

**STEM
BOX**

Teacher's Pack

Flood Risk in Falkirk

Digital Version Here



STOP



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Please note: there are some materials required for the activity that are not included in the box. Please jump to page 28 to see a complete kit list and get started!



How To Use This Box

Welcome to the Flood Risk in Falkirk STEM Activity Box

Inside this Teacher's Guide you will find all the information you need to deliver a jam-packed STEM lesson with a hands-on activity, local heritage links and future career inspiration for your pupils!

This document also doubles up as a class presentation: by following the QR code here, you can access the digital version and display the information and images on your interactive whiteboard.

Digital PDF



Introductory Presentation

0-30 mins

What is flooding and why does flooding happen in Falkirk?

Falkirk Floods: Present & Past

Why Settle Near the Water?

Intro to Civil Engineering & Hard Flood Defences



STEM Story Investigation + Hands-on Activity

30-40 mins

STEM Story Investigation + Hands-on Activity



Presentation Continues

40-55 mins

Presentation Continues

Soft flood defences: SuDS. in Falkirk

On completion of this STEM box, please take 5 minutes to fill in our quick and easy evaluation

Pupil Evaluation



Teacher Evaluation



Lesson Objectives



To explore flood risk in Falkirk and discuss personal experiences of flooding in the area.



To introduce the idea that we can affect the likelihood of our communities flooding by how we use the land around us; and that civil engineering is as much about preventing flooding as it is protecting people from flooding or restoring infrastructure after flooding.



To compare and contrast how people in the past managed flood risk with what civil engineers do in the present day



To have an awareness of what it takes to become a civil engineer and of local opportunities to find out more



Curriculum for Excellence links

Science

Through carrying out practical activities and investigations, I can show how plants have benefited society. SCN 2-02b

I can explain some of the processes which contribute to climate change and discuss the possible impact of atmospheric change on the survival of living things. SCN 3-05b

I have contributed to discussions of current scientific news items to help develop my awareness of science. SCN 1-20a

I can report and comment on current scientific news items to develop my knowledge and understanding of topical science. SCN 2-20b

Technologies

Having analysed how lifestyle can impact on the environment and Earth's resources, I can make suggestions about how to live in a more sustainable way. TCH 2-02a

During practical activities and design challenges, I can estimate and measure using appropriate instruments and units. TCH 1-13a / TCH 2-13a

Social Studies

I can consider ways of looking after my school or community and can encourage others to care for their environment. SOC 1-08a

I can discuss the environmental impact of human activity and suggest ways in which we can live in a more environmentally-responsible way. SOC 2-08a

I can consider the advantages and disadvantages of a proposed land use development and discuss the impact this may have on the community. SOC 2-08b

Having explored the landscape of my local area, I can describe the various ways in which land has been used. SOC 1-13a I can explain how the physical environment influences the ways in which people use land by comparing my local area with a contrasting area. SOC 2-13a

Possible extension work linking to measurement in mathematics:-

MNU 2-11b; MNU 2-11c 7; MTH 1-21a; MTH 2-21a / MTH 3-21a



STEM Heritage in a Local Context:

Introduction:

Can you name any **natural disasters** that happen all over the world?

What about here in Falkirk?

Point out that **flooding** is a **natural hazard** and happens frequently in Falkirk as it is an estuary environment, which means it is close to waterways (canals, rivers) and the sea.

Teacher's Note

Follow this link to interactive map of Falkirk (shorturl.at/fltHP). Zoom in and out to point out areas near to waterways (e.g. Camelon, Polmont, Carron..) and coastal areas

Did you know..

Floods are the most common form of natural disaster in the UK; widespread flooding happens at least once a year!

Vocab check:

flooding (n.)

definition: the covering or submerging of normally dry land with a large amount of water

(Scottish) Water, water, everywhere!

Water is a big deal in Scotland, let's now take a minute to appreciate how much of it we have:

How big are Scotland's seas?

Scotland's seas are nearly six times larger than the land area of Scotland and are estimated to be 462,315 km².

How long are Scotland's rivers and streams?

Scotland has more than 125,000 km of rivers and streams varying from small highland burns to deep, wide lowland rivers such as the Tay. That's enough to go round the Earth three times!

That's not all....

There is also a 220 km canal network in Scotland.

There are over 25,500 lochs in Scotland, with the Western Isles and Sutherland having the highest concentration of lochs.



With all this water around, it's no wonder that many areas of Scotland have to deal with extreme flooding events on a regular basis.

So how exactly do floods happen in Scotland?

Here are the most common types of flooding:

a) Fluvial Flooding: happens when rivers, burns and streams overflow or burst following heavy rainfall.

b) Coastal Flooding: from high tides and/or storm surges

c) Groundwater Flooding: happens when the level of water within the rock or soil underground rises

d) Pluvial Flooding: (sometimes known as 'urban' or surface water flooding and/or flash flooding) happens when drainage systems are overwhelmed and water flows out onto the streets. It is this type of flooding that will be demonstrated in the hands-on activity later.

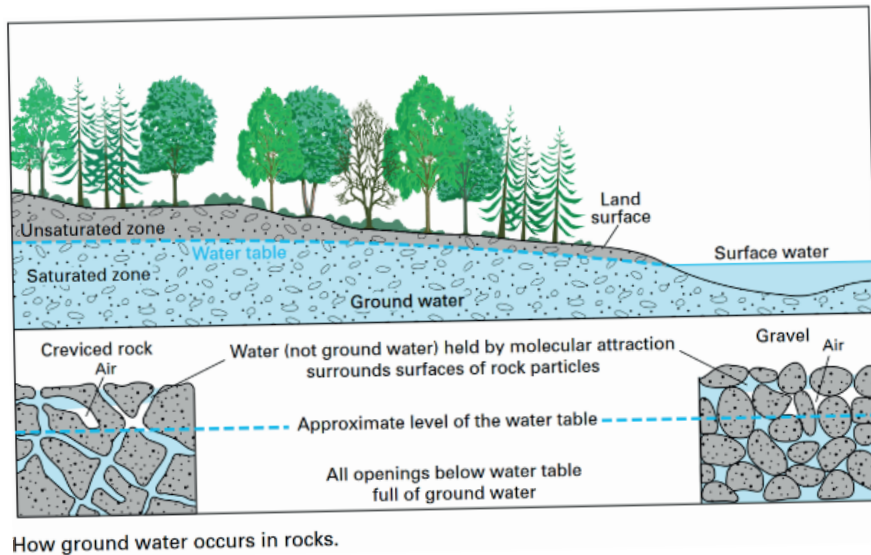
Teacher's Note

See below for some useful additional information and graphics related to these different types of flooding.

