SURVIVAL STEM: SUITABLE FOR STUDENTS AGED 7-9

Extreme Elements

STEM Learning activity resources

SUBJECT LINKS:

Science, mathematics, design and technology, computing and essential skills.

STEM CLUBS

NUMBER 1 FOR STEM

SURVIVAL STEM: SUITABLE FOR AGE 7-9

Extreme Elements

STEM Learning activity resources

Introduction

This programme has been created by STEM Learning, the largest provider of STEM education and careers support in the UK. It has been developed in partnership with Club leaders.

Extreme Elements

Have you ever wondered about the earth's wild and wonderful weather? Think you have what it takes to build an earthquake-proof house or survive in an extreme environment? In this programme, pupils will make models to help them understand how weather and extreme events occur, and what their impact can be. They'll apply what they observe to real-world situations, designing structures that protect humans and respond to the elements.

Digital and Essential Skills

Throughout this booklet, activities highlight skills sets that can be enhanced by taking part. This enables pupils to further develop both digital literacy and competency in desirable key skills. These highlighted skills allow the pupils to focus on specific aspects to achieve notable progression. If other skills better suit your club members on a particular activity, then focus on that skill.

Key information

AGE RANGE: 7–9

SUBJECT LINKS: Science, mathematics, design and technology, computing and essential skills.

DURATION: A range of activities from 20 to 60 minutes – approximately 6 hours in total.

FLEXIBILITY: Complete the whole programme over a half term or choose individual activities to suit the needs of your club.

RESOURCES: Each activity includes a list of the resources required and a comprehensive set of club leader and pupil notes.

ESSENTIAL SKILLS: Age-appropriate essential skills have been identified which can be enhanced through these activities. Further information about digital and employability skills is available at the end of the booklet.

IMPACT MEASUREMENT: Each set of resources is designed to help evaluate and assess the progress of Club members. A free student assessment toolkit can be requested from: STEMclubs@stem.org.uk.

ACHIEVEMENT: Pupils can be rewarded for successfully completing activities by downloading free STEM Clubs certificates from https://www.stem.org.uk/stem-clubs/impact-and-recognition/stem-club-certificates. Pupils may be able to use these resources to work towards a CREST Award.

APPROPRIATE VENUES: Club leaders can run most activities in general spaces e.g. classrooms, halls, and outdoor areas.

SAFETY: Each activity includes details about health and safety considerations. Club Leaders should ensure that all equipment is handled with care, particularly sharp instruments. Advice and guidelines are available from CLEAPSS and SSERC. We recommend that practical activities are risk assessed before commencing and Club Leaders should follow their employer or organisation's policies.

OTHER ACTIVITIES: Discover other exciting STEM Club activities: https://www.stem.org.uk/stem-clubs/activity-sets#primary

STEM CLUB SUPPORT: Find lots of ideas, support, training and advice at: https://www.stem.org.uk/stem-clubs

Activities

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

1 Tropical Twisters

Objective

In this activity pupils will create a tornado model and begin to think about its impact. Pupils will explore how the wind moves and discover the basic physics behind tornadoes and twisters.

HEALTH AND SAFETY:

A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

Proper eye protection must be worn throughout the activity in order to prevent corn flour or dried herbs and confetti from entering the children's eyes.

TOPIC LINKS

- Science: forces – wind movements
- Computing: use of technology

ESSENTIAL SKILLS SUPPORTED

Listening, problem solving, teamwork

Internet research

TIME

40 minutes

RESOURCES AND PREPARATION

- Fans (at least 4)
- Corn flour
- 2 x 2L drinks bottles
- Tornado cap to join the bottles
- Jam jars and bottles of various sizes
- Water
- Confetti / dried herbs or flower petals
- Small beads or buttons
- Lolly sticks
- Range of paper types – tissue paper, printer paper, newspaper, card

DELIVERY

1. Ask pupils what they know about tornadoes. Explain that they are destructive towers of swirling wind. Tornadoes and twisters are the same thing – twister is just slang for tornado.
2. According to news reports, wind is able to pick up heavy objects and throw them around as if they weighed nothing. How can this be true?
3. Start by half filling a jam jar with water and using a lolly stick to swirl the water, causing a tornado shape to form in the jar. Watch carefully how the water spins and the funnel shape is created.
4. Add a pinch of dried herbs/flower petals to the jar and wait for it to sink. Ask the pupils what will happen when you swirl the water again.
5. Add small beads or buttons and repeat.

TIPS

The group will need to work together to create a tornado using fans and corn flour. Encourage opposite pairs of pupils to use the same upwards angle on their fans.

Consider how the paper could be anchored down to stop the tornado lifting it. Anchor the paper to the floor and create the tornado again. Did the idea work?

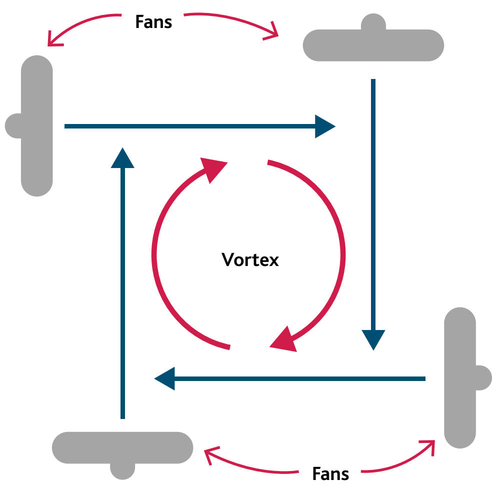
How could this idea be used in real life, for example, building houses in tornado-affected areas?

The exact physics behind tornado formation is still a mystery to science – however, the basics are understood. Put simply, tornadoes are created when an area of low air pressure forms and causes air to rush in from the surrounding areas. Usually, hot air rises, and colder air is drawn in underneath it. This colder air can form into a swirl, which draws more air up from the ground, creating a funnel shape. When the funnel of air touches the ground, it is known as a tornado.

6 Now that we know the shape of the tornado, let's try to create it using corn flour and fans.

7 Using corn flour to make the 'tornado' visible, have pupils sit on the floor and angle fans (electric or handheld) to make the corn flour curl and twist. If space allows, this part of the activity could take place outside. If doing it inside, you may want to use newspapers or sheets on the floor to make the clean-up easier.

8 The fans will need to be angled the same way. If they are positioned north, south, east and west, angle them so the air blows as though along the edges of a diamond. They will also need to be angled slightly upwards from the base. Leaders will need to adjust the distance of the fans according to how powerful they are. Smaller fans will need to be much closer.



9 Once the fans are held in place, add increasingly heavier objects to see if they are propelled upward by the air current or drop out of the tornado. Try using confetti or flower petals.

Incorporating Digital Skills

Have the pupils look up weather reports and information about tornados on the Internet. Use the following website to run a tornado simulator, you can adjust the speed and the size to see it's destructive powers:
[Tornado Simulator | NOAA SciJinks – All About Weather]

Idea!

Request a STEM Ambassador to talk about their job working in climate or the environment.

EXTENSION IDEAS

1 Houses are much easier to anchor to the ground than cars. What would your suggestion be to car manufacturers about tornado safety?

2 Can animals really rain from the sky? Tornados can empty small ponds, and then fish or frogs can be carried many miles away before they fall out of the updraft. As they are different masses, they will fall out of the updraft at different times, so it will look as though it is raining fish and frogs! Model this using different sized pieces of plasticine attached to paper shapes and dropping them into the swirling air.

DIFFERENTIATION IDEAS

Support: provide pupils with a small range of materials to create their own tornado. Ask them to video the tornado and play it back in slow motion to observe the shape more closely.

Challenge: allow the pupils more time to think about how to create the visible tornado independently. Provide fewer ideas about anchoring the paper.

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

1 Tropical Twisters

Your challenge

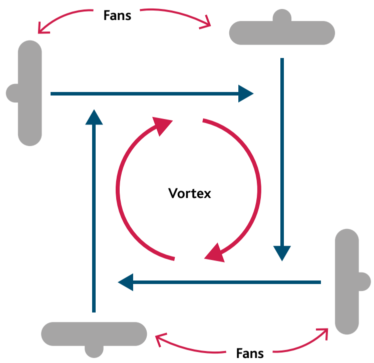
Tornadoes are powerful, towering columns of swirling air. You better hope that you never come across a real one, or you might get sucked up into the sky! Today, we are going to investigate how tornadoes are formed and think about how we might protect things from being blown away by a twister!

