Scottish Water
Always serving Scotland

The history of water and waste water services

Second level

Description of module

This is the module most focused on some historical aspects of water. It does this by looking at the development of technology, and explores this by means of research, and by challenging pupils to match the ingenuity of ancient peoples.

Main experiences and outcomes

Expressive arts

I have the opportunity to choose and explore an extended range of media and technologies to create images and objects, comparing and combining them for specific tasks.
EXA 2-02a

Health and wellbeing

Opportunities to carry out different activities and roles in a variety of settings have enabled me to identify my achievements, skills and areas for development. This will help me to prepare for the next stage in my life and learning.
HWB 2-19a

Literacy and English

As I listen or watch, I can make notes, organise these under suitable headings and use these to understand ideas and information and create new texts, using my own words as appropriate.
LIT 2-05a

Social studies

I can use primary and secondary sources selectively to research events in the past.
SOC 2-01a

I can interpret historical evidence from a range of periods to help to build a picture of Scotland's heritage and my sense of chronology.
SOC 2-02a

I can compare and contrast a society in the past with my own and contribute to a discussion of the similarities and differences.
SOC 2-04a

Technologies

When exploring technologies in the world around me, I can use what I learn to help to design or improve my ideas or products.
TCH 2-01a

By applying my knowledge and skills of science and mathematics, I can engineer 3D objects which demonstrate strengthening, energy transfer and movement.
TCH 2-12a

Through discovery and imagination, I can develop and use problem-solving strategies to construct models.
TCH 2-14a

Having evaluated my work, I can adapt and improve, where appropriate, through trial and error or by using feedback.
TCH 2-14b

SWEDTH 1 08/13

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Activity 1

Learning intentions

- To develop children's concept of chronology by focusing on one aspect: the development of the toilet, for example. The development of the bath, shower or taps could also be considered
- To develop children's understanding of the importance of looking critically at evidence

Success criteria

- Pupils can demonstrate a clear understanding of the sequence of events in the development of technology and engineering connected to water and waste water treatment
- Pupils can distinguish clearly between fact and opinion

Suggestions for teachers

This activity is based on research, using whatever is available either on the Internet or on books or a mixture of both. It is essential that pupils do grasp the difference between verifiable facts based on evidence on the one hand and conjecture or opinion on the other. This first activity is designed to do that, whilst at the same time establishing the idea of a timeline.

1 Key points

Have a look at the timeline together – resource sheets 1 to 4 – and pick out some key points on the first page. The first page covers almost 500 years, but there are more pages showing the next 200 years. Discuss why. Children could draw a pictorial entry from the timeline to illustrate technological development.

2 History of water

Introduce to children about how much of Planet Earth is covered by water (80%) and how important water is in terms of exploration and trade (i.e. building communities near rivers).

Introduce the project the children will carry out: to research the history of toilets for example, using your selected resources. Glow is a help here, and BBC Education Scotland has some good material. Also, see the Scottish Water website for more on history of water. There are plenty of books around, too, especially of the Horrible History type (HH also has interactive games that are worth playing). Talk about what life was like without toilets in the home and how people disposed of household/toilet waste (gardy loo).

3 Suggested groups

It is suggested that the class is organised into groups:

- Romans
- 17th Century (alternatively Union of the Crowns until the Union of the Parliaments, approximately)
- Modern times: 1900 onwards

If the class is small, there would be three groups; if larger, more than one group could research each period

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Activity 1
continued

4 Fact and opinion

Each group could be given Post It notes of two colours. On one set, children would write any interesting facts they found. On the other they could write anything that was opinion, either along the lines of 'people think that the Romans might have…' or 'I think this would have been disgusting because…'. These could be stuck on large sheets of paper divided into two areas, labelled Fact and Opinion.

5 Fascinating facts

As a plenary for this research part of the project, each group could pick out two of the most fascinating facts to tell the rest of the class, and one opinion. Discussion could be guided to highlight the fact that, technologically, the Romans were in many ways more advanced than people who came after them. You may like to speculate, with the children, what might come on the next page of the timeline. Throughout, the pupils should be making a clear distinction between fact and opinion, and might even challenge some facts, which could lead to a useful debate.

