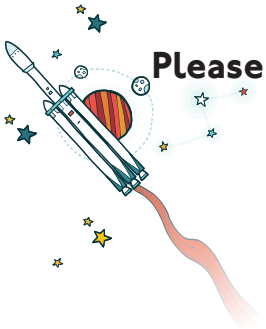
Glasgow Science Festival 2023: Glasgow's Looking Forward

Primary STEAM Activity Pack

Glasgow Science Festival 2023 will be in-person from 1st to 11th June and online from 1st to 30th June.



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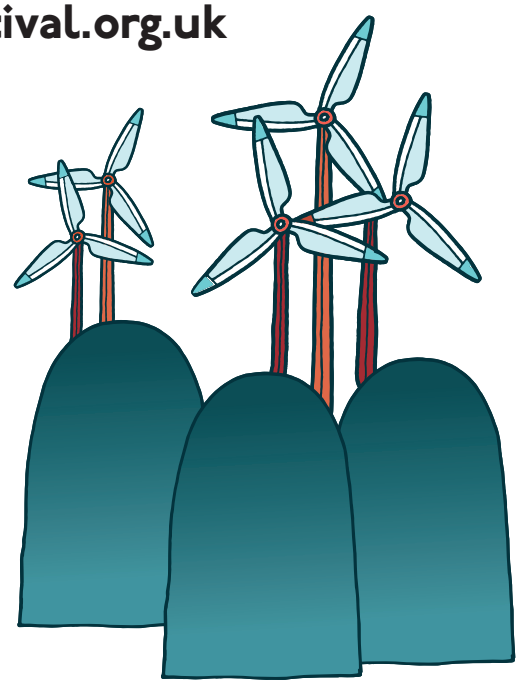


Table of Contents:

Mapping the Solar System

In this activity paticipants will learn about scale and the size of the Solar System by making a scaled map of the main features of the Solar System.

The Science:

Our planet Earth is part of a group of 8 planets which all orbit the same star, our **Sun**. This group of planets and the Sun is collectively called the **Solar System**. The Solar System contains: The Sun, Mercury, Venus, Earth, Mars, Asteroid Belt, Jupiter, Saturn, Uranus, Neptune, and the Kuiper Belt. There are several mnemonics (device for remembering something) that can help remember the order of the 8 planets such as: **M**y **V**ery **E**ducated **M**other **J**ust **S**erved **U**s **N**achos, or **M**any **V**ile **E**arthlings **M**unch **J**am **S**andwiches **U**nder **N**ewspaper (**P**iles). Try coming up with your own that includes the Asteroid and Kuiper belts!

The Asteroid Belt and the Kuiper (pronounced: Kyper) Belt are both regions of the Solar System made up of 'space debris' a.k.a a lot of stuff left over from the formation of the Solar System. Asteroids are rocky and irregularly shaped, there are estimated to be between 1.1-1.9 million asteroids in the asteroid belt. The largest is 329 miles in diameter, that's just less than the distance from Glasgow to London! The Kuiper Belt is similar to the Asteroid Belt, however the objects in this region are icy. So far only 2000 objects have been identified, but there is thought to be millions more. Remember Pluto? Pluto is now considered to be a dwarf planet within the Kuiper belt.

Everything in the Solar System is very far apart, which stops us crashing into each other! On average the Earth orbits the Sun at a distance of 93 million miles, this is a huge number so to make things easier to compare scientists use **Astronomical Units**. One astronomical unit, or AU, is equivalent to the distance of Earth to the Sun. We can use AU to compare the distances much more easily between the various features of the Solar System.

There are many things space related to look forward to, all the space agencies across the world have several very exciting missions coming up.

- **Artemis** is a series of missions that aim to take humans back to the Moon with the first astronauts launching in 2023.
- **Mars Perseverance Rover** is currently on Mars and is busy collecting rock samples that will be collected and returned to Earth in the next 10 years.
- **JUICE** (Jupiter Icy Moons Explorer) is a European Mission that launched in April 2023 going to Jupiter to observe three of the largest moons of Jupiter that contain oceans.
- **OSIRIS-Rex** is on its way back to Earth, due to land in 2023, with samples from the asteroid Bennu.