Fluvial, Pluvial and Coastal flooding:

<https://www.zurich.com/en/knowledge/topics/flood-and-water-damage/three-common-types-of-flood>

Groundwater

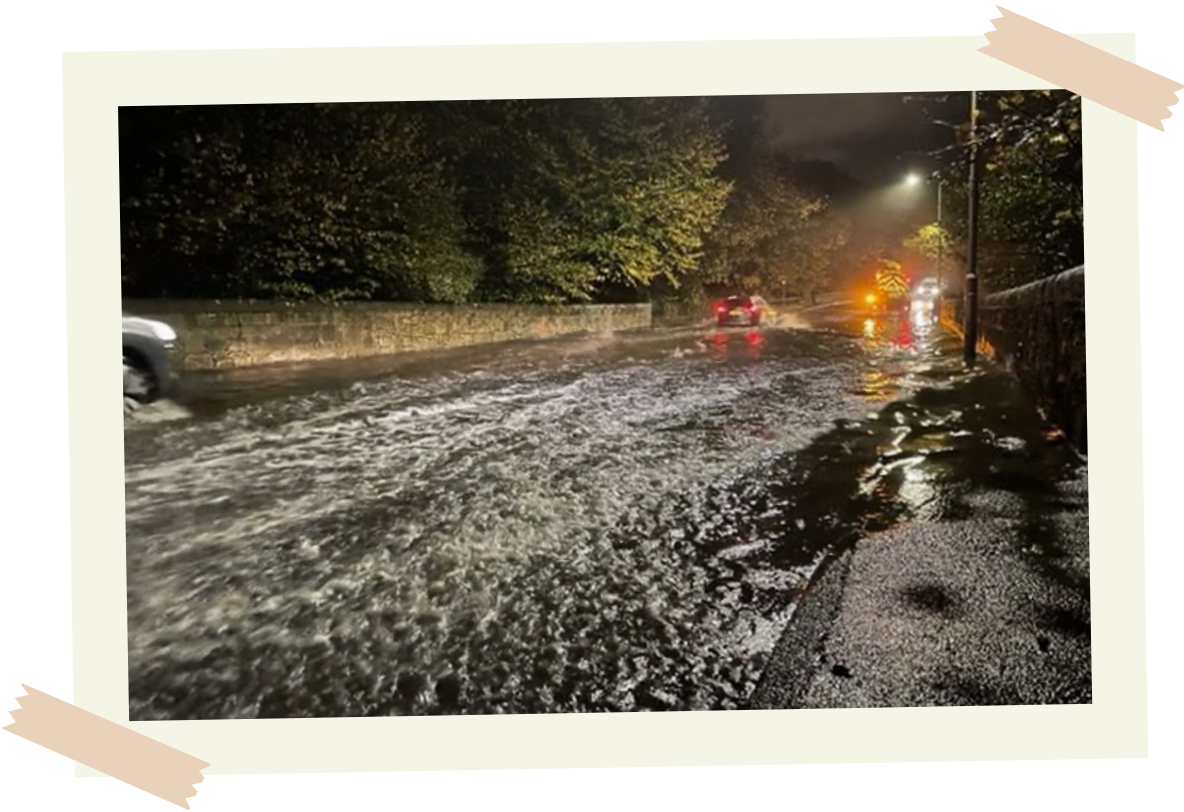


Source: <https://www.usgs.gov/>

- **Groundwater** is water that exists underground in saturated zones beneath the land surface.
- It fills the pores and fractures in underground materials such as sand, gravel, and other rock, much the same way that water fills a sponge.
- Groundwater is relied on by many for drinking water, agriculture and industry.
- It also feeds wetlands and river flows during dry spells and is vital to the maintenance of their rich ecology and biodiversity. (Credit: usgs.gov)

Falkirk Floods of the Present

These photos demonstrate some recent flooding in the Falkirk area.



Flooding on A803 near Polmont, Falkirk, October 2021, Credit: Falkirk Live

<https://www.dailyrecord.co.uk/news/scottish-news/more-flooding-expected-across-falkirk-25320636>

Vocab check:

burn (n)

Creek

a natural stream of water normally smaller than and often tributary to a river



Do you Remember...

the flooding at Cadgers Brae Brewer's Fayre (between Polmont and Grangemouth) in Falkirk after a thunderstorm?

(Link below)

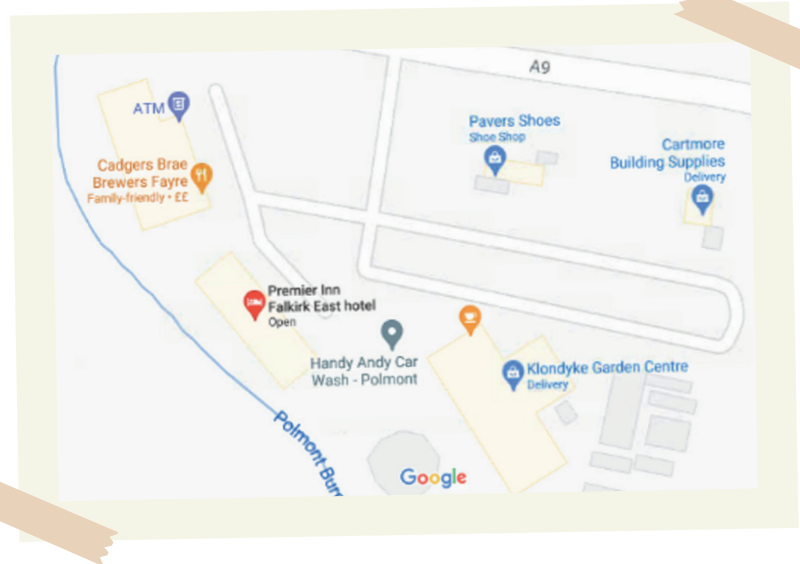
<https://www.dailyrecord.co.uk/news/scottish-news/burn-bursts-banks-falkirk-leaving-18828892>

Teacher's Note

For photos of this recent Falkirk flooding use the link above

Credit: Google Maps

**Look at the flood site
on the map –
Can you identify the source
of this flood?**



Teacher's Note

This quote from the Daily Record article states, "A downpour just before 1pm caused Polmont Burn, which is situated at the back of the Brewer's Fayre, Cadger's Brae, between Polmont and Grangemouth, to overflow and flood the restaurant's car park."