Individual investigations

1. Create a tornado using a jam jar and water.
2. Swirl the water around in the jar using a lolly stick, and notice the shape of the twister. Is it what you expected?
3. Now add a pinch of petals or dried herbs. Wait for them to settle at the bottom of the jar and repeat the swirl. What happens to the pieces?
4. Add gradually heavier objects to the tornado in your jar. Can the twister pick up heavy objects too? Is this what you thought would happen?

Group investigation

1. You group is now going to make a tornado using corn flour and fans! You'll all need to work together for this experiment to work. You could do this without the powder, but then you wouldn't be able to see the tornado!
2. A member of the group should try adding bigger and heavier pieces of paper into the twister to see how much it can lift.



How can we protect ourselves against the tornado?

1. You've discovered what the tornado can lift. Now try protecting the pieces of paper from being blown away by the tornado. How could you do this?
2. Imagine you were building a house in a place that has lots of tornadoes. What would you use to build your house? How would you protect it from tornadoes? What about your cars?

FUN FACTS

1. The largest ever tornado recorded was the El Reno, Oklahoma tornado of May 31st, 2013, which reached a width of 2.6 miles (4.3km).
2. An area in the central part of the USA is known as 'tornado alley' and has around 1000 large tornadoes a year!
3. Tornadoes in the Southern hemisphere normally turn clockwise, but those in the Northern Hemisphere turn anticlockwise.

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

2 It's raining giant hailstones!

Objective

In this activity pupils will create hailstones of different sizes, learn about hailstone formation and begin to think about their impact. Pupils will investigate how super-sized hailstones form and how much damage they can cause.

HEALTH AND SAFETY:

A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

Ensure that all pupils are away from the area where the hailstones get dropped. Impress upon the pupils the importance of respecting the experiment.

TOPIC LINKS

- Mathematics: measuring, linking hailstone size and damage caused
- Computing: use of technology

ESSENTIAL SKILLS SUPPORTED

Speaking, listening, teamwork

Internet research, data transfer, tables

TIME

50 minutes

RESOURCES AND PREPARATION

- Quick drying clay or plasticine
- Ruler
- Tissue paper - large sheets
- Measuring scales
- Sticky back plastic (optional)
- Umbrella (optional)

DELIVERY

1. Ask if any of the pupils know how hailstones are formed. Do they have any ideas about how they might be formed? (They are formed by air currents of wind, called updrafts, inside thunderstorms which carry droplets of water high enough to freeze. These become 'seeds' and as more water joins and freezes, the hailstone grows in size. Eventually, the hailstone grows too large for the updraft to support it, and it falls to the ground as hail.)
2. Create hailstones of different sizes, using the clay or plasticine. Weigh the hailstones and record their weights.
3. Have pupils hold the tissue paper sheet out and ensure fair testing by always dropping the hailstone from the same height. You could do this by using a metre stick to measure how high the stones are dropped from, or by using the same person to drop the hailstones from shoulder height.
4. Drop one hailstone at a time onto the tissue paper and record what happens. Did it make a hole in the tissue paper? If it did, measure the size of the hole using the ruler.
5. Draw a scatter plot graph to show how the size of the hailstone affects the damage to the paper. Label the x axis 'Weight of the hailstone' and the y axis 'Size of the hole in the tissue paper'. Plot all the data points onto the graph and draw a line of best fit (or trend line) on the graph to show the correlation between the size of the hailstone and the damage caused.
6. We have investigated the damage hailstones cause when they are too large to be carried upward any more, and gravity pulls them to earth.

Incorporating Digital Skills

Use a spreadsheet to record hailstone weights and measure the hole in the tissue paper, create a scatter graph with this data.

Idea!

Request a STEM Ambassador to discuss how they must predict and forecast elements of their job.

TIPS

Explain to the pupils the importance of fair testing. Explain that most tests try to find out how changing one thing affects an end result – in our test, we are testing how changing the size and mass of the hailstone affects the end result (how much damage is caused). In order to make sure that the results we get from this test are accurate, we need to make sure the test is fair – we need to make sure that we only change one thing each time we repeat the test (the weight of the hailstones). If something else is also changed – for example, the height from which we drop the hailstones – we won't know if any changes in the damage caused are a result of the weight of the hailstone or the height from which it was dropped. To keep the test fair, we must drop the hailstones from the same height each time, onto the same type of tissue paper.

EXTENSION IDEAS

1. How could we strengthen the paper so that large hailstones cause less damage? Add a layer of sticky back plastic to create 'toughened paper' and repeat the drop test.
2. Research toughened glass and how much stronger it is compared to normal glass.
3. Experience a hailstorm! Use thick paper or an umbrella and hold it over each member of the group in turn while everyone else drops their hailstones.

DIFFERENTIATION IDEAS

Support: provide pupils with the results table and graph mostly complete so they only need to plot their results.

Challenge: research super-sized hailstones using the links below and make predictions about the damage they would cause to the tissue paper using your graph. Make the giant hailstone and test it. Did the result match the prediction?

USEFUL LINKS

- More information about how giant hailstones are formed
  www.seeker.com/midwests-giant-hailstones-how-did-they-form-1768631153.html
- Maps and videos of hailstorms (USA based)
  http://hail.org/

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

2 It's raining giant hailstones!

Your challenge

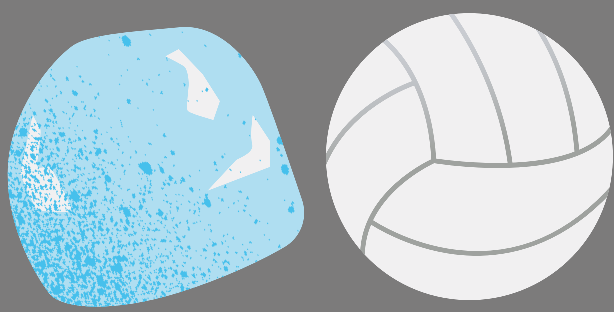
Today you're going to find out about the destructive power of hailstones. First you're going to make your own hailstones, then you will test to see how much damage they can cause!

WHAT YOU NEED TO DO

1. Make a series of hailstones of different masses and sizes, using quick drying clay or plasticine. Measure each of the hailstones and make a note of the masses.
2. Have two members of the group hold a sheet of tissue paper firmly, and drop each hailstone onto the paper to see how much damage they cause. Make sure that you drop each hailstone from the same height to make the test fair.
3. Has the hailstone caused damage to the paper? If it has, measure the width of the hole at its widest point in mm. This is the diameter of the hole. If the hailstone didn't break the paper, record 0mm.
4. Once all the hailstones have been dropped and all the results have been recorded, draw a scatter graph to show how the size of the hailstone and the damage caused are related. The Club leader will show you how to fill in your graph. Then draw a line of best fit on your graph. Your Club leader will explain how to do this.
5. Use your graph to predict how much damage would be caused by larger, heavier hailstones. If there is time, make some new, bigger hailstones and test them with the tissue paper to see if your predictions were correct!

FUN FACTS

1. The largest hailstone ever recorded was the size of a volleyball, which means it was 20cm wide and weighed a whopping 880g! It fell in South Dakota, USA, in 2010.



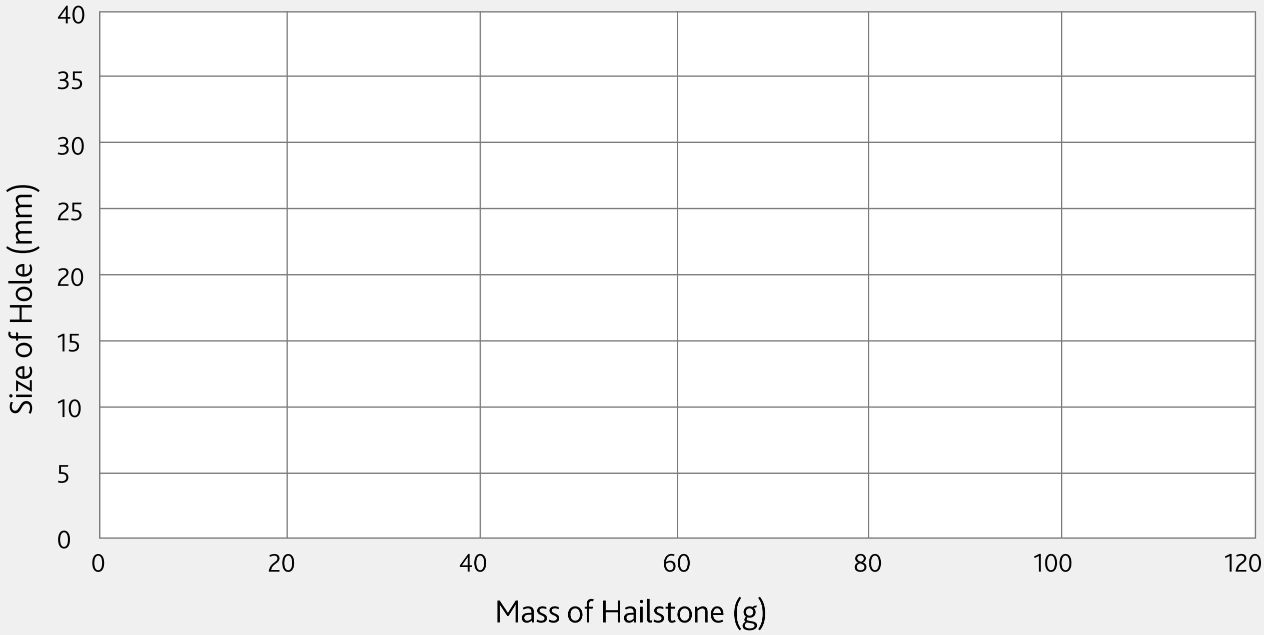
2. In July 2017, hailstones the size of golf balls fell in Spain, smashing car windows and ruining crops and people's property.