Kit List:

- Strip of paper at least 50cm long
- Scissors
- Tape
- Pencils
- Colouring pencils
- Ruler
- Access to a computer (optional – only required to look at images of the planets, alternatively if you have a book with pictures in you could use that)

How To:

1. Depending on available resources for yourself you may have to create a long enough strip of paper before you start. You will need at least 50cm so you will have to cut two strips (~5cm thick) out of an A4 piece of paper lengthways and tape them together. Careful to only tape one side or use masking tape so you can still write on it.
2. Take your strip of paper, on the left-hand side draw the Sun.
3. Measure out these points on your strip and mark them on.

Solar System Body	Distance from Sun (AU)
Mercury	0.4
Venus	0.7
Earth	1.0
Mars	1.5
Asteroid Belt	2.8
Jupiter	5.2
Saturn	9.6
Uranus	19.2
Neptune	30
Kuiper Belt	30 Onwards

4. We suggest plotting these on as cm to fit on a 50cm strip, however if you would prefer to use larger strips you could multiply these numbers, just remember to multiply all the distances to keep the scale the same!
5. Once you have your points marked on you can get creative, draw on your planets and colour them in. Consider looking up images of the planets and marking on any interesting features you notice e.g. the rings of Saturn or Jupiter's Big Red Spot.

Extensions:

These are some suggestions for other things you could mark onto your map or discuss.

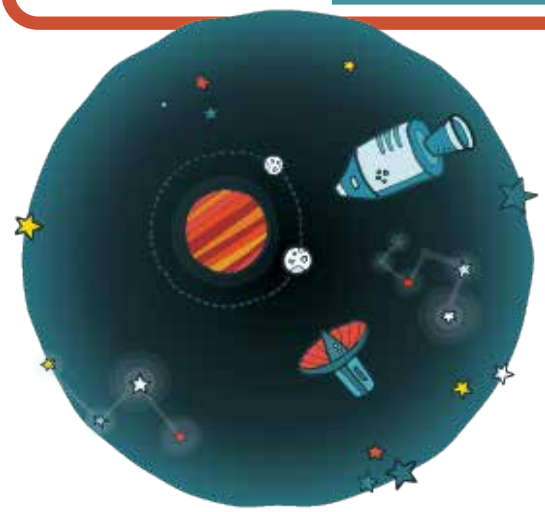
- Moons. Earth only has 1 moon (The Moon) but it is not the only planet to have moons, in fact all planets except Mercury and Venus have at least 1 moon. See if you can find out about other planets moons and mark some of these on your map.
- Pluto. One of the reasons why Pluto was declared a Kuiper Belt Object instead of a planet is due to its irregular orbit. It is not a circular orbit and instead is elliptical this means its distance from the Sun varies quite a bit.

Pluto's Orbit	Distance from Sun (AU)
Average	39.5
Closest	29.7
Furthest	49.3

Do you notice anything interesting about this orbit? HINT: Consider the orbit when its closest to the Sun and the positioning of Neptune. When Pluto was considered a planet, it was the 9th planet from the Sun however at its closest it is nearer to the Sun than Neptune (the 8th Planet from the Sun) is!

- The destinations of different upcoming or ongoing space missions (Apollo, JUICE, OSIRIS-REx, Mars Perseverance Rover).
- Dwarf Planets

Dwarf Planets	Distance from Sun (AU)
Ceres	28
Haumea	43
Makemake	45.8
Eris	68



Solar System Accessories

In this activity paticipants will create a beaded string accessory representing the scale of the Solar System.

The Science:

This activity is an alternative or follow on to the Solar System Map, where instead of drawing out the Solar System you will create a to scale model of the Solar System that you can turn into a necklace, belt, bag strap or whatever you like!