Discuss
Have you ever experienced a flood?
What was it like?



Teacher's Note

This is a good point in the lesson for pupils to reflect on their own experiences and make personal connections to the subject matter. If they haven't ever witnessed a flood in-person, ask instead if what they have seen was depicted online or in the news.



Falkirk Floods of the Past

Teacher's Note

Here are a range of questions you could ask your pupils as they look through the archive photos below. You could print the photos off so pupils can have a closer look.

Point out that these flood events took place at different times, two in the Grangemouth area, and that this area is especially prone to flooding due to its proximity to the River Carron and its tributaries.

Now let's look through archive photos of flooding in the area:

What can you see? What is happening?

What information can we gather from the photograph captions?

What can we deduce from clues in the photograph itself?

What might it have been like for people experiencing flooding in the past?

How might it have been different from how we experience flooding today?

Teacher's Note

If you have time, you could ask pupils to brainstorm their own questions relating to these photos, e.g. who are those children? Are they siblings or friends? How do they feel about their street flooding? Etc. This is a good way of generating class discussion. Further, you could use these photos, questions and discussion points as creative writing prompts.

Vocab check:

ford (n.)

a shallow place in a river or stream allowing one to walk or drive across



Flooding at Bonnybridge Ford, c.1893
Credit: unknown photographer via Falkirk Archives



Boy with yacht in flooded street, Union Road, Grangemouth. 1920

Credit: Photographer John Peat Munn via Falkirk Archives



Flooding in Grangemouth, c.1900 (Daltharo Rd)

Credit: Photographer unknown via Falkirk Archives



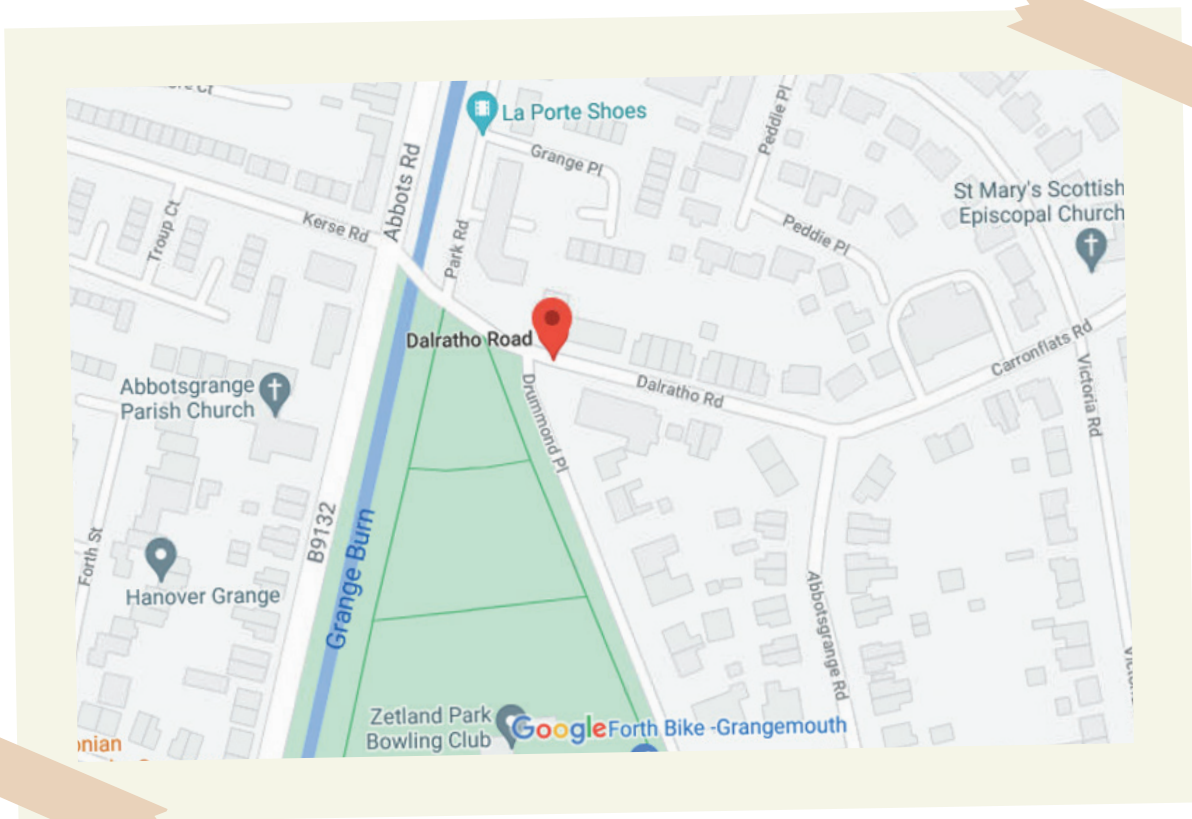
Flooding Newhouse Rd, Grangemouth, January 1926

Credit: Photographer John Peat Munn via Falkirk Archives



More recent flooding on Daltharo Rd

Credit: Photographer: Jacobs, August 2020 via grangemouthfloodscheme.com



Credit: Google Maps

Look at Dalratho Road on the map, can you identify the main source of the flood?

Teacher's Note

Grange Burn runs past Dalratho Rd. It is likely that this overflowed following heavy rain.

Discuss

Why do you think these houses and other buildings were built so close to the water?

Vocab check:



settlement (n)

a place where people establish a community (typically one which has previously been uninhabited)

Vocab check:



floodplain (n)

an area of low-lying ground adjacent to a river, formed mainly of river sediments and subject to flooding.

Many towns and cities all over the world were established on floodplains next to natural rivers and streams. In fact, I bet you can't think of a single Scottish city or town that isn't located around or near a river!

Did you know..



Even Glen Quoich near Braemar, is 65 km from the sea and estimated to be the furthest part of Scotland from the sea has the River Quoich and Linn of Quoich nearby, which in recent years has also been disrupted by flooding!

<https://www.pressandjournal.co.uk/fp/news/aberdeen-aberdeens-hire/1834197/linn-of-quoich-car-park-bridge-to-be-replaced-after-storm-frank-flooding/>

Falkirk is no exception: many of the towns within our council ward were originally small settlements located near to the River Carron and /or the River Avon and their tributaries

Teacher's Note

Here you could revisit the Google Map of Falkirk and point out all the Falkirk towns that are close to the River Carron or River Avon and their tributaries (fords, creeks, burns etc).

Why Settle Near the Water?

There were several reasons people throughout history all over the world chose to do this:

Farming:

The water from rivers provides rich soil for growing crops

This meant that the people in the settlement would never go hungry and could trade crops with other settlements.