6 Presentation points

A proper presentation of the research could follow, perhaps set in terms of a challenge:

- Your group must show what you have found out on a poster
- You must talk about your poster to the rest of the class
- The poster must have a good title
- There should be a large, clear picture
- The poster should have 10 interesting facts and two interesting opinions shown on it
- The poster must be attractive
- You have just 1 hour to complete this challenge!

Alternatively, pupils could record a video as if the toilet has just been invented – plan, write, and produce a news bulletin to inform the public of this exciting development/invention (however, be sure to stress that people didn't have televisions in that era but if they did….). Then pupils could have a screening of their video in the class or at assembly.

7 Assess

After the presentation, pupils could peer assess, perhaps by going round in their groups looking at the posters, and writing one positive comment each on a Post It about each presentation. Thus, each group would end up with a selection of comments posted on their work, which they could read and discuss. The assessment should be based on the list above, which could be presented as success criteria. The pupils could also self assess their work using resource sheet 5.

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Activity 2

Learning intention
- To help pupils appreciate the ingenuity of ancient peoples in solving problems

Success criterion
- Pupils understand how the Romans came up with their bridge and aqueduct designs by drawing and building examples themselves.

Suggestions for teachers

1 Discussion
Discuss the problem of bringing fresh water to Roman towns and cities whilst showing resource sheet 6. Resource sheet 7 shows how this was done. There are many examples of Roman aqueducts to be found in books and in Google Images, for example. Draw attention to the arches: used for aqueducts, bridges and buildings.

2 Aqueducts
Pupils could sketch aqueducts before the next tasks. They could each be given a start and end point on the page, then once they have completed their drawings, the pages can be joined together to create an aqueduct frieze that can be displayed around the classroom wall.

3 Build an arch
Give groups of children cubes – preferably good sized wooden cubes – and ask them to try to build an arch. It isn't possible, so don't let them get too frustrated. Discuss ways they, and the Romans might have solved the problem. Show pictures of some stone arch bridges (some good ones if you Google 'stone bridges of Greene County') and draw attention to the shape of the blocks.

4 Which way to go?
From here, there are several ways to go. The simplest is to get groups of children to create trapezoidal blocks from plasticine and build freestyle.

5 More suggestions
A more controlled method is to cut a template. If two concentric semicircles are drawn on card with radiating lines drawn between the curved lines, these could be cut out as templates for individual plasticine blocks. Another method is to lay a squared sausage of plasticine along the semicircles and chop it up into blocks.

6 Water channel
When the pupils are setting up the arch, they may discover the need for a temporary semicircular support underneath. Those children using the template approach could make this, perhaps from two shaped pieces of cardboard glued together with a wood block spacer between, and wooden supports on either side for stability. Pupils then create a channel for water to travel along.

7 Billy Goats Gruff challenge!
The most creative way is to frame the activity as a challenge. See resource sheet 8.

8 Recording the activity
It would be useful to take photographs or a video as the children work. Apart from anything else, this would show which children were participating, which were leading, which were hanging back and which were doing the practical work. A written record could be structured in scientific form: what we used, what we did, and what we found out. The discussion of what the pupils found out could reinforce the point that they were trying to solve the same problem as the Romans did thousands of years ago.

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Activity 3

Learning intention
- To help pupils appreciate the ingenuity of ancient peoples in solving problems

Success criterion
- Pupils demonstrate their models and how they work

Suggestions for teachers

There are many other activities which could be used to show how ancient peoples moved water. These are some.

