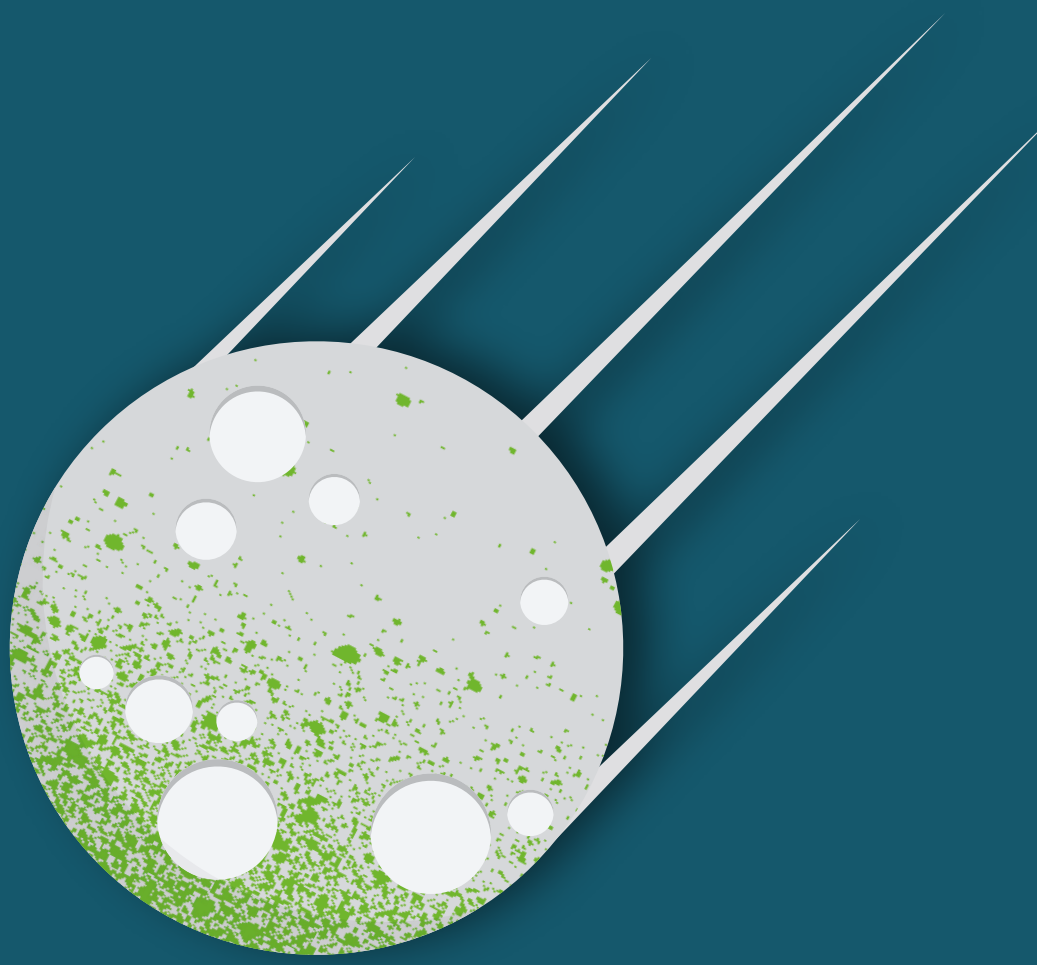
STEM CLUBS

NUMBER 1 FOR STEM

SURVIVAL STEM: SUITABLE FOR STUDENTS AGED 11-14

Can you survive an asteroid impact?

STEM Learning activity resources



SUBJECT LINKS:

Biology, chemistry, design and technology, physics and essential skill sets

SURVIVAL STEM: SUITABLE FOR AGE 11-14

Could you survive an asteroid impact?

STEM Learning activity resources

Introduction

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

This programme is part of Survival STEM, a set of three programmes exploring science, technology, engineering and maths in survival.

Could you survive an asteroid impact?

For the last few billion years an asteroid has been journeying through the cold expanses of space, on course to hit planet Earth! As it collides with the Earth, it lights up the skies and smashes the ground. Luckily for you, scientists saw it coming and you were evacuated to an underground bunker. Your challenge now is to survive the devastating aftermath.