Cattle grazing by the River Avon, c. 1975

Photographer: Alexander Gentles Fyfe via Falkirk Archives

Transport:

Before roads and motor engines were invented, bodies of water provided travel and transportation via boats, so that people could easily trade goods with other settlements.



Boat at old harbour, River Carron, c.1880

Credit: Photographer unknown via Falkirk Archives

Cleaning:

Nearby rivers were very useful sources of water for washing!



Washing Lines at West Carron, c.1890. Credit: Photographer unknown via Falkirk Archives

Can you think of any other reasons why settling near water would be good idea?

- (Fishing, swimming, leisure – boat rides)

Where exactly is the best place to position near a river?

- Settlements often grew up around shallow, fording points on rivers.
- By their nature these could be in low lying, flood prone areas but as they were the easiest way to cross over a river, therefore they were the best place to be.
- Early settlers decided the risks were worth the benefits but remember: they weren't dealing with the effects of climate change that we are today.

Therefore, many Falkirk settlements (e.g. what would later become Grangemouth, Camelon) are located in areas subject to flooding.

Why does this matter to me?



Woman Standing in Flooded Street, Union Road, Grangemouth, 1920
Credit: Photographer: John Peat Munn via Falkirk Archives

1

Falkirk still experiences heavy flooding on a regular basis. This is a serious problem as it causes major disruption of public services, costly damage to vital infrastructure and houses, sometimes injury and occasionally even death.

2

Climate change is also making things much worse: as we experience warmer, wetter weather and rising sea levels, our drainage systems (many of which were built 100s of years ago) are simply not fit for purpose anymore. The risk of flooding is therefore on the rise.

3

In brief, We have been left with a legacy of flooding problems that require constant monitoring, analysis and management by trained professionals.

Teacher's Note

If pupils are keen to find out more about the potential impact of climate change on Falkirk, you could use the information reported in this new article as a starting point
<https://www.heraldscotland.com/news/19183447.areas-scotland-underwater-2050/>

So, whose job is it to sort all this out?

It's the responsibility of many professional people!

Let's focus on one job and see what we can find out....



Teacher's Note

Here pupils will learn more about the role of Civil Engineers in flood risk management. If you wish to explore Civil Engineering further, please see the 'STEM Career Pathways' section on page 37

Meet: the Civil Engineers!



What does a civil engineer do exactly?

A Civil Engineer is someone whose job it is to **design and build infrastructure**. It usually means large structures, like bridges, dams, buildings, and tunnels.

Civil Engineering has been a profession for thousands of years, and from very early on civil engineers had some understanding of where to position buildings in order to minimise flood risk.

Vocab check:



infrastructure (n.)

term used to describe the facilities which support modern human life, e.g. water supply, sewage plants, housing, roads, schools, hospitals, airports, community meeting places, business and government buildings, bridges, railways.

Did you know..



From ancient history we have examples of structures being built so civil engineering as a concept has been around as long as people have!

The term "civil engineer" was coined by John Smeaton in the 1770's to differentiate this type of engineers from military engineers.

However, for a long time big infrastructure projects – such as building roads, bridges, and public buildings – did not have to comply with the strict rules around flood management we have in place today.

In general civil engineers in the past tended to favour 'hard' flood defences: walls, dams, reservoirs and special types of materials that were able to withstand intermittent flooding.

Hard flood defences were and still are used by civil engineers in two ways:

- to protect existing buildings and settlements from flooding
- when planning new-build developments



Did you know..

As artificial lakes of fresh water, reservoirs in fact have many different functions.

For example, these reservoirs in Falkirk were not built for flood defence, rather, to secure clean and safe water supply for the area.

Find out more about the impact that great engineering has had on Falkirk:

<https://www.youtube.com/watch?v=8NHRqaYrfhQ>



Carron Dam

Credit: Photographer: Alexander Gentes
Fyfe via Falkirk Archives



Millhall Reservoir, Polmont

Credit: Photographer: Alexander Gentes
Fyfe via Falkirk Archives

Vocab check:



Drainage (n.)

the natural or artificial removal of a surface's water from an area with excess of water

Did you know...



The Victorian era is the period of time when Queen Victoria was on the throne, from 1837 – 1901.

That means that any drains designed during this time are anything from 120 to nearly 200 years old!

Even so, for a long time civil engineers didn't think about flooding as much or in the same way as they do today.

Drainage was a significant public health issue in the Victorian era with the expansion of urban populations after the industrial revolution.

The provision of clean drinking water and safe removal of waste water was crucial in reducing disease.

Many of our drainage systems in the UK are still those designed by Victorian engineers.



Queen Victoria. Credit: Photographer: Bassano, 1882 via Wikipedia

Victorian-style drain cover, made in Grahamston, Falkirk. Credit: Robert Gibson via Falkirk Archives

By the late 20th century, increased rainfall events were causing contamination issues in our waterways. When there was heavy rainfall, the treatment works couldn't cope with the increased volume and untreated sewage would flow into rivers and seas.

What kind of problems do you think this might have caused?

Teacher's Note

Ensure pupils understand the environmental impact of this, e.g. water pollution spreading diseases to humans and animals, damage to river ecosystem, not to mention the unpleasant smell!

To minimise the risk of this happening, civil engineers have masterminded highly technical systems designed to separate surface water drainage from foul drainage.

Did you know..

Despite the best efforts of civil engineers, drainage of our waste water is still a problem today as rainfall increases and our sewage systems fail to cope – see here to find out more....

Scotland's growing sewage spill problem

<https://www.bbc.co.uk/news/uk-scotland-58040852>



Today still, sometimes hard flood defences are the only option for civil engineers when working out the best way to protect existing structures and buildings.

Did you know..

The Grangemouth Flood Prevention Scheme is currently the largest flood defence project in Scotland! This project aims to protect Falkirk's communities at risk from both tidal and river flooding. Construction could start in 2024, with completion in 2035. It will cost around £220 million! Find out more here:

<https://www.grangemouthfloodscheme.com/>



Flood Management Strategies Today

When it comes to flood management today, Civil Engineers think more about 'soft' engineering strategies.

Let's take a closer look at these two approaches side by side in relation to flood management...

Vocab check:



Hard engineering (n.)

man-made structures that reduce flooding; intervenes with river's natural process

E.g. dams, channel straightening, building levees/embankments, and flood relief channels

Vocab check:



Soft engineering (n.)