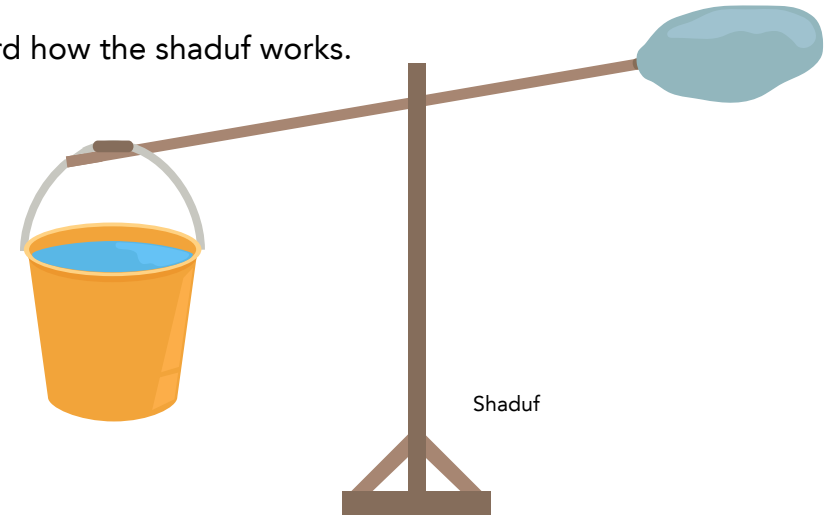
1 Shaduf

Make a shaduf. This is shown in many books, and also in the Save It module.

Groups of pupils use scrap or construction kits to build model shadufs or traditional wells. This could be done in the form of a challenge: to design and build a working model. Pupil's designs and models could be put on show for the rest of the school.

Alternatively, a class model shaduf could be made from, say, broomsticks and skipping ropes. This is best outside, with the broomsticks securely stuck in the ground. There's a lot of good science to be gained from this, with the idea of pivot and counterweight coming in.

Pupils could record how the shaduf works.



Shaduf

2 Pumps

Disassemble a balloon pump or bicycle pump to show how it works, and explain that instead of blowing, a water pump sucks water from under the ground. A transparent soap dispenser shows this quite well. Link with WaterAid activities on **www.wateraid.org/uk/audience/schools#/get-involved** and elsewhere.

3 Archimedes screw

Make an Archimedes screw. This is quite difficult, but there are some suggestions on YouTube, for example, that will appeal to the practically-minded pupils who are up for a challenge.

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Resource sheet 1

History of water and waste water timeline

1325
Franciscan Friars lay a pipeline into Cambridge from a spring 1km outside the town. Religious communities acquired a good reputation for water supply management in the 12th, 13th and 14th centuries.

1439
The mayor of London asked the Abbot of Westminster to help provide fresh water for the 55,000 people of the city.

1460
A system of lead pipes was laid under the streets of Hull. Householders paid for pumps to extract the water.

1574 - 1582
Peter Morris (a Dutchman) installed an ingenious pump below London Bridge. It was driven by a waterwheel and forced water up a tower over 100 feet high where it entered a cistern. The water was then strained through a mesh and fed through large wooden pipes and small lead pipes to houses in London. There were five wheels by 1582.

1584
Sir Francis Drake helped Plymouth Corporation to get an act of Parliament allowing them to bring water 25km, across moorland to the town. Water was taken to cisterns in Plymouth to be used without charge. The supply served for 300 years.

1596
Britains first flushing toilet called a water closet (W.C.) was designed by Queen Elizabeth's godson.

1605
Oxford used covered gullies to collect spring water from Hinksey Hill. The gullies lead to a 20,000 gallon (90,000 litre) tank protected by a stone house.

1677
In York, water from the River Ouse was pumped by wind power into a tank on the top of Lendal Tower. This gave a good head of water for the houses inside the walls of the city.

1775
Alexander Cumming reinvented the water closet.

1777
James Prosser improved it.

1778
Joseph Bramah perfected it.

1808
Richard Gillespie devised a filter system for Glasgow's Cranston Hill waterworks which used a layer of sand and gravel.

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Resource sheet 2

History of water and waste water timeline continued

1820s
Robert Thom in Scotland and James Simpson in England perfected mechanical and sand filtration respectively.

1826
Aberdeen collected water from near Bridge of Dee driving a tunnel alongside the river and thereby gaining filtered water seeping from the river bed.

1840
John Roe helped solve the problem of blockages in sewers by devising the eggshaped sewer in which water force contained within the steeply sloping sides carried solids away.

1847
The fouling of drinking water was made a criminal offence. Bristol obtains water by aqueduct and pipeline from sources 25km distant.