Extreme Elements

2 It's raining giant hailstones!

Results table:

Hailstone mass (grams)	Damage caused (millimetres)



CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

3 Make a rainbow

Objective

In this activity pupils will see white light split into the different colours of the rainbow. Pupils will explore the real-world conditions needed to create a rainbow and how these relate to the light spectrum.

HEALTH AND SAFETY:

A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

Explain to the pupils the risks associated with bright lights, especially when shined into people's eyes. Ensure that students use the equipment responsibly.

TOPIC LINKS

- Science: light, reflection and refraction
- Computing: use of technology

ESSENTIAL SKILLS SUPPORTED

Speaking, listening, problem solving

Internet research, digital photography

TIME

20 minutes

RESOURCES AND PREPARATION

- Jam jar or Pyrex bowl
- Water
- White card
- Mirror
- Torch, sunlight, mobile phone light or bright white LED
- Water mister/spray bottle (for example, for plants)

DELIVERY

1. Ask pupils when they might see a rainbow. Do they know how rainbows are made?

Note - Rainbows are made when sunlight shines through droplets of rain. So, for a rainbow to form, you need both light and water. When sunlight shines through water droplets, it makes a rainbow. Sunlight, which is white light, is made up of all the different colours of light put together. There actually is no white light – we just see white when all the different coloured lights come together. When white light shines through water, it can split into all the colours that make it up. When this happens, we see a rainbow in the sky.

Explain that today the pupils are going to discover how to make a rainbow in the classroom.

2. Encourage the pupils to explore the equipment and, thinking about what they've just learned about how rainbows form, try to make their own rainbow.
3. After 10 minutes of discovery, talk them through the model.
4. Two thirds fill the jar or bowl with water and place on a white surface. Carefully place the mirror in the water and angle the torch so that the light reflects off the mirror. Alter the angle of the mirror and torch to find the best result and use the white card to show the rainbow. As the light passes through the water, it will refract. This means that it slows down and changes direction slightly because it is travelling through a different, denser, medium. It is this refraction that splits the white light into its component colours. The refracted light is then dispersed onto the card, with the longer wavelengths at the top of the rainbow (we see these as red) and the shorter wavelengths at the bottom (we see these as blue).
5. Ask the children to explain how this experiment mimics what's going on when we see a rainbow in the sky. The torch is acting as the sun and the jar of water acts as the rain. The mirror and the white card simply make the effect easier to see.

TIPS

- Make sure the light source is very bright, white light LED torches or mobile phone lights are perfect for this experiment.
- Try the experiment in a darkened room.
- Have the pupils work in teams of three, one to hold the torch, one to hold the mirror and one to track the rainbow with the white card.

Idea!

Ask a STEM Ambassador to support the activity and run a Q&A about the environment aspects of their job.

Incorporating Digital Skills

Have the pupils capture images of the rainbow effect using a digital camera, print the photos and create a display. Encourage them to search the Internet for information on rainbows and create a list of facts in a Word document.

EXTENSION IDEAS

1. Provide a hose or water sprayer and an outdoor space to create 'rain'. Use sunlight or a torch to provide the white light source. Can the pupils create a rainbow?
2. Pupils could create a rainbow light / rainbow night light by fixing a small push light to the inside of a jam jar lid and painting some of the sides and the base with white paint.
3. Double rainbows often occur in nature. They occur when sunlight is refracted out of the front and back of the raindrop at the same time. See if the children can alter the set up to mimic a double rainbow.

DIFFERENTIATION IDEAS

Support: set up the experiment beforehand and ask the children to use the torch to try to make a rainbow effect on the white card. Then discuss how this is similar to real-world examples of rainbows.

Challenge: why is the sky blue? Use a torch, water and milk as a model for what is happening in the sky. Fill a clear jar with water and add a teaspoon of milk. Stir well and shine a torch onto the surface of the liquid. The milk acts as the gases in the Earth's atmosphere and scatters the different coloured light waves. Blue light has the shortest wavelength and is the most easily scattered which makes the milk appear blue. The sky looks blue because we are seeing blue light scattered across the atmosphere. Shine the torch through the side of the jar and the liquid will have a red tint. In the evening the sun is lower in the sky and light has further to travel. Blue light is scattered too much before it reaches us, red light has the longest wavelengths which don't scatter so easily. This makes the sky look reddish just like a sunset.

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

3 Make a rainbow

Your challenge

Everyone loves it when a beautiful, colourful rainbow stretches across a sunny, blue sky. But how are these colourful bands created? And why do we only see them sometimes? In this activity, you will see how white light can be split into the different colours of the rainbow, and discover the conditions needed to create a rainbow – even when it's dark outside!

WHAT YOU NEED TO DO

1. Collect all the equipment and try out different ways of shining the light to create a rainbow.
2. If you are successful, the image of the rainbow will appear on the white card, rather than in the air.
3. Top tip: remember that light is refracted by water, and rainbows occur in nature during sunshine and rain! Keeping this in mind, how could you use your equipment to simulate the combination of rain and sunshine?
4. Once you find a combination of equipment that works, draw a diagram to show what you did.

FUN FACTS

1. Did you know that double rainbows are very common? This is because light is refracted out of the front and the back of the raindrop and it takes millions of raindrops to make a rainbow. The second rainbow has its colours reversed though!
2. There are seven colours that we can see in a rainbow, red, orange, yellow, green, blue, indigo and violet.
3. You can never reach the end of a rainbow. When you move, you see different raindrops making the rainbow. So if you move, the rainbow moves as well.
4. On the ground we see a semi-circle in the sky, but if you were really high up, such as in an airplane, you would see a complete circle.

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

4 Wall of water

Objective

In this activity pupils will find out how a tsunami is formed, how much destruction it can cause, and what humans can do to protect their communities.

TOPIC LINKS

- Science: geology, plate tectonics
- Design and technology: protective structures by the coast
- Computing: use of technology

ESSENTIAL SKILLS SUPPORTED

Problem solving, creativity, aiming high

Internet research, data handling

TIME

60+ minutes

RESOURCES AND PREPARATION

- Paddling pool
- Tables
- Water
- Modelling clay
- Lego, lolly/craft sticks or other construction equipment
- Newspaper/scraps

HEALTH AND SAFETY:

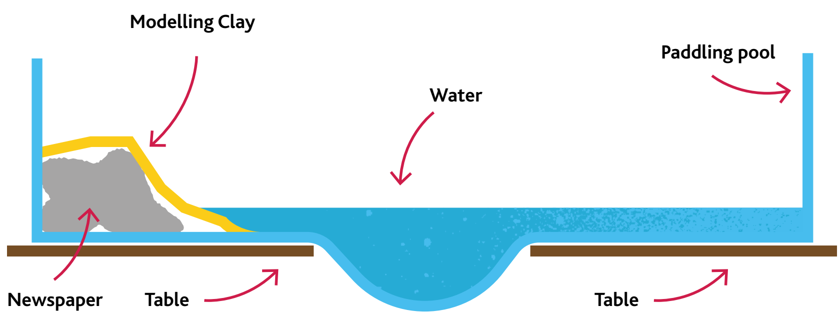
A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

DELIVERY

1. See what pupils know about tsunamis. (A tsunami is caused by an underwater volcanic explosion or earthquake.) Set up a model within the space to observe the phenomenon:
2. Tsunamis are often caused when the ocean floor lowers, so the entire sea level drops, before being strongly pushed back up, creating a wall of water. A shift in the Earth's tectonic plates can cause such an effect, and that's why they can cause tsunamis.
3. Model this by placing the paddling pool across two tables with a gap in the middle. At one end, pile up crumpled newspaper or paper scraps. Cover with modelling clay and create a slope to represent the shore. Add water until it just reaches the shore. Add toy houses or pictures of a village to the top of the slope to represent a coastal town. Have the pupils assist with making and setting up this apparatus if time allows. Otherwise, prepare the apparatus before the session.