Defences that work with the river system, rather than against; less invasive than hard engineering

E.g. forecasts and warnings, preparation, flood plain zoning, planting trees, and river restoration

Teacher's Note

Use the images via this link to demonstrate to pupils the difference between hard and soft flood defences

<https://www.bbc.co.uk/bitesize/guides/zx9kfrd/revision/3>

Discuss

What is the difference between hard and soft engineering strategies?

Do you think one is better than the other? Explain why you think this.

Let's explore more in our STEM Story Investigation...

Teacher's Note

At this point in the lesson we recommend you do the STEM Investigation (jump to pg. 27) as this will effectively demonstrate 'soft' flood defences for your pupils, which you can then go on to discuss after the activity is finished

Presentation Continued

after STEM Investigation

Teacher's Note

The second discussion will introduce the concept of sustainable urban drainage systems (SuDS) and how civil engineers today use these to help mitigate the risks of flooding when working on new and existing developments.

Watch the animation "Ever wondered where the rain goes?" (3½ minutes)

<https://www.youtube.com/user/susdrain>

Credit: Susdrains

Recap from video:

What are SuDS ?

Why are SuDS. used today?

SuDS = sustainable urban drainage systems.

Civil engineers today use SUDS - an example of 'soft' defences - to prevent flooding as they believe that our built environment should not be at the expense of the natural environment; and that we, humans, should be living in harmony with our natural environment.

Civil engineering today is as much about mitigating the effects of flooding as it is protecting people or restoring infrastructure after flooding.

Where possible SuDS allows Civil Engineers to work with nature, allowing flooding to happen but in a more controlled manner. It's lower cost both economically and environmentally, improves river quality and can create natural, outdoor spaces for people, flora & fauna to enjoy.

Discuss

Discuss: have you seen any of these SuDS near where you live?

- Wetlands
- Permeable paving
- Swales
- Wet basins and ponds
- Dry basins
- Tree pits
- Rain gardens
- Green roofs

<https://www.nature.scot/professional-advice/placemaking-and-green-infrastructure/green-infrastructure/sustainable-drainage-systems-suds>

Teacher's Note

You could play and stop the video at certain points or alternatively access Nature Scotland's photos of SuDS in Scotland via the link above

PLENARY: Flood Risk in Falkirk Quiz



Questions

1. What is the most common type of natural disaster in the UK?
2. How long are Scotland's rivers and streams?
a) 125,000km b) 250,000km c) 525,000km
3. Which of these rivers does NOT run through Falkirk?
a) River Carron b) River Clyde c) River Avon
4. What was the cause of the flooded car park between Polmont and Grangemouth in 2019?
a) River bursting its banks
b) Downpour causing Polmont Burn to overflow
c) Coastal flooding during a storm
5. Give one reason why people in the past chose to settle near rivers and streams:
6. How is climate change increasing flood risk?
a) Thermal expansion of the oceans as they warm up, leading to sea level rise and coastal flooding.
b) More extreme weather conditions will lead to river flooding.
c) Both of the above
7. Name an example of each type of flood defence:

Hard defence:

Soft defence:
8. What does SuDS stand for?
9. Give 2 examples of SuDS found in Falkirk

Answers

1. Flooding is the number 1 natural disaster in the UK!
2. a) 125,000km
3. b) the River Clyde runs through the city of Glasgow and the counties of Argyll, Renfrewshire, Lanarkshire, Dunbartonshire, and Inverclyde.
4. b) Downpour causing Polmont Burn to overflow
5. Farming, transport, cleaning, leisure
6. c) Both
7. Hard defence: e.g. dams, reservoirs, embankments, flooding channels; Soft defence: e.g. forecasts and warnings, preparation, flood plain zoning, planting trees, and river restoration. Any SuDS.
8. SuDS stands for Sustainable Urban Drainage System
9. Wetlands, Permeable paving, Swales, Wet basins and ponds, Dry basins, Tree pits, Rain gardens, Green roof

STEM Story Investigation

Heavy rain and surface water flooding have been forecast right across Falkirk, with the risk of flooding impacting vital power connection throughout the region, including generators at water treatment plants which are beginning to run out of fuel.

Storm water and untreated water releases could occur in the area at significant rates impacting local school parks, residential streets, commercial farmland and a popular nature reserve.

Civil Engineer Ella is strategizing on where flooding is most likely to take place so that she can put systems in place to prevent it, and you are on her team.

Can you help Ella find out which type of land use will cause the deepest flood?

Follow up questions:

- How does this information impact the community?
- What defences could your team implement at each site to make in the initial decisions/response?
- Are these hard or soft flood defences?
- Which agencies would need to be notified or involved in this effort?



STEM Story Investigation

Digital PDF



Teacher's Note

Please access the risk assessment for this activity via the QR link:

Here you can also access digital versions of worksheets for pupils to record plans, predictions and results (also found on pg. 32-36 of this booklet).

STEM Investigation summary:

This investigation will demonstrate the effectiveness of different SuDS (sustainable urban drainage systems) at mitigating flood risk in built up areas. Pupils will ensure their test is fair, make predictions, record and reflect on their results.

Pupils will be introduced to the idea that we can affect the likelihood of our communities flooding by how we use the land around us and that civil engineering is as much about preventing (or rather, mitigating the impact of) flooding as it is protecting people from flooding or restoring infrastructure after flooding.

Complete Kit list per box:



IMPORTANT TO NOTE:

Materials in red are not included in the box!!

- 4x paint roller trays pre-prepared as per instructions below
- Soil
- **a handful of sticks/plant matter and turf** (see below)
- **4x empty 2l drinks bottles** with holes in the lids-(not essential but creates a nice 'rain' effect. **Watering cans** or similar could also be used)
- 4x Rulers
- 2x 500g bars of modelling clay (you could also use plastic building blocks, or any other materials that would create an impenetrable surface area. Polyfiller works well but you would need to complete a risk assessment to safely use and dispose of this material in the classroom.)



Teacher preparation (prior to lesson):

In the day(s) before the lesson:

1. Take 4x 2l plastic bottles and if possible pierce holes in the lids (or watering cans if using instead)
2. Dig up a small (20cm²) square of turf and gather some sticks, leaves and other plant matter from outside.
3. Label the trays 1, 2, 3 and 4.
4. Use the modelling clay to create a “reservoir” in trays 1, 2 and 3 -see photo (b). Tray 4 should have the whole shallow part of the tray filled. This represents hardstanding which could be a tarmac surface like a school playground or road, or a paved surface like a driveway or patio.