1848
Manchester builds five reservoirs in the Langdendale Valley 15km from town.

1852
The General Board of Health recommends building new sewers in every town.

1853
Leicester was the first town to set up a waste water treatment works.

1859
Glasgow's Loch Katrine works were opened and gave 230 million litres per day. At the time the Corporation was warned about the dangers of lead pipe corrosion by soft acid waters.

1861
Aberdeen extended its River Dee extraction to 28 million litres per day.

1865
The first interceptor sewers of London, conceived by Joseph Balgazette, were completed and carried London's sewage down the banks of the Thames to be dumped into the estuary.

1867 - 68
Franchise Reforms and Public Health Acts enabled local authorities to take water organisations and systems into public ownership.

1869
The "Native Guano Co." at Hastings and Leamington dried, pressed and sold sewage as manure.

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Resource sheet 3

History of water and waste water timeline continued

1880
Liverpool impounds the River Vyrnwy in Powys by use of a masonary dam, the first all-stone dam in Britain.

1885
First attempts at the bacteriological examination of water.

1890
Bacterial and activated sludge beds were devised for "purifying" waste water.

1892
Birmingham gets 18,000 hectares (45,000 acres) of Wales to build three reservoirs in the Elan Valley - opened in 1904.

1900
Manchester enlarged Thirlmere in the Lake District.

1930s
By the 1930's the routine way to treat water was to:
- Screen it to catch branches, solids and dead animals;
- Treat it with sulphate of alumina to coagulate remaining solids;
- Chlorinate it against bacterial infections

1945
The Water Act led to reorganisation and regrouping within the industry and greater efficiency.

1963
The Water Resources Act created 29 River Authorities charged with conserving, redistributing and augmenting the water resources of their river basins.

1967
The Central Scotland Water Development Board was set up and concerned itself with developing new bulk supplies for sale to Local Authorities.

1973
The Water Bill for England and Wales created 10 Regional Water Authorities.

1975
The 9 new Scottish Regional Councils and the Islands Councils obtained the functions of public water supply, sewerage and sewage disposal broadly similar to those of the Regional Water Authorities in England and Wales.

