted children to:

- manage and take risks
- work together to solve problems and persevere when things don't go as planned first time
- develop the ability to compromise when working with others and listening to opposing views
- build confidence and contribute to group discussions, expressing their own views
- identify skills they have developed and understand where else they may be useful
- reflect on and evaluate their learning experiences and justify their views for change to take place
- be motivated, enthused and engaged in their learning
- build knowledge of the importance of STEM and make the most of these learning opportunities which will benefit them in later life
- identify that STEM is all around us

Implementing the plan

Laura McCafferty was the teacher with responsibility for leading STEM. She gathered feedback from staff which identified a lack of confidence, alongside incorporating STEM into a busy curriculum.

A gradual approach to implementation was therefore developed, to support staff in the development of delivery of STEM.

For further details please contact Laura McCafferty

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Falkirk Council

RAiSE Raising Aspirations in Science Education

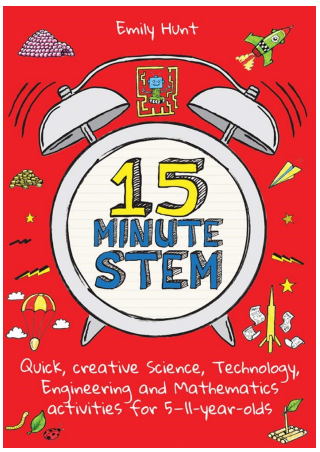
The Wood Foundation

Education Scotland Foghlam Alba

First Steps

Two learning spaces were identified to become STEM Hubs—one for Primary 1 and 2 and the other for Primary 3-7.

Inspired by the Emily Hunt 15 Minute STEM book, 40 challenges were created to promote learners' curiosity and self-discovery. Staff supported the discussion and analysis of results with the children. Each activity was mapped to the Experiences and Outcomes to clearly show how STEM activities aligned to existing learning and curricular drivers. These challenges provided a focus on skill development—with Falkirk's Five Future Skills of Communication, Collaboration, Complex Problem Solving, Critical thinking and Creativity at the heart of them.



Challenge 2 – Engineering in the Arctic

Resources:
• Marshmallows • Cocktail sticks • A large plate or tray

Method

1. First, make the circular base of the igloo on your plate or tray.
2. Then, build up marshmallow layers. Remember to make smaller circles and curve the sides inwards to make your igloo a dome shape. All sides should meet in a single row of marshmallows along the top.
3. Finally, review your design. Is it structurally strong?

Optional Extra: Recreate your structure again without the cocktail sticks. Can you make it strong enough to stand without them? How? What did you have to think about when doing this?

1. Engineering in the Arctic	Why are igloos dome shaped?	Indoor

What will we learn?

An igloo is a dome shaped hut made of compacted snow blocks. Air pockets trapped in the snow make it a good insulator so temperatures inside the igloo are higher than outside and the heat doesn't escape.

A dome is an effective shape for an igloo because it is structurally strong. There is a keystone at the top of the igloo. The keystone is the last block on top of the igloo and is normally larger than the ones used to construct the walls. All the blocks are held in place by the downward force of the keystone.

When building a structure in this activity, we may need to use cocktails sticks for support but weight is enough to hold a real dome together.

Further Investigation

Can you find any keystones in architecture around you? Can you see any dome or arch shapes in architecture around you.

Careers in STEM - Architect, Civil Engineer

Curriculum Links

Science

Materials - Properties and uses of substances - By exploring the properties of different substances and how they can be changed, learners gradually develop their understanding of the connection between structure and properties. They explore the development of new substances which have useful properties, and begin to relate physical and chemical properties to models of atomic structure. Learners begin to use symbols and chemical formulae as a way of communicating information about elements and compounds.

Early	First	Second
Through creative play, I explore different materials and can share my reasoning for selecting materials for different purposes. SCN 0-15a	Through exploring properties and sources of materials, I can choose appropriate materials to solve practical challenges. SCN 1-15a	By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed. SCN 2-15a

Numeracy and Mathematics

Shape, position and movement – Properties of 2D shapes and 3D objects

Early	First	Second
I enjoy investigating objects and shapes and can sort, describe and be creative with them. MTH 0-16a	I have explored simple 3D objects and 2D shapes and can identify, name and describe their features using appropriate vocabulary. MTH 1-16a	Having explored a range of 3D objects and 2D shapes, I can use mathematical language to describe their properties, and through investigation can discuss where and why particular shapes are used in the environment. MTH 2-16a Through practical activities, I can show my understanding of the relationship between 3D objects and their nets. MTH 2-16b

Skills Development

The local cluster schools have an agreed skills progression framework that is used to support the children in identifying key strengths and next steps. A recent addition of mapping these skills to Falkirk's Five Future Skills (Communication, Collaboration, Complex Problem Solving, Critical thinking and Creativity) afforded an opportunity to consider these through a STEM lens and in line with the work in the STEM Hubs. This has helped bring the skills to life.