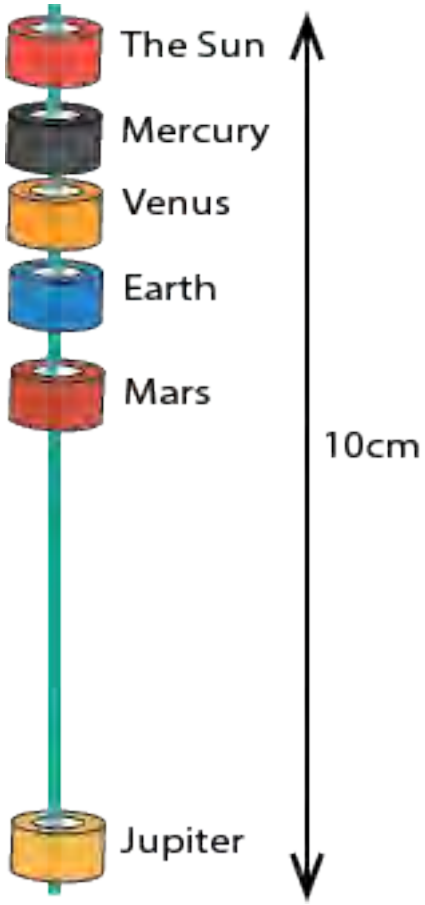
Kit List:

- Scissors
- String (~50cm)
- Beads (at least 10 of different colours/ sizes to represent the different planets)
- Ruler

How To:

1. Measure out 100cm of string. This will allow you to get as far as Neptune, with a bit left over to tie all the knots. For this activity we recommend missing the Kuiper belt, unless you can find a bead that you think would represent this region well!
2. Attach your Sun bead right at the beginning of your string and tie a knot below it so it can't move.
3. Using the same measurements as the previous activity, although we have doubled them to allow more room for the beads, you can tie on your planets.
4. You can then tie the string together and make a Solar System accessory.

Solar System Body	Distance from Sun (AU)	Value in cm
Mercury	0.4	0.8
Venus	0.7	1.4
Earth	1.0	2.0
Mars	1.5	3.0
Jupiter	5.2	10.4
Saturn	9.6	19.2
Uranus	19.2	38.4
Neptune	30	60



Wind Powered Car

In this activity participants will make a vehicle that can move with the wind.

The Science:

Our energy that we use has mostly been acquired from burning **fossil fuels**, such as coal and oil. This is **unsustainable** as these resources are not renewable on a human timescale. The majority of the coal on Earth formed during the **Carboniferous Period** (358-298 million years ago) and the **Permian Period** (298-251 million years ago), these are periods of geological time from before the dinosaurs were on Earth! This is due to the Earth at this time sustaining large, forested wetlands in tropical regions, allowing for lots of build-up of plant matter. Coal forms when plant matter decays and gets buried, eventually turning into coal from all the heat and pressure from burial. Some coal fields have formed more recently but the process of burial takes millions of years. This means eventually we will run out of coal and oil reserves.

There are other issues with burning fossil fuels, you have probably heard of **global warming** and **climate change**. These can be caused and made worse by burning fossil fuels, as they contain a lot of **carbon**. Carbon then reacts with the **oxygen** in the atmosphere creating **carbon dioxide** or CO_2, this can then trap heat from the Sun in our atmosphere. Throughout geological time the CO_2 levels have fluctuated causing very hot and very cold periods (think Ice Ages!) but this usually takes a much longer time and is due to natural events such as volcanoes. The current global warming event is due to human activity and is happening much more rapidly.

As we move away from burning fossil fuels, we will need to find new sustainable and renewable ways to power our homes and vehicles. Many ways are being explored and developed now, for example have you ever seen or even travelled in a hybrid or fully electric car?

You may be familiar with **Wind Turbines** which are a common sight around Scotland. Wind turbines can harness the energy from wind. The wind turns the propeller blades around a rotor, this rotor is connected to the main shaft which spins a generator creating electricity. This electricity can then be used to create power. We are going to test wind power today by making a small car that only uses the wind to move.

Kit List:

- Straws x2
- Wooden Skewers x3
- Cardboard
- Bottle caps (or similar to use as wheels) x4
- Card
- Tape
- Scissors
- Knife/Sharp utensil for poking holes in bottle caps.

How To:

1. Cut a rectangle piece of cardboard.
2. Using tape attach the straws to the bottom of the car. These should be at either end along the short edge of the rectangle. Ensure these are parallel to each other.
3. This step is to be done by **adults only.** Poke a + shape in the centre of the bottle caps using the knife.
4. Poke the wooden skewer through the holes of one bottle cap, keeping the cap at the end of the skewer.
5. Feed the cap-less end of the skewer through one of the straws.
6. Attach another bottle cap to the end of the skewer to create wheels.
7. Repeat steps 4-6 for the other end of the car.
8. Check the wheels spin and adjust as necessary.
9. Ask an **adult** to do this step. Either using the knife or a sharp end of the skewer poke a hole in the centre of the cardboard car.
10. Insert a skewer into the hole you just created and secure with tape so the skewer doesn't wobble.
11. Cut a rectangle out of the card to create a mast.
12. Thread the rectangle onto the upright skewer at both ends to secure.
13. Now set your car on a flat surface, either in front of a fan or you can just blow on it and watch it move.