This programme investigates the science involved in surviving an asteroid impact – from how you would grow crops in the long winter that follows the impact, to how you could protect yourself from burning acid rain.

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: 11–14

SUBJECT LINKS: Biology, chemistry, design and technology, physics and essential skill sets.

DURATION: A range of activities from 20 to 60 minutes – at least 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 student notes.

ESSENTIAL SKILLS: Age-appropriate essential skills have been identified which can be enhanced through these activities.

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.

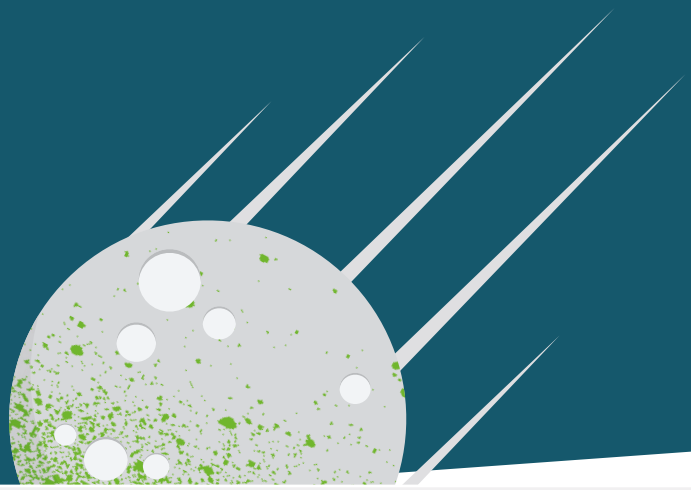
ACHIEVEMENT: Students can be rewarded for successfully completing activities by downloading free STEM Clubs certificates from https://www.stem.org.uk/stem-clubs/impact-and-recognition/stem-club-certificates. Students may be able to use these resources to work towards a CREST Award.

APPROPRIATE VENUES: Club leaders can run most activities in general spaces e.g. classrooms, halls, and outdoor areas. Some activities need to be conducted in labs and workshops – these are marked clearly in the Club leader guide and in the table below.

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#secondary

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 11-14

Can you survive an asteroid impact?

1 Acid from the skies

Objective

In this activity, students will simulate the effect that acid rain has on several different kinds of material (metal, lime, brick, and cloth), both with and without a water-resistant coating, to see how well the materials can be protected from acid rain.

TOPIC LINKS

Chemistry: chemical reactions, pH measurements

TIME

50 minutes

ESSENTIAL SKILLS SUPPORTED

Problem solving, speaking

RESOURCES AND PREPARATION

- Hydrochloric acid (0.1M-1M)
- Distilled water
- A beaker
- Two petri dishes
- Two test tubes
- A permanent pen
- A pipette
- pH strips
- Several kinds of materials:
- Magnesium strip (a flammable metal)
- Zinc granules (metal)
- Red flower petal (living material)
- Red apple skin (living material)
- Calcium carbonate (small limestone chunks work best)
- Water-based fabric waterproofing spray (can be bought online or in outdoors shops)
- Tweezers for holding samples if spraying with waterproofing solution
- A glass stirring rod
- Extension: a spray bottle

Note: Asteroids are rocky bodies in the solar system that orbit the sun. When an asteroid or a piece of an asteroid, known as a meteoroid, enters Earth's atmosphere, it is called a meteor. If part of this object makes it to Earth's surface, rather than simply burning up in Earth's atmosphere, it is called a meteorite. This should explain why different terminology is used throughout this activity.

HEALTH AND SAFETY:

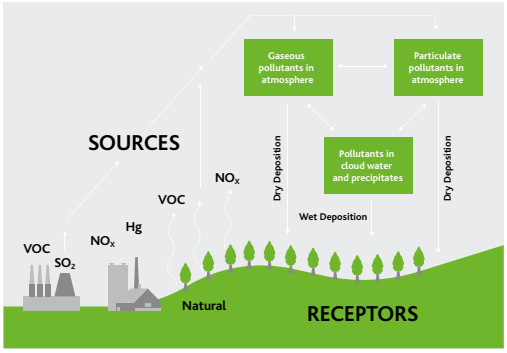
A suitable risk assessment using guidance from CLEAPSS and SERCC should be written and adhered to for this activity.