Laura decided to record a video where the children would talk about the skill they had developed, how they had developed it and where else they may use it. This video was then shared with parents to encourage ongoing positive relationships and links between school and home learning.

The 'Five C's' skills framework has been shared across all Falkirk primary schools to promote continuity and support skills.

The framework developed has been shared here and on the next page.

Early Level

Communication	I can ask and answer questions about my activities I can describe what was done and explain what happened I can discuss similarities and differences in my findings I can repeat, recall and give examples I can share my ideas with other people ** I can listen to others within my group **
Collaboration	I can share my ideas with other people ** I can listen to others within my group ** I can take turns I can share resources I can work with my friends I can work with people I am unfamiliar with
Complex Problem Solving	I can make suggestions about ways to solve a problem I can solve problems by acting out a situation** I can suggest creative solutions to everyday problems**
Critical Thinking	I can make a simple prediction of what might happen I can suggest creative solutions to everyday problems** I can begin to suggest how a STEM learning experience can be improved I can predict, check and give reasons I can sequence, compare and question
Creativity	I can solve problems by acting out a situation** I can explore and observe through play I can imagine, construct, create and organise I can make, dramatise, illustrate and demonstrate

First Level

Communication	I can talk about how STEM impacts my life I can discuss how STEM is used in different jobs and careers I can talk about STEM in the news I can explain, give examples, identify and discuss I can review and report findings I can listen to and value the opinion of others** I can share, explain and justify my views with others** I can suggest ways to solve problems***
Collaboration	I can work well in a group I can take turns and share I can listen to and value the opinion of others** I can share, explain and justify my views with others** I can compromise when working with others
Complex Problem Solving	I can help design, make and use models in STEM learning experiences I can accurately take measurements and record results I can solve problems by looking for patterns and using the guess, check, improve strategy I can remain positive when completing a task, even when things do not work out well I can suggest ways to solve problems*** I can show perseverance when things don't go as planned
Critical Thinking	I can suggest ways to solve problems*** I can categorise information by comparing, contrasting and investigating I can predict what might happen in an investigation and begin to think about why I can identify risks and dangers before completing a task
Creativity	I can predict, plan and improve I can plan, invent and design I can practise, show and construct I can present information in a variety of ways (tables/charts/diagrams) I can report my findings in different ways (speaking/drawing/writing)

Second Level

Communication	I can report on a STEM learning experience using appropriate vocabulary I can discuss the relevance of STEM in careers and in my own future I can debate, experiment, evaluate and conclude I can report, observe and outline I can listen to, value and ask relevant questions about different opinions*** I can share, explain, justify and debate my views with others*** I can discuss and evaluate ways to solve problems**
Collaboration	I can work well in a group to achieve a goal I can show patience when working with others I can ensure everyone has the opportunity to participate in group tasks I can listen to, value and ask relevant questions about different opinions*** I can share, explain, justify and debate my views with others*** I can compromise when working with others
Complex Problem Solving	I can think of ways to solve problems and test them out I can solve problems by using the guess, check and improve strategy I can solve problems by creating lists or tables, working backwards and using logical thinking I can show perseverance and determination when things don't go as planned I can discuss and evaluate ways to solve problems**
Critical Thinking	I can listen to, value and ask relevant questions about different opinions*** I can share, explain, justify and debate my views with others*** I can demonstrate awareness of how STEM impacts on society I can make observations, collect information and measurements using appropriate devices I can examine, calculate and debate
Creativity	I can design, invent, develop and prepare I can construct, apply, adapt and solve I can present data in a variety of ways (tables/charts/diagrams/graphs)

Laura also looked created answer booklets to go with the challenges which encourage the children to identify and transfer the skills developed in other curriculum areas to STEM learning opportunities.

For example, the children may have to keep tallies on how often something happens, they may have to measure distance or create a graph of their findings therefore enhancing their skills in mathematics in a different context with a purpose.

Literacy skills were also enhanced when children wrote up what they did during their STEM activity. For some learners, writing up was a challenge and a barrier to learning, therefore, key questions were developed for children to discuss and they could film each other's responses so the teacher could find out what they had learned and understood. Videos could also be shared with parent/carers to promote discussions at home based on STEM. Use of technology in recording and sharing videos encouraged development of skills in technology.

Key Question card examples

Challenge 1 – Air Powered Car

What did you want to find out?

What did you have to do?

Did it work the first time you tried it?

Did you have to change anything to make it work better?

What surface did your car travel furthest on?

Why do you think it was that surface?

What did you learn from doing this experiment?

Challenge 11 – Fireworks in a Jar

What did you want to find out?

What did you have to do?

How did using different liquids change what happened?

What have you learned or found out?