1982
Kielder Reservoir opened - one of the biggest lakes in Europe.

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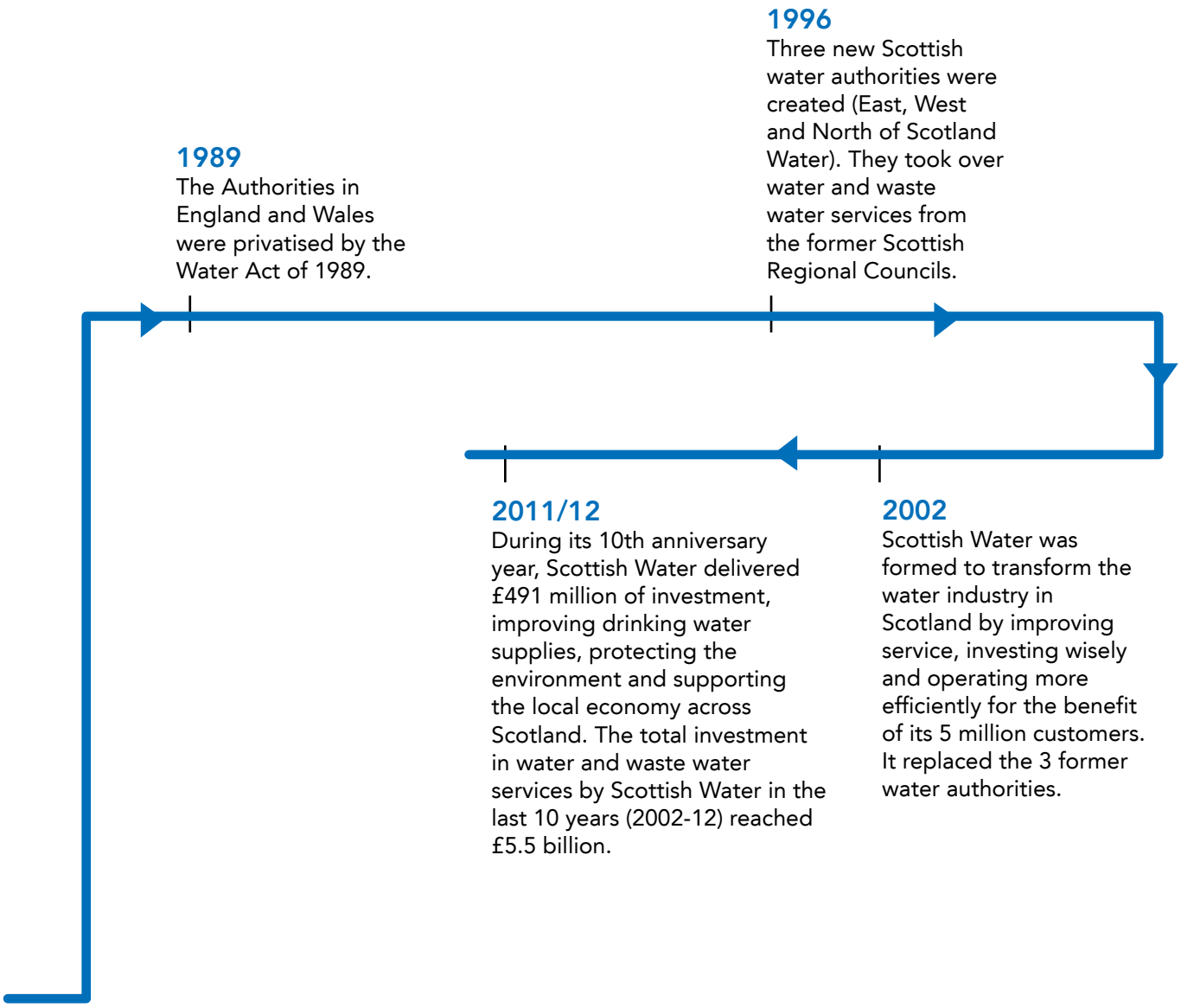
Resource sheet 4

History of water and waste water timeline continued



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Resource sheet 5

Self assessment sheet

Name .....

Date .....

Other group members .....

.....

Describe how you organised your group to do this challenge. Who did what, in other words.

What things did your group do well?

What did you do well?

What might you do differently next time, if you had to do something like this again?

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Resource sheet 6

Fascinating facts

1 **Water is heavy** and collecting and carrying water takes a long time. Our ancestors built many of their villages and towns near springs and rivers so that they could get water easily.

2 There is evidence around the world of our ancestors using pipes and ditches for **moving water** to where people lived. They were also digging deep wells and making dams to collect and store water.

3 The **Roman Empire** is famous for its baths and examples of these can be seen around Britain. The average Roman used more than 1300 litres of water every day, mostly for bathing and ornamental fountains.

4 The Romans were also among the first to think about how to get rid of **waste water**. In Rome there is a sewer that was built 24 centuries ago that is still in use today. It is called the Cbaca Maxima and is open to the public.

5 The Romans knew that getting clean, fresh water was very important. They built **aqueducts** - great stone channels - to carry water to their towns and cities. Sometimes these aqueducts had to cross valleys, and then a bridge had to be built to carry the water across to the other side.