Extension:

- The type of energy we are thinking about here is **Wind Power**. Wind is created in the atmosphere when cold air and hot air meet, creating **turbulence**. Try pouring some hot water (add colouring to make this easier to see) into a glass of cold water and see if you notice anything.
- Experiment with different sizes and shapes of mast, then have a race and see which is most effective.
- Place some masking tape along the track and mark on where the car stops, compare these for different size sails and decide which shape/size is best.

Fossils of the Future

In this activity participants will create their own versions of dinosaur fossils out of clay and create what they think a fossil from our time will look like in the future.

The Science:

Fossils are the preserved remains of a once-living thing. They are often the only evidence we have for previous life on Earth that is now extinct. It's thanks to fossils that we know about the dinosaurs, ammonites, ichthyosaurs, and many other creatures that lived hundreds of millions of years ago. Someone who studies fossils is called a **palaeontologist**. A famous palaeontologist is Mary Anning who lived in Dorset in the 1800s. She collected and discovered fossils along the **Jurassic Coast** where many of her discoveries date back to the age of the Dinosaurs.

How do fossils even form?
After an animal or plant has died, they will settle on the bottom e.g. ground, ocean floor. If conditions are right, the hard parts e.g. bones, tree bark or shells (and sometimes soft tissue) will be buried under layers of **sediment** which squeezes out any water. Over time the layers of sediment will harden into **rock**, and the fossil will remain at depth under all the layers of rock and sediment for a long time, usually millions of years.

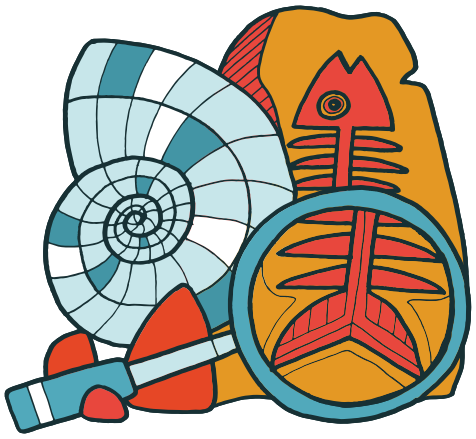
Fossils come in 2 main categories: **body** fossils and **trace** fossils.
Body fossils are those that are the preserved remains of a creature, for example the bones, teeth, or shells.
Trace fossils preserve activities and behaviours of the creatures, for example a footprint, a burrow, or even animal poo!

The **Anthropocene** is a proposed name for the current period of geologic time that we are living in. Scientists think that future **geologists** will be able to see traces of human life in the rocks. Some examples of the things they may find include plastic litter, tech waste and concrete.

We are going to create a fossil representing the past (a dinosaur footprint) and a fossil representing our time on Earth which may be found by future **palaeontologists**. Think about things existing today that might last long enough to be preserved and become a fossil, now we are going to create your past and future fossils.

Kit List:

- Clay
- Rolling pin
- Dinosaur toy or modelling tools
- Paper
- Pencil
- Object for future fossil (e.g. bottle cap)



How To:

1. Design your dinosaur footprint on paper.
2. Roll out your clay so it is flat and around 1cm thick.
3. If you have a toy dinosaur you can use this to create a footprint to start with, if not
4. Use whatever tools you have around the house to create your footprint in the clay.
5. Allow to harden. This is your fossil of the past.
6. Using the rest of your clay, roll out another flat 1cm thick piece.
7. Now we're going to create the fossils of the future, take your object that you have chosen and create an imprint in your clay. Or you could get creative and use modelling tools.

No clay to hand? Try this:

Kit List:

- Flour
- Salt
- Cold Water
- Bowl
- Other kitchen spices (optional)

How To:

1. Mix together 200g flour with 200g salt.
2. Add in other spices here for colour but this is optional.
3. Slowly add up to 140ml water.
4. Knead the clay for several minutes, if needed add more water but careful not to make the mixture too wet.
5. If they clay is too soft to hold shape, knead in more flour.
6. The clay can be kept in airtight conditions for ~3 days.
7. Leave your clay creations out for ~24 hours so they fully dry out.