When working with highly-acidic chemicals, such as hydrochloric acid, students must wear safety specs.

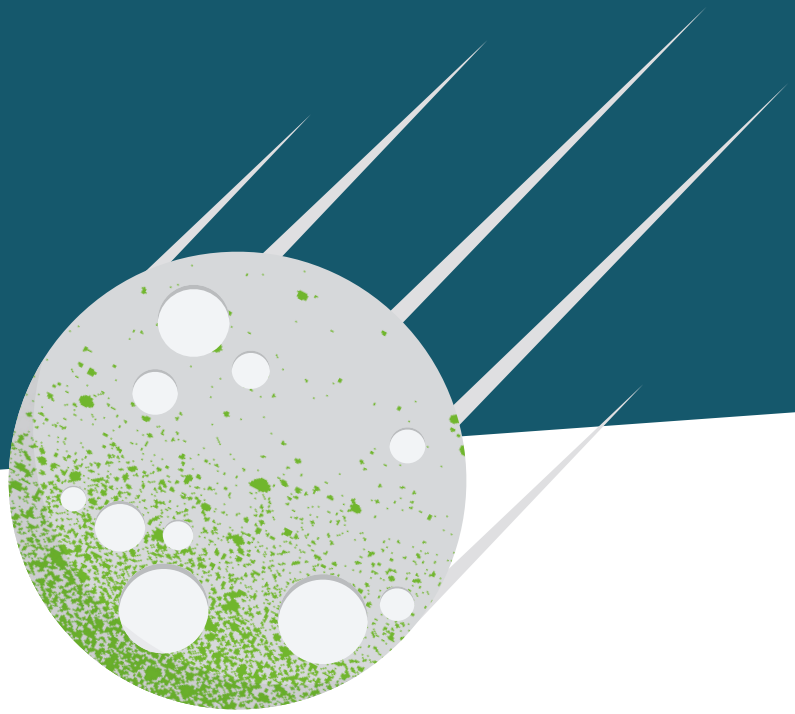
Magnesium is a reactive metal. You may choose to demonstrate the effect of hydrochloric acid on this metal (with and without a waterproof coating) for the class. It is recommended to do this in a test tube. Add acid to the magnesium strip using a pipette.

DELIVERY

1. Explain that an asteroid impact would cause harmful gases to mix with the air. These gases become trapped in the water vapour (in clouds), lowering the pH of the water droplets. Acid rain is the result of the pH of water in the sky dropping below 5.6.



2. Ask the class what sort of negative effects they think acid rain can cause (limestone and marble may become damaged, plants may die, aquatic environments and habitats may become polluted, and human health may be affected through drinking water).
3. Ask students to consider possible ways we could protect ourselves from the problems caused by the acid rain. (Research has shown that buildings likely to be damaged by acid rain can be protected from pollution by applying a thin, single layer of a water-resistant coating.)
4. Students can simulate the effects of acid rain on several different materials, both with and without a water-resistant coating, to see how well each material fares against acid rain.



Incorporating Digital Skills

Consider:

- **Use of video to record experiments.**
- **Internet use to research acid rain.**
- **Create a digital presentation: effects of acid rain and the environment.**

BACKGROUND

Acid rain is usually a product of pollution, specifically the pollutants sulphur dioxide and nitrogen oxide. Acid rain used to be a more significant and common problem, however, thanks to the efforts of governments worldwide to reduce the production of sulphur dioxide and nitrogen oxide, instances of acid rain have decreased in recent years. An asteroid impact would lead to acid rain as the destruction it would cause on the surface would lead to large fires that would produce numerous pollutants. Gases from within the earth might also be released, as well as gases from inside the asteroid. All of these pollutants would mix with Earth's atmosphere (or, more specifically, the water vapour in the Earth's atmosphere), thus leading to potentially very significant episodes of acid rain.

The pH scale runs from 0 to 14, with 0 being the most acidic a solution can be and 14 being the most alkaline a solution can be. 7 is a neutral pH – water usually has a pH level of 7. The pH scale is logarithmic, which means that it's non-linear. As such, the difference between two solutions that have pH levels of 3 and 5 is more than double the difference between two solutions that have pH levels of 4 and 5 – as you move away from the neutral pH of, each integer indicates a greater difference than the last.