Photo (a)



Photo (b)

In the lesson, with pupils:

5. When you are about to run the activity, ask pupils to assist you in filling in the shallow parts of the remaining three trays as follows;
 - Tray 1: just soil
 - Tray 2: just turf
 - Tray 3: turf and collected plant material (in photo (c), an old Christmas tree!)
 - Tray 4: nothing added– just the modelling clay or whatever material you are using.

So that pupils can easily distinguish which is which, the trays should be labelled as follows:

- Tray 1: 'Soil'
- Tray 2: 'Grass'
- Tray 3: 'Forest'
- Tray 4: 'Hardstanding'



Photo (c)

(All Photos Above)

Photo credit: ICE Scotland

Activity in class:

Divide the class into 4 groups. Each group should have an empty 2l bottle and be given one of the pre-prepared trays.

Explain what the materials in each tray represent – ensure pupils understand the differences between them.

Explain clearly what they will be doing: pouring 'rain' water from the bottles over their tray and then carefully observing and measuring the 'run-off' water, that is, how much water collects in the deeper part of the tray. The group that measures the most run-off water has the tray which represents the land which would experience the most – the deepest- flooding, and therefore poses the most significant flood risk.

Acknowledge that this activity might seem simple enough, but in order for this to be a fair investigation, we need to be mindful at every step.

Ask, what steps can we take to ensure this is a fair test?

Firstly, bottles should be filled up with the same amount of water. If the bottles are all exactly the same then this should be straightforward, but if they are different bottles, some kind of measuring jug should be used.

Secondly, how are we pouring the 'rain' onto the trays? If using holes in the lids, there needs to be the same number of holes. If not, then the water needs to be carefully poured all over the tray as evenly as possible (without any spilling onto the floor).

Thirdly, run-off water should be measured using the same type of ruler provided in the STEM box. Rulers need to be positioned in the same place across all 4 trays and measured consistently.

Now ask pupils to make predictions:

Ask, what do you think is going to happen in each tray and why?

Pupils could identify the trays that they think will collect the most water and the least, making sure they are able to explain why they think this.

Once the groups have agreed on these measures and discussed predictions, you can make a start. It is up to you whether you do each tray one by one as a whole class or set them off individually.

Once the 'rain' has been poured and run-off measured, groups should then come back together and feedback as to the depth of water they measured.

Possible questions:

Were your predictions correct? Why / why not?

Which land use had the deepest flood?

Which had the least amount of run-off?

Can you explain why each tray had a different amount of run-off? What factors were influencing the amount of run-off that collected in the deeper part of the tray? Why do you think this is?

Extension Ideas:

- The pupils could find an appropriate graphical method to show the different run-off amounts for each land use. These online resources may be useful:
- <https://www.bbc.co.uk/bitesize/guides/zrg4jxs/revision/1>
- Pupils could create their own mini 'SUDS' model – in a plastic container – using recycled materials and/or Lego (or similar) to represent the built environment.
- Pupils could carry out a survey of the grounds of the school to determine how much is free draining and how much is hardstanding. This could be drawn on a plan and percentage areas calculated.
- Pupils could consider their school neighbours and the impact it would have if they turned their entire school grounds into hardstanding
- SuDS. treasure hunt: If there is a new housing development nearby, the pupils could go and look for SUDs features.



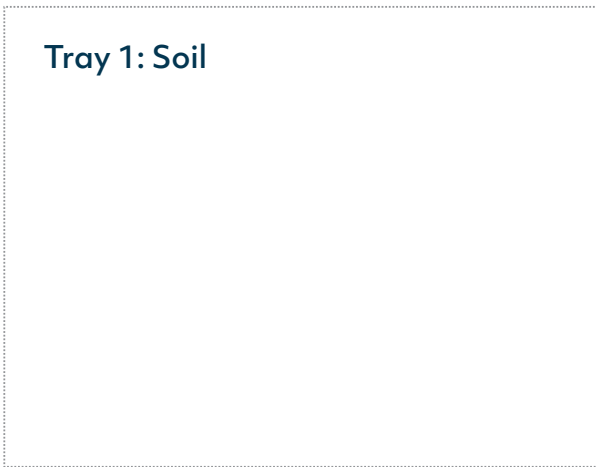
This activity has been adapted from the 'Flood Risk Activity' originally created by the Institution of Civil Engineers (ICE).

Flood Risk in Falkirk: Planning and Predictions

I am investigating:

Before pouring the water, **draw and label** a diagram of the materials used in each land use tray, adding a brief description of what each tray represents beneath:

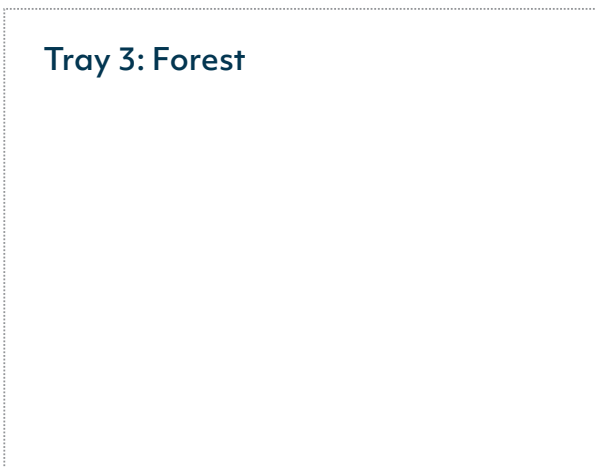
Tray 1: Soil



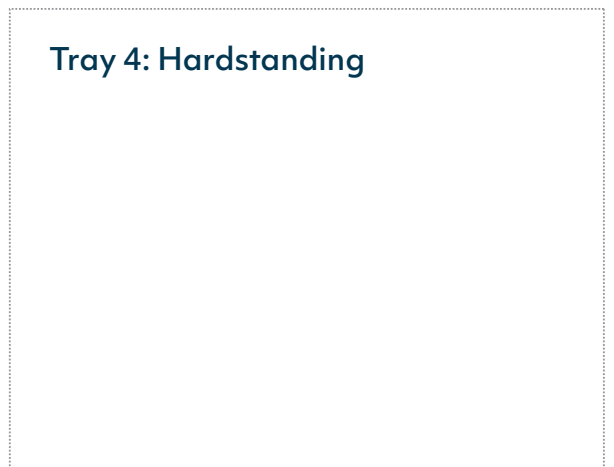
Tray 2: Grass



Tray 3: Forest



Tray 4: Hardstanding



How will you ensure this is a fair test?

Predictions: what do you think will happen once we have poured the 'rain' water over each tray?
Explain your answers as fully as you can.