What skills have you developed?

Answer booklet example

#FalkirkSTEMpire

Try different surfaces.

Surface	Distance travelled

On which surface did your car travel furthest? Why do you think this was?

_____

_____

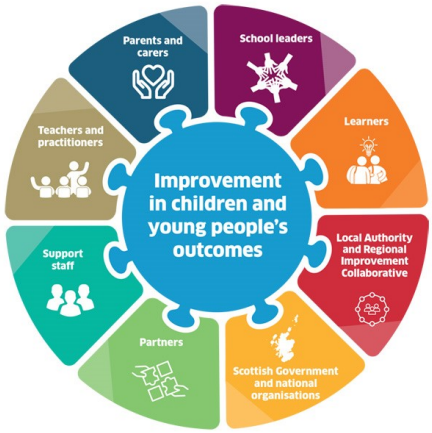
_____

_____

Record your results as a _____ graph below:

Impact

Pre-Covid, parents and carers were involved in the delivery of STEM learning experiences within our hubs. This gave them a deeper understanding of STEM and its importance in future careers. One of the parents has been appointed (though Pupil Equity Funding) to run the STEM Hubs along with one of the Support for Learning Assistants. Their role is to question, supervise, encourage discussion and curiosity and note engagement using the Leuven Scale.

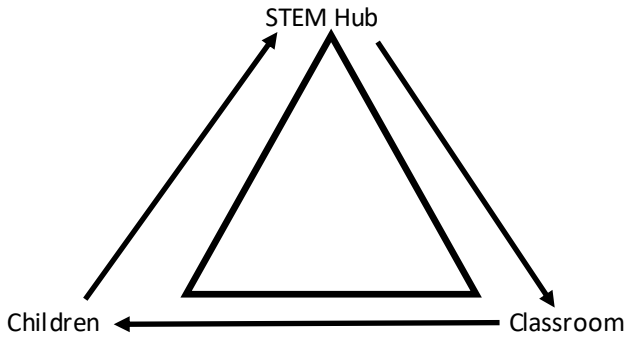


All children from P1 to P7 have at least half an hour each week visiting the STEM Hub to complete a STEM-related task. They develop a wide range of skills such as problem solving and critical thinking. Many existing skills are further consolidated and given a purpose as the children transfer what they know about data handling to support STEM learning when completing tally charts and graphs to present findings. The children may also be asked to write or draw how they completed a task thus reinforcing literacy and skills.

The teaching of IDL, concepts, skills, knowledge and understanding of STEM must happen in the classroom. The children will then develop their understating through investigation, problem solving, communication, challenge and creative thinking in the hubs to then share and assess back in the classroom. For example, P3s learned about EGYPT/dioramas in the class, they then created their own in the STEM room, observing the growth of plants along the river bank, which then took their water from the 'Nile'. They learned about mummification in class then experimented and observed the mummification of apples in the STEM room. This is good practice and linked up relevant, coherent and meaningful learning which hits the design principles of CfE.

Whilst at the hub, children will record their own learning: key skills developed, vocabulary used or learned, annotated diagrams of learning, questions they now have. It is this learning that they will bring back to the class to share and assess.

Following an experience in the hubs class teacher's role is to facilitate STEM discussion time, noting key learning, questions and potential for next steps in learning. There should be triangulation between the classroom, the children, the hubs and back to the classroom again to ensure STEM is embedded throughout and not considered 'stand alone'. STEM is used to enhance classroom practice.



Feedback

Feedback from pupils, staff and parents has been very positive.

Pupils

"I enjoy taking part in different activities and working in small groups."

"I like that we get to do the tasks ourselves and we discover new things so develop our knowledge."

"We work in teams so develop communication and cooperation skills."

Staff

"The STEM hubs are equipped with more than a classroom can provide and have an abundance of opportunities for all learners and all kinds of projects."

"The STEM through stories works well as learners can take their learning from the classroom into the STEM hub and back to the classroom which provides a complete learning experience allowing learners to investigate an idea from question ideas, written notes, sketches and maths questioning to fully working models and prototypes."

"Children are excited to go to the hubs to discover and learn. They develop skills for working independently and with a group. It is not just the Science, Technology, Engineering and the Maths skills that they develop it is inquisitiveness, questioning, perseverance and problem solving which are important life skills which will also help them in the wider word of work."

"All learners can contribute and discover through STEM. Activities can be adapted to different age ranges and pupil abilities."

"Adult support from the STEM leaders and the class teacher help to support and challenge pupils as they work on their STEM activities/tasks or projects."

Parents

"My child absolutely loves STEM. He finds learning very difficult but STEM is totally his thing and he can tell me all about what he has learned and why something has happened. We do lots of STEM learning at home now and loved making our own lava lamp."

"The STEM hubs provide a learning environment that opens up children's minds to new ideas and to try something different."