TIPS

- **Ask the students to think about how people, buildings, objects, land animals, aquatic animals and plants would each fare against acid rain.**

DIFFERENTIATION IDEAS

Support: leave out the acid rain simulation and the pH measurements if these are not suitable for less able students.

Challenge:

1. Ask students to investigate the effect of the strength of the acid. Real acid rain is not as corrosive as hydrochloric acid. Repeat the experiment with a diluted solution and observe the differences. Why did we use hydrochloric acid in this experiment?
2. Let the students come up with other ways they can protect clothes and homes from acid rain. Can they think of other (cheap/lightweight/available) materials that work better than the waterproof spray?

Idea!

Invite a STEM Ambassador to talk about renewable and non-renewable energy sources.

EXTENSION IDEAS

1. Investigate the effect of acid rain on a living plant. The Club leader could demonstrate this using a spray bottle to spray a house plant with a dilute solution of hydrochloric acid (0.1M) in a spray bottle daily for several weeks.
2. Alternatively, students can investigate the germination of cress seeds in different concentrations of acid.

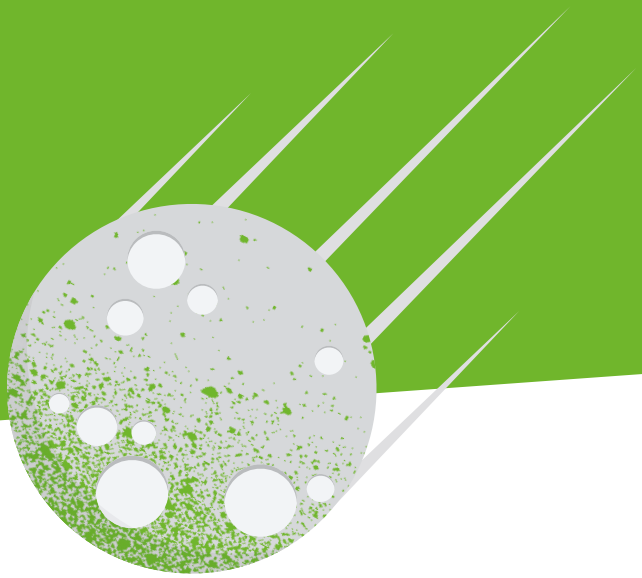
USEFUL LINKS

How to simulate acid rain
www.wikihow.com/Simulate-Acid-Rain

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

1 Acid from the skies



Briefing

An asteroid has hit Earth, and now the air on Earth is full of acidic gases. These gases react with the water droplets in the clouds, making our rainwater much more acidic. This acid rain has started to erode our buildings and damage the warm clothes we need to survive the cold.

YOUR TASK **It is your job to figure out how to protect us against the acid rain coming from the sky!**

WHAT YOU NEED TO DO

Phase 1 – Let it rain on your materials

You will use hydrochloric acid in this simulation. Hydrochloric acid is stronger and more concentrated than actual acid rain, but acid rain usually only affects objects, plants and animals after a few days or weeks. Using the stronger hydrochloric acid will help to speed up the process so that we can immediately see the effects of acid rain on different materials.

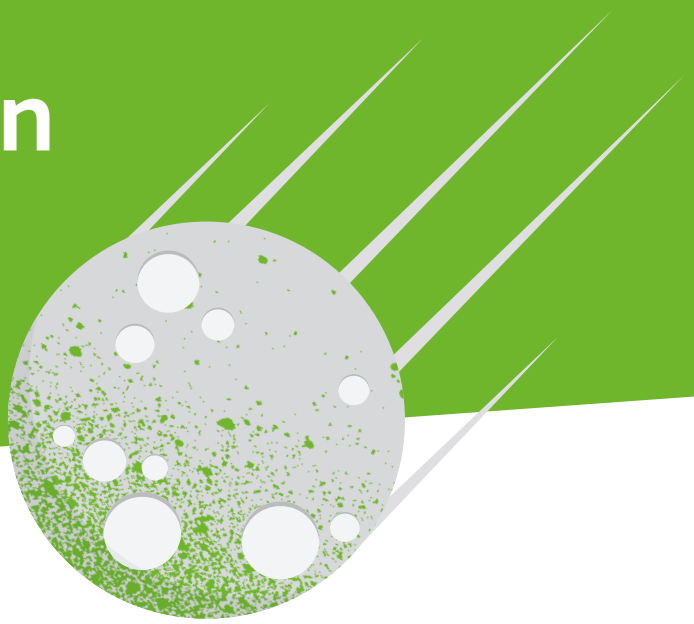
SAFETY: consult safety information. Depending on their strength and concentration, some acids will be categorised as corrosive, while others will be a moderate hazard. Consult information such as Hazcards® for further details. Eye protection must be worn.