Launching Rockets

In this activity participants will make their own rockets that launch into the air using either a fizzy tablet or their own breath as fuel.

The Science:

Gravity acts upon the Earth to stop everything floating away, that means to make a rocket fly upwards into space, we need a **force** in the **opposite direction** that is strong enough to propel it **upwards**. If you watch a video of a rocket being launched you'll notice that there is a LOT of smoke and flames, this is all the propellant that is needed to overcome gravity.

For the fizzy rocket experiment, we are using a **vitamin tablet** as rocket fuel. Fizzy tablets often contain bicarbonate of soda and citric acid. When the tablet is dissolved in water, it fizzes and releases bubbles of **carbon dioxide** (CO_2).

As more and more carbon dioxide gas bubbles are released, the pressure inside the canister builds. Eventually, there is enough pressure inside the canister to push the lid off, causing a pop! The force of the gas escaping **downwards** pushes the rocket **upwards** in the opposite direction.

Kit List:

- Paper
- Ruler
- Fizzy tablet (Alka-Seltzer, Vitamin C, Berocca etc)
- Water
- Scissors
- Tape
- Container with a lid that can pop open (e.g. film canister, Kinder egg toy container, Pringles can, mini Play-Doh tubs, bottle with sports lids e.g. Fruit Shoot/Lucozade, vitamin tablet tubes or a used up glue stick)
- Pens/Pencils/Crayons (optional)

How To:

1. Measure the length of the film canister.
2. Cut out a strip of paper that will cover the canister.
3. Colour and decorate this strip of paper.
4. Remove the lid from the film canister and roll the strip of paper to form the rocket body. The open end should be at the base.
5. Secure with tape
6. Cut out a ¾ circle.
7. Colour and decorate as you wish.
8. Fold circle into a cone shape and secure with tape.

How To:

9. Attach to rocket body using tape, this should be at the opposite end of the film canister to the lid.
10. Get creative and add fins or other decorations to your rocket.
11. Now you are ready for launch. We recommend doing this part of the activity outside.
12. Fill the film canister about two thirds full of water.
13. Ensure everyone is standing well back.
14. Add half a fizzy tablet to the water and quickly attach the lid.
15. Place rocket on the ground lid side down and stand well back.

Alternative (no fizzy tablets):

Kit List:

- Straw (paper or reusable)
- Paper
- Tape
- Pencil
- Scissors
- Colours (optional)

How To:

1. Cut out a rectangle piece of paper. This can be any length you want and wide enough to fully wrap around a pencil.
2. Colour this in as you wish.
3. Cut out 2 large arrowhead shapes.
4. Colour in as you wish.
5. Wrap the rectangle around a regular pencil and secure with tape.
6. Attach the arrowheads to the base and fold to create fins.
7. Twist and pinch the top of the rocket body to create a nose cone.
8. Remove pencil and replace with straw.
9. Blow into the straw to launch the rocket.

Extension:

Experiment by making rockets of various lengths and see if this affects the distance travelled.

Erupting Volcano

In this activity participants will perform a simple acid + alkali reaction to simulate an erupting volcano.

The Science:

Volcanoes exist all over the world and there are on average 50 eruptions per year. Some volcanoes erupt **lava**, like those on Hawaii and some erupt with huge **ash clouds**, such as the recent Hunga Tonga-Hunga Ha'apai eruption in 2022. Eruptions can change the shape of the volcano, if lava is flowing out it will cool and solidify creating new rocks. This will eventually build up the shape of the volcano. Explosive ash cloud eruptions can destroy the volcano shapes and cause parts of the volcano to collapse.

When you mix an acid like **acetic acid** (vinegar) with an alkali, there is a chemical reaction. Bicarbonate of soda is an **alkali.** When it's added to the vinegar, it combines with acetic acid and releases bubbles of carbon dioxide gas. The bubbles mix with the washing up liquid, creating a fizzy, frothy volcano!

The repetition of this activity combined with adding layers shows how volcanoes build up their shape over the course of several eruptions.