Tray 1: Soil

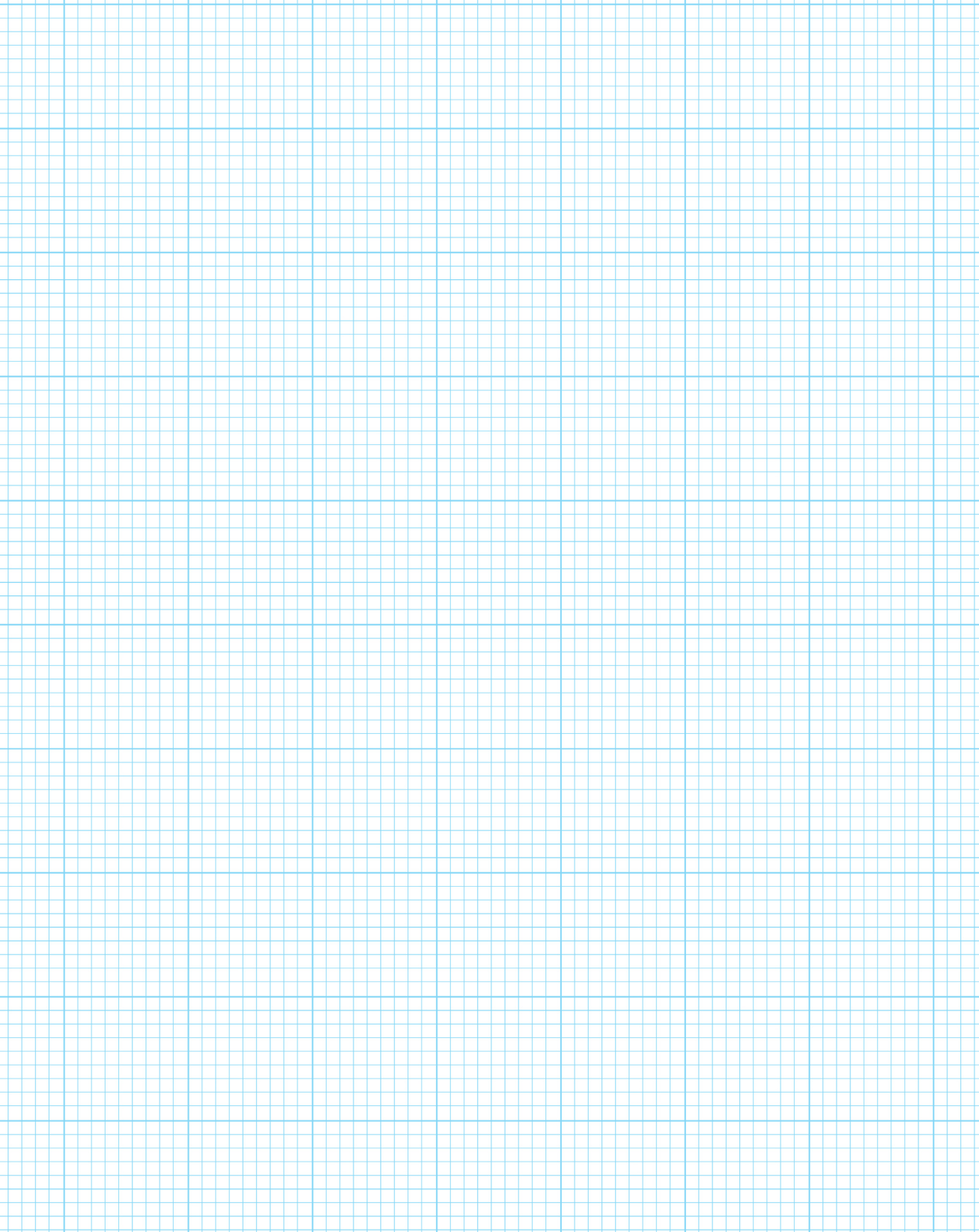
Tray 2: Grass

Tray 3: Forest

Tray 4: Hardstanding

Extension:

Can you choose an appropriate graphical method to show the different run-off amounts for each land use? Ensure that you properly label your graph.



Analysis

Which land use had the most run-off and therefore the deepest flood?

Which had the least amount of run-off?

Can you explain the differences in run-off measurements? What factors were influencing the amount of run-off that collected in the deeper part of the tray?

Career Pathways: Civil Engineering

Thinking about a career in civil engineering? The ICE is a great place to start!



What is ICE?

The Institution of Civil Engineers (ICE) in Scotland is a professional body that organises knowledge, events and promotes civil engineering by working in partnership with industry, government and education. With over 8000 members, ICE represents those that design, build and maintain Scotland's transport, water supply and treatment, flood management, waste and energy infrastructure.

Check out this video from ICE to find out what civil engineers do and how they have shaped our world...<https://www.youtube.com/watch?v=Rib0qYAxsPY&t=16s>

Here are 3 real-life civil engineers talking about their career pathways:

Scott is a Flooding Engineer: <https://vimeo.com/651685730>

Gillian is a Geotechnical Engineer: <https://vimeo.com/651684340>

Kevin is a Roads Engineer: <https://vimeo.com/651687057>

Here are Civil Engineers from around the world:

<https://www.youtube.com/watch?v=53WOV0IEor0>

Discover more:

Civil Engineering explained: <https://www.ice.org.uk/what-is-civil-engineering>

How to become a civil engineer: subjects to study; civil engineering as a career; degrees or equivalent <https://www.ice.org.uk/what-is-civil-engineering/how-can-i-become-a-civil-engineer/advice-for-under-16s>

ICE YouTube channel https://www.youtube.com/channel/UCrREcMC_0O2dHG3GuhC9LIA

Did you know? Civil Engineers specialise in a variety of areas including:

- Airport Engineering
- Geotechnical/Soil Engineering
- Harbour Engineering:
- Road Engineering:
- Hydraulic/Water Resources Engineering
- Irrigation/Drainage Engineering
- Engineering for Local Government
- Materials and Testing Engineering
- Pipeline Engineering
- Railway Engineering
- Structural Engineering

Useful Links for further exploration:

<https://cecasotland.co.uk>

<https://www.wes.org.uk/content/shes-engineer-1>

Examples of Employers:

SEPA: <https://www.sepa.org.uk>

Kelburne Construction:
<https://www.kelburneconstruction.co.uk>

ARUP: <https://www.arup.com>

Jacobs Engineering Ltd: <https://www.jacobs.com>

Balfour Consultancy Ltd:
<https://www.balfourengineering.com>

BAM Nuttall: <https://www.bamnuttall.co.uk>

Laing O'Rourke: <https://www.laingorourke.com>

Scottish Southern Energy: <https://www.ssen.co.uk/>

Falkirk Council:
<https://www.falkirk.gov.uk/services/jobs-careers/>

Explore Further



Visit the following organisations online

Teaching resources

Beat the Flood – An activity created by Practical Action

<https://practicalaction.org/schools/beat-the-flood/>

Flood Defence – a DIY Challenge Day resource created by the Institution of Engineering and Technology (IET)

<https://www.stem.org.uk/resources/elibrary/resource/34127/flood-defence>

Further Civil Engineering resources created by the Institution of Civil Engineers (ICE)

<https://www.ice.org.uk/what-is-civil-engineering/inspire-the-next-generation/educational-resources>

More STE(A)M (Engineering) activities for primary and secondary pupils, created by the Engineering Development Trust (EDT)

<https://www.etrust.org.uk/primaryresources>

<https://www.etrust.org.uk/secondaryresources>

Background reading and links for practitioners

Susdrain

Susdrain is a community that provides a range of resources for those involved in delivering sustainable drainage systems (SuDS).

Diffuse Pollution Management Group(DPMG) - ensures that actions to reduce diffuse pollution are managed effectively by working together with rural, environmental and biodiversity groups.

Fish and Fisheries Advisory Group - supports the RBMP process and contributes to the development and delivery of relevant elements of river basin plans, including understanding the status of fish stocks in Scotland; and reviewing and improving our fish classification results.

National Advisory Group - advises on and supports the development of river basin planning in Scotland. It has a number of roles, including the preparation, delivery and implementation of the river basin management plans.

Responsible authorities - Responsible authorities are bodies that work with SEPA to assist with the development and implementation of river basin planning, and include:

- NatureScot
- Scottish Water
- Forest and Land Scotland
- Scottish Canals
- Local authorities:
- District salmon fisheries board
- National park authorities

River Basin Management Planning - SEPA is working in partnership with many sectors, public bodies and non-governmental organisations, to carry out these responsibilities and implement the plans. The RBMPs encourage new ways of working together to manage and improve our water environment through more effective co-ordination between partners.

Scottish Environment Protection Agency - has statutory responsibilities around the monitoring and regulation of water. SEPA also manages a £2million annual Water Environment Fund which provides funding to projects that aim to help restore Scotland's catchments from the source, through rivers, lochs and floodplains, into estuaries and out to sea.

Scottish Water - Scottish Water is a publically owned company with responsibility for supplying mains drinking water and for removing and treating waste water. It is responsible for the network of water and sewer pipes. They provide 1.3 billion litres of fresh drinking water to homes and businesses across Scotland – enough to fill 52 Olympic-sized swimming pools – every day. They maintain over 30,000 miles of sewer pipes, enough to go round the UK coastline three times, and over 1,800 treatment works which take away 840 million litres of waste water every day before returning it safely back into the water cycle.

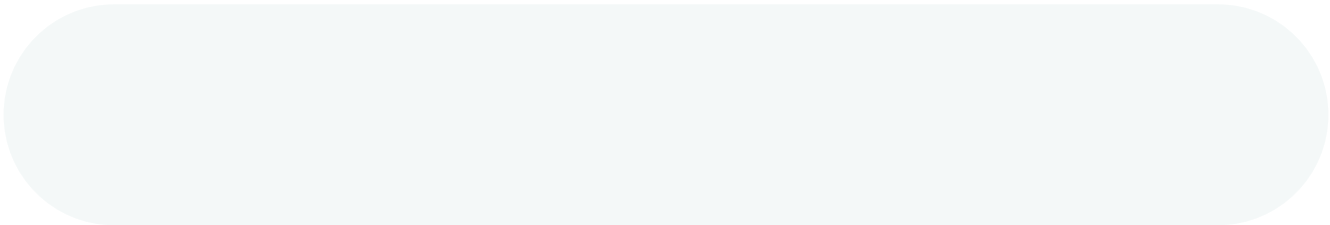
The Scottish Government - has policy responsibility for maintaining and improving the quality of all fresh and marine waters in Scotland.

Source: SEPA

Certificate of Completion



This certificate is awarded to



for the completion of the **Flood Risk**
STEM Box Experiment



Taking care of your STEM Box

Thank you for choosing to use this STEM Box resource in your classroom. In preparation for the lesson we wanted to include a few helpful pointers to ensure the activities go as planned:

To enable a smooth introduction to this topic of Flood Risk for everyone, we have included teacher's notes alongside the lesson script. There is also a whiteboard-friendly version of the information to be accessed on your digital board or laptop.

Within the activity section, we have provided the majority of resources needed for pupils to carry out this investigation, however we reasoned that we would be better off asking teachers to source a few extra materials to save on unnecessary costs (and the environment!). The materials you will need to gather yourself are clearly listed on pg. 28

We have designed this investigation as shared between 4 groups of 7 or 8 pupils in a 30-pupil class, it can also be easily adapted to suit smaller or bigger groups or individuals.

If you need additional copies of any of the worksheets, please feel free to photo copy from the teacher's guide.

COVID 19: The STEM box is designed in such a way as to encourage learning in a way that works socially distanced or within small groups/pairs where pupils can use their own tools independently and share where appropriate. Wiping down of any shared item is encouraged.

Please keep your STEM Box in a cool, dry location The box is made from 75% recycled material, 100% recyclable & degradable The worksheet wallets included are 100% recyclable The packaging can be used more than once. We encourage reuse where appropriate by keeping your printed Teacher's Guide handy, and placing all unused materials or worksheets back In the box for another class. If using we recommend that you prepare the water bottles with holes in the lid prior to the lesson.

Flood Risk in Falkirk

Content creation and curation supported by Alison Ward at ICE Scotland. STEM Activity originally created by Alison Ward at ICE Scotland.

Compiled and Edited by Natalie Allison and Harriet Ward

Graphic Design: Bluestone 98

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This STEM box has been funded by National Lottery Heritage Fund as part of Great Place Falkirk: Landscape, Industry, and Work project and the Scottish Government as part of Falkirk Science Festival.

Risk Assessment



Warning:

The STEM Box is a Science Experiment Kit Not suitable for children under 8 years

For use under adult supervision

Some parts may cause skin or eye irritation

Some parts may be Flammable

May Contain Small Parts

Recyclable

Handle with Care Store in a cool, dry place

For Educational Purposes Only