1. Take two petri dishes. Label one 'no protection' and the other 'protection'.
2. Place a small piece of each of the materials you will investigate in the petri dish labelled 'no protection'.
3. Cover another piece of each material with the protective solution you've chosen to use. For this, hold the material using the tweezers, and spray the object until all sides are covered in a thin layer of the solution. Place these pieces in the petri dish labelled 'protection'.
4. Use the dropper to cover the items in both of your petri dishes with hydrochloric acid.
5. Put the lid on both petri dishes.
6. Describe what the materials looked like as you covered them with hydrochloric acid. Write down your initial observations.
7. Leave your experiment for 30 minutes and do the activity below before returning to it.

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

1 Acid from the skies



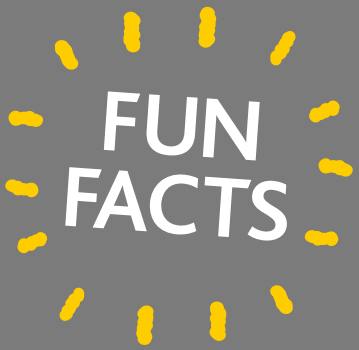
Creating acid rain

Acidity can be measured using the pH scale. Acid rain has a pH of 5.4 or lower (the lower the pH, the more acidic a solution is). In this activity, we will use water with a pH of 4.0. Carry out the following instructions to create the acid rain you will use to conduct your experiment.

1. Add 50ml tap water to a 100ml beaker
2. Use a pipette to add one drop of hydrochloric acid (using 0.1 mol dm-3 concentration acid)
3. Stir with a glass rod
4. Check the pH of your solution using pH paper. You do this by dipping the glass rod into your "acid rain" and then touching the rod on the pH paper.
5. Compare the colour of the pH paper to the colour chart.
6. If your solution has not reached pH 4.0 then repeat steps 2 to 5 until you reach a pH of 4.0

Phase 2 – Observing the effect of the rain

Go back to your petri dishes and take a careful look at each of the items. Pay attention to the colour, shape, size and structure of each of the pieces. Compare the two petri dishes. What changes have taken place in half an hour? How do the objects in the two petri dishes differ? Why do you think this has happened?



1. Most acid rain occurs as a result of human activities. Pollutants made by humans mix with water vapour in the air and lead to acid rain. However, volcanoes can also release gases into the air that then cause acid rain.
2. After the asteroid that killed the dinosaurs hit Earth, freshwater species (such as crocodiles) may have survived thanks to the minerals in the water that neutralised the acid (made it less acidic).

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

2 But why is the Sun gone?

Objective

In this activity, students observe that plants need light in order to photosynthesise. Hornwort (a water plant) will produce oxygen (as a product of photosynthesis) in the presence of light. This can be observed in the form of air bubbles.

TOPIC LINKS

Biology: photosynthesis

TIME

40 minutes

ESSENTIAL SKILLS SUPPORTED

Problem solving, aiming high

RESOURCES AND PREPARATION

- Pond water
- Pondweed (e.g. cabomba spp)
- One beaker per group
- White translucent paper
- A clamp and stand
- An LED light bulb
- A ruler
- Funnel
- Boiling tube
- Potassium hydrogen carbonate powder or solution
- Thermometer
- Ice
- Universal indicator (liquid or paper)
- Various buffer solutions (such as pH 4, pH 7, pH 9.2 and pH 12.6)
- Safety glasses

Note: Asteroids are rocky bodies in the solar system that orbit the sun. When an asteroid or a piece of an asteroid, known as a meteoroid, enters Earth's atmosphere, it is called a meteor. If part of this object makes it to Earth's surface, rather than simply burning up in Earth's atmosphere, it is called a meteorite. This should explain why different terminology is used throughout this activity.