TIPS

If you are short on time, have the paddling pool already set up when you start the session. Remember to allow time at the end of the session to empty it too!



Incorporating Digital Skills

Use of spreadsheet to record the wave height with and without a sea wall, against the protective wall plot a graph to present the results. Record observations in a Word document table. Research Tsunamis on the Internet to find how far they can travel.

4. Ask pupils to mark the water level in the clay.
5. To simulate a tsunami, gently pull down the pool in the middle and watch the water level around the edge of the pool drop.
6. Next, push back hard and watch the water surge above the mark. Mark the highest point of the wave either in modelling clay again, or on the side of the pool with a marker. Can pupils work out the difference between the highest and lowest points for the waves?
7. Repeat this a few more times, trying to pull the pool down the same amount each time. Pupils should record their observations, and find out the average height that the waves reach.
8. Now set pupils the challenge: can they design a sea wall to protect the town on the shore?
9. Show pupils the building materials available to them (Lego™, craft sticks, etc.) and ask them to draw out a design for the wall, explaining how high they will make it and how they will position it. They can compare ideas and refine their designs before building.
10. Now allow pupils to construct their sea wall. They can press Legos or craft sticks into the modelling clay to represent how it will be built into the sand. Explain that holes in the wall will help to break up the power of the wave, but a wall with holes may not last as long as a solid wall.
11. Once they've completed their construction, try the simulation again and ask them to measure the highest point the water reaches. Repeat a few times to see if the wall stays in place and record the average height of the wave. Is it lower than the tests without a sea wall? Does a sea wall with holes in it work better than a sea wall without holes? Does a sea wall with holes last as long as one without?

Idea!

Request a STEM Ambassador to talk about how they use modelling in their career.

EXTENSION IDEAS

1. You could investigate how water surges up a narrow channel (for example a river) using plastic guttering. This would model phenomena like the Severn Bore. It is a huge wave, but is it more like a tsunami or storm surge? (It's the latter, as it's is due to the position of the moon, gravitational pull and wind, not movements in the earth's crust.)
2. You could price different materials and set a budget. Pupils may not be able to afford their first-choice materials. Can their design be adapted?

DIFFERENTIATION IDEAS

Support: limit the materials available for building the wall so that pupils can focus on their designs and refinements.

Challenge: allow pupils to experiment with a range of building materials. Give them time to research real sea walls and try to incorporate what they learn into their own models.

USEFUL LINKS

Information about the Severn Bore
http://www.severn-bore.co.uk/

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

4 Wall of water

Your challenge

The ocean can be loads of fun, but it's also very powerful, and can sometimes cause damage to towns and villages on the coast. You'll look at how tsunamis form, and try to protect a village from the ocean's force.

YOUR TASK Build the best possible sea wall to help protect a town from a dangerous tsunami!

WHAT YOU NEED TO DO

1. Help your Club leader set up the pool and create a town by the sea. How high is the water when it's calm?
2. Now watch when the tsunami hits! How high does the water go? Measure the waves and fill in the chart below.
3. Design a sea wall to help protect the town. Use the space below. Show your design to other groups. Agree on a design that everyone thinks is best.
4. Another tsunami is coming! Build your sea wall to protect the town.
5. Test it out. Does it help stop the wave from reaching the houses? Write your results in the chart. Can you make any changes to your wall to make it work even better?
6. Make any changes and test it out again. Write your measurements in the chart.

FUN FACTS

1. Tsunamis can travel at 500 miles per hour (805 km per hour) which is almost as fast as a jet airplane.
2. The first wave of a tsunami is not the strongest. The waves get larger and stronger over time.
3. If caught in a tsunami wave, don't try to swim! It is better to grab a floating object and let the wave carry you,

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

4 Wall of water

Results table:

	How high do the waves go?	Average height
No sea wall Test 1 Test 2 Test 3		
With sea wall #1 Test 1 Test 2 Test 3		
With sea wall #2 Test 1 Test 2 Test 3		

WHAT YOU NEED TO DO

1. How tall does the wall need to be?
2. What materials will you use to make your wall?
3. How will you make it stand up?
4. Is it ok for some water to come through?
5. Do holes in the wall make the sea wall better or worse?

Extreme Elements

4 Wall of water

Your design

STEM CLUBS

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

5 Shake the room!

Objective

In this activity pupils will consider why earthquakes happen and how they impact humans. They will begin to understand how the design and structure of buildings is linked to how well the building can withstand an earthquake.

HEALTH AND SAFETY:
A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

TOPIC LINKS

- Science: forces
- Design and technology: building and comparing different structures
- Computing: use of technology

ESSENTIAL SKILLS SUPPORTED

Problem solving, creativity, staying positive

Data logging, software use, data handling

TIME

50 minutes

RESOURCES AND PREPARATION

- Pan of jelly (1 per group)
- Various construction materials:
  - For structure: dry spaghetti, toothpicks, etc.
  - To connect pieces: mini marshmallows, sticky tack, plasticine
  - You could also use Lego™, K'nex™, or recycled materials
- Stopwatches

DELIVERY

1. Prepare pans of jelly ahead of time.
2. Tell pupils that they're going to be architects today – and their challenge will be to design and make a building that can survive an earthquake.
3. Show pupils their building materials and give them time to experiment with their designs to build the sturdiest structure possible. They can draw out their ideas before building if they wish.
4. Ask pupils what happens during an earthquake: the ground shakes (turns to jelly!) and buildings often collapse. Explain that they're now going to test their designs in their pans of jelly.
5. Observe what happens when the jelly is shaken. They should use stopwatches to time how long their structures stand. Whose building stayed standing the longest?
6. Now allow them to revise their design and try again. Can they make changes that will help make their structures more resistant?
7. As a group, look at the most effective structure. What do they think made it so sturdy?

EXTENSION IDEAS

1. Many of the structures the pupils create may not resemble any buildings they've seen in real life! Ask them to design what the exterior of their building would look like if built with real construction materials.
2. Find out places in the world where earthquakes are very common. What kind of buildings are common there? Why?

DIFFERENTIATION IDEAS

Support: allow pupils to use any design they like to create their structure.

Challenge: give pupils additional constraints that they must consider while creating their structures, such as a minimum height, or a fixed number of toothpicks or marshmallows they can use.

Incorporating Digital Skills

- Use Tinkercad to create structures in 3D CAD. Could these be 3D Printed and tested?
- Setup and procedure (microbit.org) Use a Micro:bit as a data logger to record the forces on a structure during an earthquake.
- Stop Disasters! (stopdisastersgame.org) Use this game to simulate Earthquakes.
- Research earthquakes, choose five countries around the world and record how many earthquakes they have a year and how strong they are in a spreadsheet. Use the information to plot a graph.

Idea!

Request a STEM Ambassador to judge the sturdiness of your students structures.

TIPS

- Prepare the dish of jelly ahead of time. Pupils may want to wear aprons to protect their clothes.
- Ensure that pupils do not shake the pan too roughly. It should not be forceful enough to cause any of the jelly to spill out.

USEFUL LINKS

- More information about earthquake waves
http://www.kids-fun-science.com/earthquake-waves.html
- Plate tectonics map and factsheet
www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/Earth%20Science%20Week/esw11/BGS%20Plate_Tectonics.pdf

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

5 Shake the room!

Your challenge

The dreaded call of 'earthquake' is heard, and the room starts to shake. You better hope that the building you're in has been built to survive earthquakes! Earthquakes are some of the most powerful forces in nature, but they can be beaten.

Certain areas of the world are more likely to experience earthquakes than others. In these places, special measures are taken to protect against earthquakes and to prevent buildings from falling down during earthquakes. Can you find out why earthquakes happen more in some places rather than others, and how to protect buildings from being destroyed by earthquakes?

YOUR TASK Design and build a structure that can survive an earthquake.

WHAT YOU NEED TO DO

1. Look at the building materials you have. How could you use them to build a building strong enough to survive an earthquake?
2. You can draw some ideas in the space below. Once you've settled on your design – build it!
3. Put your building in the pan with jelly, and shake it back and forth. Another person should time it. How long can your building stay standing?
4. Whose structure stayed up the longest? What do you notice about the structures that lasted longest? Make some notes.
5. What could you change about your building's design to make it stronger? Design build and test another structure using what you've learnt. Did you get better results this time around?