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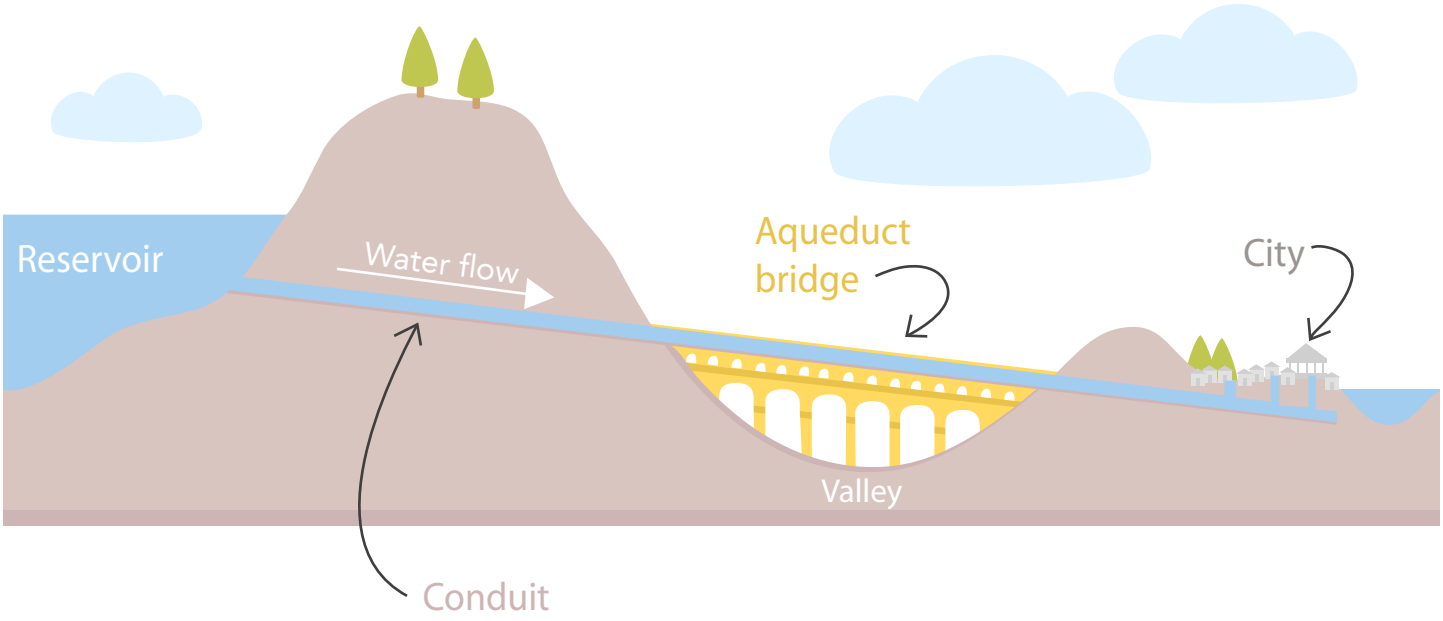
Resource sheet 7

Roman aqueduct

This diagram shows how an aqueduct takes water across a valley.



Construction of an aqueduct was a huge project so even in ancient times the Roman aqueducts were attractions. Built and designed for their appearance as well as function.

Early aqueducts had to rely on the force of gravity to move water over long distances. The water could only move from a high point to a lower point, but they could carry large amounts of water very efficiently.

Modern aqueducts use electric pumps to move water along.

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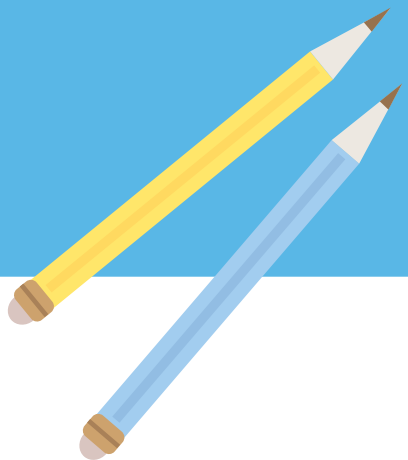
Resource sheet 8

The Billy Goats Gruff challenge!

The Billy Goats' bridge has been washed away by a flood. Oh no! The goats need to get across to the lovely green grass on the other side, but they need your help to build a new bridge.

You can use:

- Plasticine, made into blocks (but you can't squidge them together, because you couldn't do that if they were stone – stone doesn't squidge!)
- 2 sheets of A4 card
- A pair of compasses
- A protractor
- A knife
- Cardboard sheet
- Scissors
- Sellotape
- Glue
- Pencils



1. Your bridge must be made of nothing but plasticine blocks: no glue, no sellotape, no cardboard - nothing else to hold it up!
2. You might like to make models of the goats and the troll as well.
3. When it is finished, Great Big Billy Goat (your teacher) will test the bridge to see if it strong enough.

You have **1 hour** to complete this challenge.

Good luck - the Billy Goats are depending on you!