DELIVERY

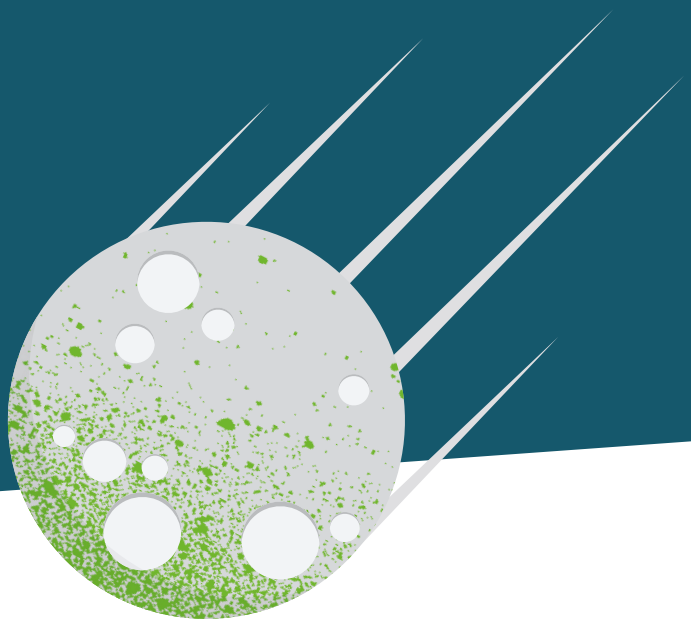
1. Ask students if they have plants at home. Do they grow inside or outside? What is required for the plants to grow well?

2. Explain that plants make the energy they need to grow through a process called photosynthesis. Photosynthesis requires sunlight. The chlorophyll (this is the substance that makes plants green) inside the plant's leaf cells uses sunlight to start a chemical reaction that produces sugar (the food source for the plant) and oxygen. Plants also need water and nutrients to grow, which they usually get from soil using their roots.

3. Set the scene for how the asteroid impact would affect Earth: dust blown up by the impact will block out the sun. How could this affect our plants?

4. Demonstrate bubbling pond weed in the front of the class. Let the class figure out what the bubbles mean and how it links to the process of photosynthesis. Many bubbles mean that the plant is producing a lot of its own food. Fewer bubbles mean that the rate of photosynthesis is lower and that the plant is not making much of its own food.

5. State that in this activity the pupils will simulate dust clouds blocking the Sun, comparing the rate of photosynthesis before and after a meteorite hit. They will investigate the effect of light, as well as pH (acid rain caused by a meteorite) or temperature (nuclear winter caused by a meteorite), on the plant's photosynthesis.



HEALTH AND SAFETY:

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

Make sure the students wash their hands thoroughly after handling the pond plants. If they have any cuts on their skin, they should wear a plaster or gloves.

Safety glasses should be worn when handling the buffer solutions.

Idea!

Request a STEM Ambassador to talk to students about the real world applications of photosynthesis to their research or job.

TIPS

- Write the word equation for photosynthesis on the board to clearly show the reactants and products of the reaction.
- The work should be carried out in groups of at least three students (counter, timekeeper and scribe).
- If the rate of photosynthesis is very low, carbon dioxide might be a limiting factor. Add some potassium hydrogen carbonate to the water if this seems to be hampering the experiment.

Incorporating Digital Skills

Consider:

- **Use of video to record experiments.**
- **Excel to record results and present in a chart.**

EXTENSION IDEAS

1. Ask students to investigate the optimum environment for the pondweed. When does the plant produce the most bubbles?
2. It is possible to get Euglena from science suppliers, which students can examine them under a microscope. This single celled organism has chloroplasts and eats normally like an animal.

DIFFERENTIATION IDEAS

Support: set up the apparatus for students.

Challenge: students can investigate the effect of the third factor (acid rain or temperature) on the rate of photosynthesis. Students can also repeat the experiment considering all three factors at the same time.