FUN FACTS

1. Earthquake waves, called P-waves and S-waves, travel through the ground and are the result of major movements within the earth's crust.
2. In 2016, a Japanese architect renovated the first earthquake-proof building, by adding carbon fibre rods to anchor the building to the ground. From a distance, the rods look like a cloak, wrapping around the building.
3. The UK has between 20 and 30 earthquakes each year, but they are usually very small and don't cause any damage.

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

5 Shake the room!

Building designs

Notes

STEM CLUBS

NUMBER 1 FOR STEM

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

6 Under Pressure

Objective

In this activity students will learn about the specialised conditions required for geyser formation, and create a model to understand how the pressure within the Earth causes geysers to erupt.

HEALTH AND SAFETY:

A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity. Pupils should wear appropriate eye protection.

Ensure the openings of the bottles are pointed away from pupils.

Check the temperature of water pupils are using to ensure it's not too hot.

Glass or rigid bottles must not be used in this activity. Use plastic drinks bottles intended for fizzy drinks.

TOPIC LINKS

- Science: pressure build up within the earth
- Computing: use of technology

ESSENTIAL SKILLS SUPPORTED

Problem solving, listening, speaking

Data handling

TIME

40 minutes

RESOURCES AND PREPARATION

- Water balloons
- 1L or 2L plastic fizzy drink bottles
- White vinegar
- Baking powder
- Liquid hand soap
- Plastic tubs
- Kitchen roll

DELIVERY

1. Ask pupils if they've even seen a geyser. You may want to show a video of a geyser erupting (see Useful links for example). Explain to pupils that geysers occur when a pool of water underground heats up to a very high temperature, and sends the water exploding up into the air.
2. To demonstrate what's happening, give pupils partially inflated balloons and ask them to squeeze gently. Can they feel how the air inside pushes against the balloon? Now have them gently squeeze a fully inflated balloon. They should be able to feel the pressure of the air inside even more now.
3. Explain that a geyser works in a similar way – the gas builds up underground. But the ground is rocky, and can't stretch like a balloon. What will happen? (The pressure will build up until it explodes out of a hole in the ground, bringing the underground water up with it.
4. Tell pupils that geysers need very hot water to work, but that they're going to try to get the same effect with a chemical reaction instead.
5. Give each group an empty tub, and a plastic drinks bottle. Each group should fill the bottle most of the way with warm water, and add a few drops of liquid soap. To create the reaction, they'll need a way to build up pressure—have them add vinegar to the water, drop in baking soda and quickly cover the top of the bottle with the palm of their hand.
6. Without shaking the bottle, will they be able to produce an eruption?
7. Allow pupils to experiment. They could consider: what happens if they repeat the experiment reusing the water remaining in the bottle? What if they use different quantities of soap, vinegar or baking soda? How long should they hold their hand over the opening? What would happen if they didn't cover the top of the bottle? What makes the most effective geyser?

Incorporating Digital Skills

Use a spreadsheet to record the amount of ingredients used each time and record how high the 'geyser' is or how far it travels. Create a chart to show which set of measurements create the best geyser.

8. To understand pressure, give a pupil a water balloon filled with water. If they squeeze it to increase the pressure, what will happen? (It will burst.) The geyser is the same – the increase in pressure is due to heat from the magma giving the water molecules more energy to move. As the bubbles of hot water float to the surface, they burst, cooling the surface of the water. The cold water sits on top of the hot water, allowing it to become superheated. When new bubbles form as the water begins to boil, they rise to the surface. This time, an explosive chain reaction occurs, where the whole reservoir of water is flash heated at the same time, and violently erupts from the hole. As the rock is so impermeable, it has to be forced out of the hole at the top.

WHAT'S GOING ON?

The water is from groundwater, like rain or snow, which trickles into cracks in the rock to form a pool of water underground. The shape of this pool of water affects the height of the geyser. The heat is from magma, or molten rock, at the base of the groundwater, heating it up, in a similar way to boiling water in a kettle (with the heat source at the base). When the water is heated, the pressure builds up and eventually the water erupts from a hole in the ground. As the rock is so impermeable, it has to be forced out of the hole at the top.

EXTENSION IDEAS

1. Find out where the geyser fields are in the world.
2. Learn about the different geyser shapes. Model different shaped geysers, for example using an inverted funnel to see how the cone shaped geyser may erupt. Slice a block of clay in half and hollow out different shaped reservoirs before joining them back together. Test them out with vinegar and baking soda.

DIFFERENTIATION IDEAS

Support: provide quantities for some of the ingredients so pupils can focus on a single variable. eg instruct them to use a set amount of liquid soap and vinegar, and ask them only to explore how much baking soda they'll need. Alternatively, you can use effervescent tablets and experiment with the quantities of other ingredients.

Challenge: tell pupils the ingredients they'll need, but allow them to find the best combination of quantities for an explosive geyser.

TIPS

Cover your workspace with newspaper for easier clean-up. You may want to do this activity outdoors if weather permits.

For an example that very closely matches the physics of a geyser, use a Moka coffee pot. Moka pots are designed so that water gets pushed through a layer of coffee grounds when it reaches a high enough temperature. The rising temperatures cause an increase in pressure as the particles in the water get excited. The increased pressure then forces the water up through the coffee grounds, as the metal container of the Moka pot can't expand to accommodate for the rise in pressure. After the process is complete, almost no water is left in the bottom compartment – it's all been pushed up and out, just like in a geyser.

Idea!

Request a STEM Ambassador to talk about how they apply science skills and predictions in their job.

USEFUL LINKS

Britannica Kids Geyser article
https://kids.britannica.com/kids/article/geyser/400107

World Geyser Sites
http://www.wondermondo.com/Attractions/Geysers.htm

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

6 Under pressure

Briefing

Geysers are an amazing natural phenomena. They are jets of super-hot water that get forced out of the Earth at high speeds, flying hundreds of feet into the air! Today, you are going to learn about the natural forces that cause geysers to erupt and attempt to make your very own geyser.

YOUR TASK Create your own geyser. Find the perfect combination of ingredients to get the most spectacular results!

WHAT YOU NEED TO DO

1. Fill your bottle most of the way with warm water. (Not hot!)
2. Add a few drops of liquid soap, and some vinegar.
3. Drop in some baking soda and quickly cover the top with your hand.
4. Now move your hand away—what happens?
5. Record your results, and see if you can make an even better geyser. Write down your 'recipe' for a geyser in the space below.

THINGS TO THINK ABOUT

1. What makes the bubbles shoot out?
2. Think about the role pressure plays in geysers. What does this tell you about how you can make your own geyser?
3. What happens if you don't cover the hole? What if you add more soap or less baking soda?

FUN FACTS

1. The most famous geyser is called 'Old Faithful' in Yellowstone National Park, USA. It has this name because the underground pool of water refills quickly, meaning that the geyser erupts about every 90 minutes.
2. Geysers can erupt underwater too.
3. The Strokkur geyser in Iceland erupts every 5-8 minutes and can reach up to 40 metres high.
4. The highest recorded geyser in history was the Waimangu geyser, which erupted to 160m. The last time this geyser erupted was in 1904.

Extreme Elements

6 Under pressure

Recipe for a geyser

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

7 Snowflake similarities

TOPIC LINKS

- Science: weather conditions, crystallisation, mirrors
- Design and technology: designing and making a kaleidoscope
- Maths: 6 sided shapes, patterns, symmetry
- Extension: computing: using software to explore shapes and patterns

ESSENTIAL SKILLS SUPPORTED

Teamwork, problem solving, speaking,

Software coding

TIME

50 minutes

RESOURCES AND PREPARATION

- Paper, white tissue paper
- Cardboard tubes
- Sticky tape
- Scissors
- Silver mylar (space blankets) / mirrored card / aluminium foil (needs to be very flat)
- Clear plastic bag / plastic pocket/ tracing paper
- Sequins and biodegradable confetti
- Black card
- Tablets and kaleidoscope app, for example KaleidaCam

Objective

In this activity pupils will consider if all snowflakes can really be unique. They will make a simple kaleidoscope to explore this. Pupils will explore how different weather conditions can affect individual snowflakes.

HEALTH AND SAFETY:

A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

Ensure that children use their kaleidoscopes responsibly. You should warn the children about the dangers associated with looking directly into bright lights (even through a kaleidoscope) and with misusing sequins and confetti.

DELIVERY

1. See if pupils are aware of the idea that all snowflakes are different. Can that really be true? To answer this, we need to know how snowflakes form.