Kit List:

- Large box
- Reusable plastic cup
- Food colouring (several colours)
- Baking Soda/bicarbonate soda
- Vinegar
- Washing up liquid
- Water
- Materials for building volcano (play-doh, clay, paper mache, cardboard etc get creative!)
- Jug
- Optional: Sand, gravel, soil to simulate surrounding area of volcano.

How To:

1. Place the cup in the box.
2. Surround the cup with your volcano building materials and create a shield volcano. Ensure you can still access the cup.
3. Optional: fill in the rest of the box with sand/gravel or whatever you choose.
4. Add 1 tbsp baking soda and 1tbsp washing up liquid into the volcano cup.
5. Add 2 tbsp water and mix thoroughly.
6. In the separate jug mix together 125ml vinegar with some drops of food colouring.
7. When you're ready pour the vinegar into the volcano cup and stand back.
8. Watch the eruption take place.
9. Once the eruption has finished remove the cup and rinse it out.

How To:

10. Make a note of what direction the lava ran in.
11. Get your materials (you may have to wait for the volcano to dry depending on the materials used) and add a new layer to the area where the lava ran.
12. Run the experiment again, with a different colour lava, and see if the lava runs in the same direction or if it chooses a new path.

Extension:

- You could try changing the quantities of the vinegar and baking soda and see what happens. Please note you may wish to conduct this experiment outside when experimenting with quantities.
- You could also look up a case study example and include this experiment as a demonstration.

Kit	Mapping	Accessory	Car	Fossils	Clay	Fizzy Rockets	Straw Rockets	Volcano
Paper	X			X		X	X	
Scissors	X	X	X			X		
Tape	X		X			X	X	
Pencils	X			X		X	X	
Colouring pencils	X					X	X	
Ruler	X	X				X		
Computer	X							
String		X						
Beads		X						
Straws			X				X	
Wooden Skewers			X					
Cardboard			X					X
Bottle Caps			X	X				
Card			X					
Knife			X					
Fan			X					
Clay				X				
Rolling Pin				X				
Dinosaur toy				X				
Modelling tools				X				
Flour					X			
Salt					X			
Water					X	X		X
Bowl					X			
Spices					X			
Fizzy tablet						X		
Lidded container						X		
Plastic box								X
Plastic Cup								X
Food Colouring								X
Baking / Bicarbonate of Soda								X
Vinegar								X
Washing up Liquid								X
Building materials								X
Jug								X
Gravel/Sand								X

Curriculum Link	Mapping	Accessory	Car	Fossils	Rockets	Erupting Volcano
Through exploring nonrenewable energy sources, I can describe how they are used in Scotland today and express an informed view on the implications for their future use. SCN 2-04b			X			
I can investigate the use and development of renewable and sustainable energy to gain an awareness of their growing importance in Scotland or beyond. TCH 2-02b			x			
By observing and researching features of our solar system, I can use simple models to communicate my understanding of size, scale, time and relative motion within it. SCN 2-06a	x	x				
I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made. SCN 2-19a					x	x
Through research and discussion I have an appreciation of the contribution that individuals are making to scientific discovery and invention and the impact this has made on society. SCN 2-20a			x			
I can report and comment on current scientific news items to develop my knowledge and understanding of topical science. SCN 2-20b	x	x	x	x	x	x
I can describe the physical processes of a natural disaster and discuss its impact on people and the landscape. SOC 2-07b						x
I can describe the major characteristic features of Scotland's landscape and explain how these were formed. SOC 2-07a						x
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			x			
I can analyse how lifestyles can impact on the environment and Earth's resources and can make suggestions about how to live in a more sustainable way. TCH 2-06a				x		
I can make suggestions as to how individuals and organisations may use technologies to support sustainability and reduce the impact on our environment. TCH 2-07a			x			
I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction. SCN 2-01a				x		
By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed. SCN 2-15a					x	x
Having investigated where, why and how scale is used and expressed, I can apply my understanding to interpret simple models, maps and plans. MTH 2-17d	x	x				
Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading. MNU 2-20a	x	x				
I have carried out investigations and surveys, devising and using a variety of methods to gather information and have worked with others to collate, organise and communicate the results in an appropriate way. MNU 2-20b	x	x				
I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology. MTH 2-21a / MTH 3-21a	x	x				