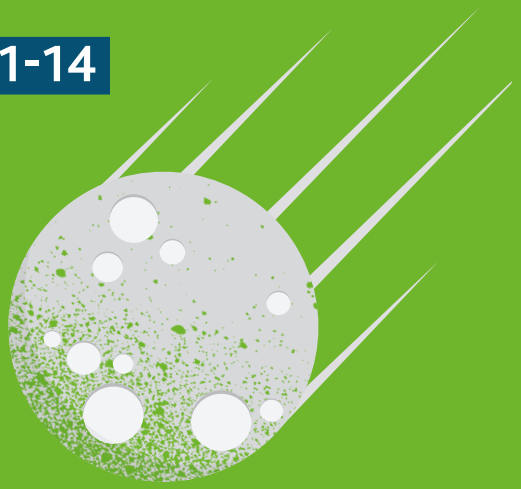
USEFUL LINKS

- TED Ed video that explains photosynthesis
  www.youtube.com/watch?v=eo5XndJaz-Y
- YouTube video: Photosynthesis and the Teeny Tiny Pigment Pancakes, by the Amoeba Sisters
  www.youtube.com/watch?v=uixA8ZXx0KU
- Characteristics of plants and photosynthesis
  http://www.biology4kids.com/files/plants_main.html

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

2 But why is the Sun gone?



Briefing

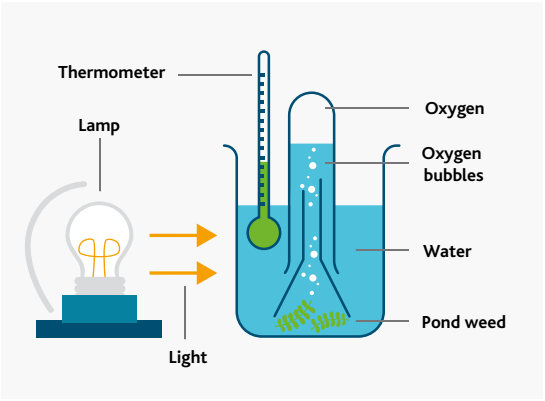
A massive meteorite has hit Earth and thrown huge amounts of dust into the sky, blocking out the Sun. Scientists have warned us that without the Sun, plants will struggle to make their own food and could die out. The process plants use to make their own food is called 'photosynthesis'. It is a bit like cooking, in that it requires certain ingredients before the food can be produced. Plants need water, carbon dioxide, the green chlorophyll in their leaves and light from the Sun to make the energy they need through photosynthesis. As well as making food for the plant, photosynthesis also produces oxygen, which humans and other animals need to breathe in order to survive.

YOUR TASK **Find out what happens to plants when the dust from an meteorite strike blocks the Sun and changes the environment.**

SAFETY: Wash your hands thoroughly before and after handling the pond plants. If you have any cuts on your skin, ask your Club leader if you should wear a plaster or gloves. Wear a lab coat and safety glasses.

Phase 1 – Observe photosynthesis

1. Each group takes one beaker filled with pond water.
2. Cut off a piece of the pondweed (approximately the length of your finger) and place it in your beaker.
3. Place the funnel upside down over the pondweed so that it covers it, and the thin end of the funnel is in the air. Place the boiling tube over the funnel (as shown in the diagram).



4. Set up your lamp as shown in the diagram. This will act as your Sun. Use a ruler to measure the distance between your pondweed and the lamp – it should be at a distance of 10cm. Tip: you may need to use a clamp and stand to keep your lamp in the correct position. Your Club leader will tell you if you need to do this.
5. Wait for your Club leader to switch off the light in the room.
6. Turn on your lamp (the Sun) and leave the setup for two minutes.
7. After two minutes, the timekeeper should start the stopwatch.
8. Observe if your plant can still make its own food by counting the number of air bubbles that are produced in one minute. Record your data in the table provided.
9. Repeat step 8 two more times, taking new measurements each time. This is important for making sure that your data is accurate.

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

2 But why is the Sun gone?

Phase 2 – The Sun is gone

1. Now it is time to see what would happen if the Sun were partially blocked by a 'dust cloud'. Place the white translucent paper between the lamp and your pondweed beaker.
2. Start the stopwatch and count the bubbles for one minute. Repeat this step two more times. Write all your results in the table.