2. Explain that as snowflakes freeze, water molecules line up, changing from a fluid liquid into a hexagonal, solid ice crystal. If enough ice crystals stick together, a snowflake forms. Its journey to the ground – how it falls and how it freezes – then affects its shape. So, snowflakes may start as the same shape, but will end up looking different to all other snowflakes by the time they reach the ground.

3. Tell pupils that they are going to make a kaleidescope to investigate different shapes and patterns that are similar to snowflake patterns.

   Note: Kaleidoscopes produce hexagonal, symmetrical, unique images. In this way, they produce patterns that are similar to the patterns crated in snowflakes. However, the patterns produced by kaleidoscopes are the result of mirrors, rather than the crystallisation process that produces snowflake patterns. So, while kaleidoscopes and snowflakes are similar in some ways, they are still very different.

TIPS

Share a video of snowflakes falling in case some pupils have not experienced snow.

Incorporating Digital Skills

Use computing software to explore shapes and patterns, such as Tinkercad or codeblocks.

4. Cut three strips of mylar / mirrored card to fit the full length of the cardboard tube.
5. Tape the outsides together to form a triangular prism.
6. Insert this into the tube, and seal one end, making a hole in the black card to look through.
7. Cover the other end with a tracing paper packet or a clear plastic bag, filled with sequins and confetti.
8. Point the kaleidoscope towards the light and twist it to watch the patterns inside change.

   Note: Make sure that no one looks directly into a light through a kaleidoscope, as this might damage their eyes.
9. Ask pupils why they see a 6-pointed image when there are only 3 sides to the mirror. (Answer: each flat face of a mirror is reflecting the vertex, or corner, that is opposite it.
   This tricks the eye into thinking there are double the amount of vertices (corners) than there really are! This is also what makes the image symmetrical.)
10. Use tablets to explore mirroring effects and symmetry, using everyday photographs. Different lines of symmetry can be used to explore how increasingly complicated snowflakes could look. Provide pupils with a copy of a snowflake identification chart www.snowcrystals.com/guide/snowtypes4.jpg and see if they can use the kaleidoscope app to create these shapes.

EXTENSION IDEAS

1. Cut out snowflakes using tissue paper. Pupils will need to fold a circle into 6 segments, not 8. How can they make every snowflake different?
2. Use Scratch and this starting point, then modify or remix the code in editor mode. Allow the children to play with the program and design some snowflakes, then ask them to use editor mode to change the coding of the program. https://scratch.mit.edu/projects/15008960/
   Set a mini challenge – you could ask pupils to create a multicoloured snowflake. (Change the colour every time the pen is picked up).

DIFFERENTIATION IDEAS

Support: have some of the materials pre-cut or pre-assembled. Students can just use the kaleidoscopes to attempt to make snowflake shapes and then discuss how they work.

Challenge: using their memory, the pupils could draw their favourite snowflake shape seen through the kaleidoscope. Introduce the different snowflake types: plates and dendrites. Plates are plainer snowflakes, dendrites have more gaps in them and look more elegant.

USEFUL LINKS

More information about snowflake shapes
http://www.snowcrystals.com/guide/guide.html

Idea!

Request a STEM Ambassador to give a Q&A on how they help the environment in their job.

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

7 Snowflake Similarities

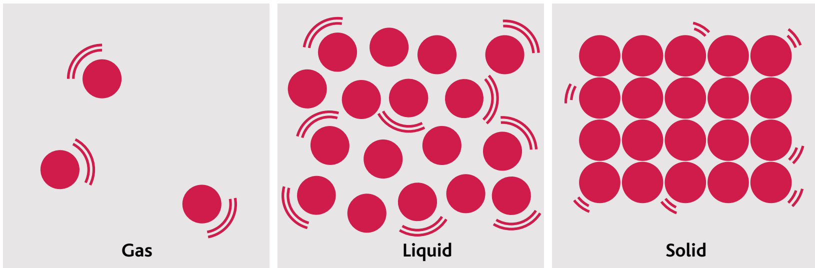
Briefing

Learn about how ice crystals form to make snow - the process that goes into making each snowflake unique. Then explore the different patterns that could be made in a snowflake by building your very own kaleidoscope!

YOUR TASK Make a kaleidoscope to examine how, even when only tiny changes are made to the snowflake, the effect on the overall pattern can be great.

WHAT YOU NEED TO DO

1. Think about how molecules line up in a liquid (water) and a solid (snow).



2. Cut three strips of mylar / mirrored card to fit the full length of the cardboard tube.
3. Tape the outsides together to form a triangular prism. The shiny part should be facing inwards.
4. Insert this into the tube, and seal one end with a piece of black card. Poke a very small hole in the black card to look through.
5. Cover the other end with tracing paper or a clear plastic bag, filled with sequins or confetti. For best results, pull the paper/plastic tightly over the end so that the sequins and confetti can freely move around.
6. Point the kaleidoscope towards a light source, but not directly towards a light, and twist it to watch the patterns inside change.

   Note: Never look directly at a source of light, even through a kaleidoscope, as you could badly damage your eyes.
7. Why do you see a 6-pointed image when there are only three mirrors in the kaleidoscope?

FUN FACTS

1. Snowflakes can be categorised into a number of types: plate, column, dendrite, lacy, stars, needle and capped column.
2. According to the Guinness World Records, the largest snowflake was 15 inches wide and 8 inches thick! This was recorded in January 1887, by Matt Coleman in the USA.

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

7 Snowflake Similarities

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

8 I will survive!

Objective

In this activity pupils will think about how they could use parts of the environment to survive. They will learn the key things required to survive in the wild and how to use things in their surroundings when in a desperate situation. Pupils will explore a virtual environment, using virtual reality (if available).

HEALTH AND SAFETY:

A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

Consider dietary needs or allergies when choosing the survival foods.

TOPIC LINKS

- Design and technology: assess resources, design shelter, create a shelter
- Computing: use of technology

ESSENTIAL SKILLS SUPPORTED

Teamwork, creativity, leadership

Software and app coding

TIME

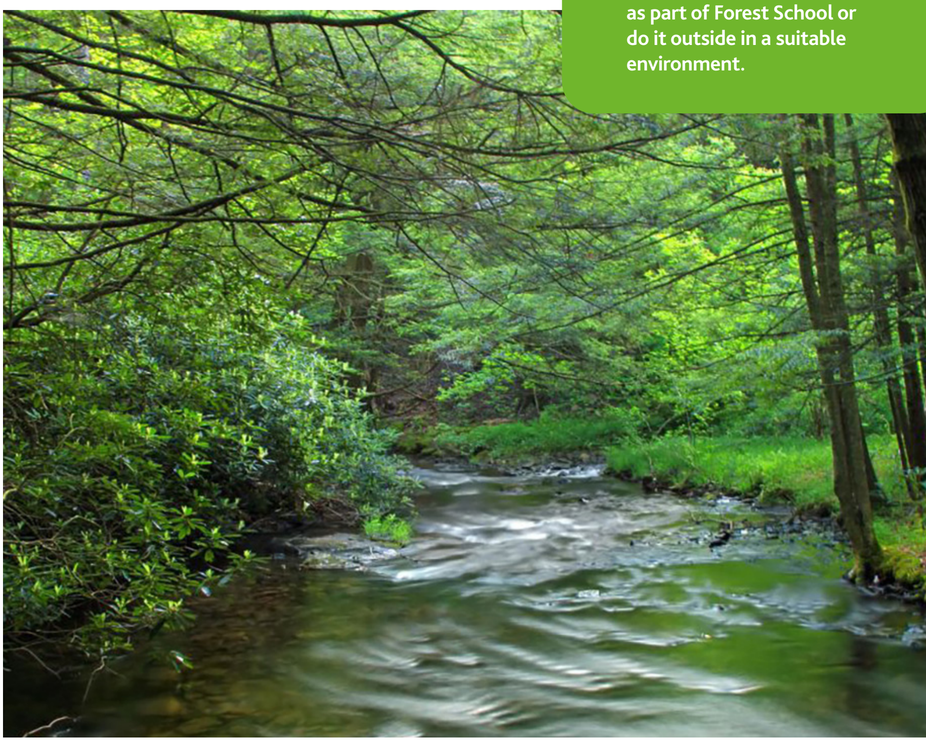
60 minutes

RESOURCES AND PREPARATION

- Outdoor space for creating a group shelter
- Detailed photograph
- Rucksack with 'survival' supplies (as listed below)
- Torch
- Rip-stop nylon, tarpaulin or similar
- String
- Plastic flask/container
- Magnifying glass
- Emergency food (fruit, chocolate, energy bars, nuts etc.)
- Blanket

DELIVERY

1. Tell pupils to imagine they have just been dropped into the wild – maybe they spawned instantly like in Minecraft or teleported somewhere like Dr Who.
2. Use a detailed photograph of a remote and unfamiliar environment and allow pupils to study this. For example:



TIPS

- Create a story for the pupils to make the activity more engaging – for example, they've been marooned on a desert island and need to survive until help arrives.
- You could use this activity as part of Forest School or do it outside in a suitable environment.

3 Provide each group of pupils with an emergency kit or backpack containing items such as a torch, rip-stop nylon / tarpaulin, string, plastic flask/container, magnifying glass, chalk, blanket, etc and instruct them that the first thing to do is create a safe shelter. Encourage the pupils to work in small teams to gather supplies from the surrounding area to help them make the shelter. Encourage the pupils to explore the materials in the pack and those available in their surroundings and how they can use them to build a safe, dry and warm shelter. By making best use of the materials how big could they safely make the shelter and could it fit all of them inside?

4 Key questions:

- what do you have in the emergency kit? How could you use the items to make a safe and dry shelter? How could you keep warm? Is a big open shelter better than a smaller enclosed shelter?
- where would be a good place to build a shelter? Is there a lot of wind or is the ground damp? What materials are available in the surrounding area? How could you use them with the items in the pack? Encourage the pupils to look at how branches and trees can provide support and stones can be used to weigh down the edges of the tarpaulin.
- how could you stop predators or biting insects from entering your shelter?

5 Teach the pupils a suitable knot to help them build their shelter, you may need to assist them as they build. Where possible build outside where trees and bushes can be used. If indoors, explore how tables and desks could be used.

When the shelter is finished check it is secure before gathering the pupils inside. Once inside discuss how they could improve the shelter: make a fence to keep out wild animals; use the magnifying glass to start a small controlled fire to keep them warm and to cook food; add damp leaves to the fire to create smoke to deter mosquitoes; what about a raised floor using branches or similar to prevent insects from crawling inside?

Incorporating Digital Skills

Use software to explore shapes and patterns, such as Tinkercad to create a design for their shelter.

EXTENSION IDEAS

1 Place pictures of different types of animals and insects around the area where the pupils will build the shelter. Ask which ones might pose a threat to their safety and why. How could they protect themselves? If building shelters indoors encourage the pupils to look up the animals. For more instant information create, QR codes (quick response code) which link to a website or on-line document. QR codes can be created using a free app such as QR Code Maker.

DIFFERENTIATION IDEAS

Support: create the shelter in a space with lots of materials the pupils can use.

Challenge: encourage them to think about a purpose for each design element of the shelter. For example, adding a flap of fabric in the doorway or using branches to block it will help keep the shelter warm and prevent insects flying in.

Idea!

Request a STEM Ambassador to talk about how they get to travel in their role.

USEFUL LINKS

Guide to tying different knots
www.animatedknots.com/indexbasics.php

There are many ways to build shelters with and without tarpaulins, the following links will help you plan the shelters:
https://www.outdoorlife.com/photos/gallery/hunting/2013/05/survival-shelters-15-best-designs-wilderness-shelters

http://www.forestschoolportfolio.com/unit-2-practical-skills-for-a-forest-school-programme/1-6-erect-a-temporary-shelter-using-tarpaulin-and-ropes/

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

8 I will survive!

Briefing

You wake up, blinking the sunlight out of your eyes, and try to remember how you got here. But you can't think straight. You look around and notice that you're in the wilderness – somewhere you've never been before. You've only got what's on your back and what you can find in the environment around you. Will you survive the night? Let's find out!

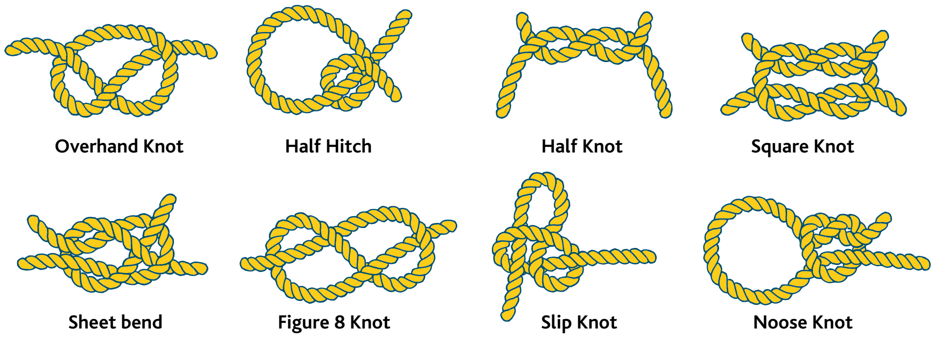
YOUR TASK First things first, you need to make yourself a shelter.

WHAT YOU NEED TO DO

1. Use the image or information about the environment to learn more about what is near you.
2. Can you spot any dangers? Are there any animals around? Are they safe or do they pose a threat to humans? How do you know?
3. Can you spot anything that can help you? Is there high ground that you could use? A stream or river where you might be able to find water? Or sticks and stones that could be used to build a shelter?
4. Make a list of all the potential dangers in your surroundings. Make a list of all the potential tools and resources in your surroundings. Use the space provided below to do this.

Threats	Tools and Resources

5. Now, look through your team's emergency backpack to find out what you have. Can you think about how to use what's in your backpack and what's in your surroundings to make a shelter?
6. How can you create a shelter for everyone to fit in? What else could you use? Practise tying some knots using the rope and decide which would be the best knot to hold the shelter in place.



FUN FACTS

1. Bear Grylls is the most well-known survival expert. He is the Chief Scout for the Scouting association which includes scouts, cubs and beavers.
2. A healthy adult can survive up to 21 days without food, but only 3 days without water.

STEM CLUBS

NUMBER 1 FOR STEM

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

9 It's electrifying!

TIPS

Try it in the dark to see sparks fly!

Incorporating Digital Skills

Consider using Scratch to create a 'Struck by lightening' game.

Objective

In this activity pupils will think about what causes lightning storms, and explore how static electricity is created.

TOPIC LINKS

- Science: electricity, static electricity
- Design and technology: create mini flashes of lightning
- Computing: coding (extension)

ESSENTIAL SKILLS SUPPORTED

Listening, speaking
Coding

TIME

20 minutes

RESOURCES AND PREPARATION

- Beanbags
- Cardboard box
- Balloon
- Woolly jumper / hair / tumble dryer sheet
- Metal spoon
- Rubber glove
- Computers with Scratch (for extension)

HEALTH AND SAFETY:

A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

DELIVERY

1. Ask pupils if they have ever experienced an electric shock. Explain that sometimes your shoes and clothes build up a type of electricity called static electricity. The electrons in this electricity are desperate to move to other places – door handles, railings, other people etc. When the electrons get the chance to jump from your skin to another object or person, you feel this as a tiny shock!
2. Explain that something very similar is happening in the atmosphere when lightning occurs, although it's obviously on a much larger scale! Model how this happens:
   - during a storm, water droplets are thrown around inside a cloud. (This could be modelled using participants of the group holding beanbags)
   - when the droplets collide, they build up an electrical change. (Drop the beanbags into a larger bag or box with a weak base)
   - the electrical charge builds up within the cloud until it has to be released! (Pick up the box and all the beanbags drop out). We see the movement of the electrical charge as it heads towards the earth as a flash of lightning
3. Blow up a balloon.
4. Rub it on a woolly object. This will negatively charge the balloon and positively charge the woolly object, causing them to stick together without glue (remember, opposites attract). You could also stick the balloon to other objects that don't have a negative charge, such as the wall.
5. Now gradually bring a metal object close to the charged balloon. The charge that has built up on the balloon will be released rapidly when the metal object is nearby.

Idea!

Request a STEM Ambassador to talk about how they use coding in their job.

EXTENSION IDEAS

1. Look at a plasma ball – lightning in a ball. Can you explain what is happening in scientific terms? Watch a video if you don't have one to hand.
2. Use the coding program Scratch to create a 'struck by lightning' game, where you must select all the objects that conduct electricity. If they conduct electricity they will glow and remain glowing, if they do not, all the glowing objects will be earthed and the storm will pass.

DIFFERENTIATION IDEAS

Support: In order to understand how an electrical charge move, model using sequins on a balloon to show the electrons building up and then bursting out to the ground.

Challenge: Provide other objects that may repel or attract the balloon. For example, plastic pipe, metal pipe, polystyrene plates. Ask pupils to explain in terms of positive, negative and neutral electrical charges.

STUDENT GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

9 It's electrifying!

Your challenge

Have you ever seen a lightning storm? They are pretty spectacular! Today, you'll learn how nature makes electricity, and generate some of your own!

WHAT YOU NEED TO DO

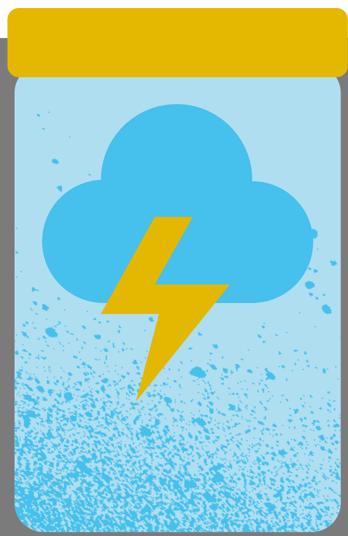
1. What do you know about lightning and how it occurs? Listen to your leader and follow the instructions as you imagine what it may be like to be inside a cloud during a storm.

2. Now create your own electricity using a balloon and a woolly jumper:
   - blow up a balloon
   - rub it on a woolly object. This will give the balloon a negative electrical charge, that it will want to pass to other objects. This causes the balloon to attract/stick to things. For example, the wall
   - wearing a rubber glove, gradually bring a metal object close to the charged balloon. The electrical charge that has built up on the balloon will 'jump' when the metal object is nearby, because it wants to pass on its electrical charge

3. Can you make the lightning jump sideways? Upwards? Now can you create your electricity in the dark?

FUN FACTS

1. You cannot make lightning in a jam jar safely – after all, lightning is electricity. Any videos on the internet showing this are hoaxes!
2. Lightning can occur inside clouds, between clouds and from clouds to the ground. The study of lightning is called fulminology.
3. About 100 lightning bolts strike the Earth's surface every second. That's about 8 million per day!



CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

10 Get CREST SuperStar Awards

By completing 8 activities in this resource pack, your STEM club members could get a CREST SuperStar Award.

ABOUT CREST

CREST is a scheme that inspires young people to take on the role of scientists and engineers. CREST helps young people become independent and reflective learners. With no set timetable, projects can start whenever you want, and take as long as you need.

HOW TO GET YOUR CREST SUPERSTAR AWARD

1. Learn more about CREST Awards by visiting https://www.crestawards.org/ or contact the CREST team on crest@britishscienceassociation.org for advice and support.
2. Sign-up for a free account - https://apply.crestawards.org/
3. Select 8 activities from this pack and deliver them. The CREST Primary Getting Started guide has all the details! Download it from: https://primarylibrary.crestawards.org/getting-started-guide-primary/62140323
4. Have each student complete a CREST SuperStar Passport to monitor their progress
5. Log in to your CREST account to submit the student project, pay the entry fee and request certificates and iron-on badges. These will be posted to your delivery address.

TAKING THEIR WORK FURTHER

If members want to take activities further, they can work towards a CREST Discovery Award. CREST Discovery Awards require around 5h of work and offer an introduction to real project work and give students the freedom to run their own investigations. They can be completed in one day, with students working together in self-managed groups. Select one or two activities that have open investigation potential and encourage extended research and scientific investigation. Projects should be made suitable for CREST Discovery Days. The CREST Discovery Getting Started guide has all the details! Download it from: https://discoverylibrary.crestawards.org/getting-started-guide-discovery/62140325

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

11 The Skills Builder Framework

Skills Builder FRAMEWORK

The Activities and Employability Skills

Each activity within this resource pack has identified the essential employability skills it supports and develops in students.

These skills have been mapped to the essential skills identified by the Skills Builder Framework, which breaks down eight essential skills into 16 teachable and measurable steps. Club leaders and teachers can use the activities to promote good practice and enhance each student's individual learning curve. Helping to promote transferable skills key to their education and future employment.

ABOUT THE SKILLS BUILDER PARTNERSHIP

The Skills Builder Partnership brings together educators, employers and skills-building organisations around a common approach to building eight essential skills. Their programmes include training and resources, supporting schools and colleges to embed a rigorous approach to building skills and achieve the Gatsby Benchmarks. As an individual teacher or Club leader, you can freely access a suite of online teaching tools and resources, designed by their team of teachers to build essential skills. The suite includes learning activities, supporting videos, classroom resources, assessment tools and the Skills Builder Framework, which you can use in STEM clubs and classroom teaching.

THE SKILLS BUILDER FRAMEWORK

The Skills Builder Framework breaks down eight essential skills into 16 teachable and measurable steps, providing a common set of expectations and a roadmap for progression. Step 0 is for the least experienced learners and Step 15 represents a highly skilled adult. The Framework can be used by teachers and Club leaders to talk to students about their skill strengths and areas for development and is a useful tool for framing conversations about careers and employability. Focusing student learning through the Framework, enables students to recognise their own essential skill levels and work to master them over time. The Framework can provide a language for students to articulate this progress to helping to develop employability skills and prepare students for future careers.

Skills Builder also provide multiple online assessment tools, including a student self-assessment, student-by-student teacher assessment and class- level formative assessment through the Skills Builder Hub. This means that programmes can be differentiated and focused to meet individual needs.

Extreme Elements

11 The Skills Builder Framework

EIGHT ESSENTIAL SKILLS

The eight essential skills broadly break down into four domains we know both teachers and employers value.

Communication

1. Listening – ability to listen and understand information.
2. Speaking - vocal communication of information or ideas.

Creative Problem solving

3. Problem Solving – ability to find a solution to a complex situation or challenge.
4. Creativity – use of imagination and the generation of new ideas.

Self-Management

5. Staying Positive – ability to use tactics to overcome setbacks and achieve goals.
6. Aiming High – ability to set clear, tangible goals and devise a robust route to achieving them.

Inter-personal

7. Leadership – supporting, encouraging and motivating others to achieve a shared goal.
8. Teamwork – working cooperatively with others towards achieving a shared goal.

You can find out more about essential skills and the Framework on the Skills Builder website, https://www.skillsbuilder.org/framework and you can access resources on the Skills Builder Hub https://www.skillsbuilder.org/hub

You can find additional support and information on careers and employability skills on the STEM Learning Careers pages, https://www.stem.org.uk/ stem-careers. You can also download the free Skills Builder toolkit from the STEM Learning website https://www.stem.org.uk/rxfum6

CLUB LEADER GUIDE: SUITABLE FOR AGE 7-9

Extreme Elements

11 Digital Skills

UNDERSTANDING DIGITAL SKILLS

Digital Skills are the product of digital literacy that we are all emersed in, especially within educational settings. The rapid use of digital technologies over the last 10-15 years have impacted the way we live our lives within a modern technological society.

Within this STEM Club activity, they are vast opportunities to utilize Digital Skills, which will have been taught already within the schools curricula. It's important that the use of digital skills is not meant to replace traditional methods; but enhance and further develop your students STEM learning future.

Digital skills can be grouped, recognised and celebrated.

Cross Curricula Baseline Digital Skills	Computing curriculum baseline digital literacy	Computing curriculum specific skill	D&T/Engineering specific digital skills	Science specific digital skills	Maths specific digital skills
Communication tools	Safe technology use	Digital media	Digital design (CAD)	Modelling and simulation	Modelling
Presentation	Evaluative skills	Programming	Programmable embedded systems	Sensor-enabled data collection	Data analysis / data science
Word processing and DTP	Moral, ethical and lawful behaviour	Applied knowledge of systems and networks	Digital manufacturing (CAM)	Data analysis, inference and communication	Calculation
Data handling		Modelling and simulation		Digitally enabled explanation	Graphing
Devices, tools and applications		Software development			Dynamic geometry
Productivity and task management		Data manipulation			
		Cyber security			

EXAMPLES OF USE

When conducting experiments, recording results in Excel makes it easier to present those results in a graph. This is a good example of Cross Curricula Baseline Digital Skills. Within a design and making opportunity, it would be fantastic to develop this design using 3D Computer Aided Design (CAD) and outputting on Computer Assisted manufacturing (CAM) and Rapid Prototyping (RP) such as 3D Printing. This is obviously D&T/Engineering specific digital skills.

Within the guides opportunities are signposted, these aren't the extensive list. You may find alternative Digital Skill provision. Remember you know your pupils and what equipment and skillsets staff are equipped with. This could be a great opportunity to investigate staff CPD.

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Achieving world-leading STEM education
for all young people across the UK.

For more information on the programmes and publications available from STEM Learning, visit our website **www.stem.org.uk**