	Pondweed in sunlight			Pondweed with Sun blocked by a dust cloud		
	Trial 1	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**
Number of bubbles produced in one minute						

Phase 3 – Adding more factors

1. The lack of sunlight is not the only consequence of the meteorite strike. The dust clouds that are blocking out the Sun will cause the Earth to get much colder and the gases released into the air after the meteorite strike could cause acid rain.
2. Repeat the steps from phases 1 and 2, this time adding another environmental factor mix: either a lower temperature, or a lower pH caused by acid rain. Make sure you keep the light partially blocked by the 'dust cloud' during these tests – you are trying to observe the effects of two factors at the same time!

   a. Lower temperature: add crushed ice to your pondweed beaker. Use a thermometer to measure the temperature and record this in the table.

   b. Lower pH from acid rain: add the buffer provided by your Club leader to lower the pH of the water in your beaker. Use pH meter or pH indicator paper to roughly measure the pH and record this in the table.

SAFETY: Safety glasses and should be worn when handling the buffer solution.

3. Now that you have collected all your data, let's see if we can work out what it means!

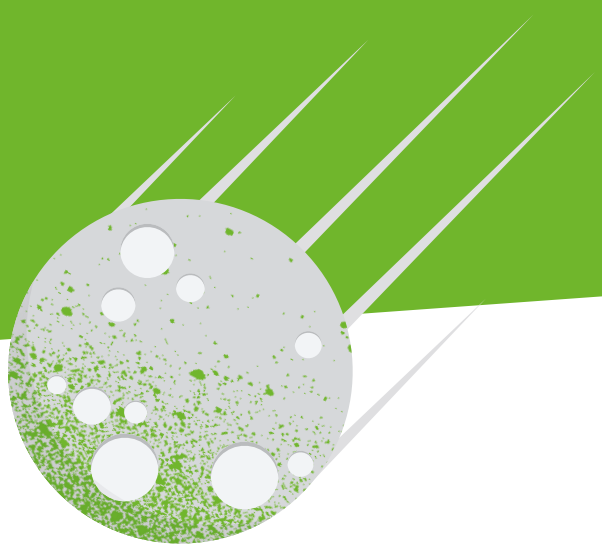
	Pondweed with Sun blocked by dust a cloud in icy water Temperature: ……			Pondweed with Sun blocked by a dust cloud in acidic water pH: ……		
	Trial 1	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**
Number of bubbles produced in one minute						

FAST FINISHERS: Complete the table above by investigating the final factor from phase 3.

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

2 But why is the Sun gone?



QUESTIONS

1. What did you test?
2. What are your results? How many bubbles were produced in each of the trials?
3. What gas is inside the bubbles?
4. Why does a decreasing number of bubbles suggest a decreasing rate of photosynthesis?
5. What effect did the dust cloud (translucent paper) have on the rate of photosynthesis?
6. What kind of an effect would you expect if the cloud got thicker and allowed even less sunlight through? Could you test for this?
7. What happens to plants if photosynthesis stops?
8. Without plants, herbivores such as cattle and omnivores like us humans would struggle to find things to eat. What possible solutions can you come up with to prevent plants from dying after the asteroid has collided with the Earth?

FUN FACTS

1. Plants are known as primary producers. This is because they produce energy through photosynthesis. Living things that cannot photosynthesise are called consumers, because they consume other organic materials to get energy.
2. Because plants get their energy from the Sun, they are almost always at the start of the food chain. Take plants out of an area and soon after the entire food chain will collapse.
3. There is at least one species of sea slug that is able to create its own food through photosynthesis, just like plants. This slug (Elysia chlorotica) is bright green and has incorporated genes from the algae that it eats to give it this amazing ability to create its own food.

STEM CLUBS

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

3 A breath of fresh air

Incorporating Digital Skills

Consider:

- **Website and online video research.**
- **3D CAD and Printing.**

Idea!

Request a STEM Ambassador to run a Q&A on why it is important we reduce pollution.

Objective

In this activity, students learn about the negative effects of breathing polluted air and create their own gas masks.

TOPIC LINKS

- Biology: lungs and breathing
- Design and technology: creating and redesigning a gas mask, testing the effectiveness of air filters

TIME

60 minutes

ESSENTIAL SKILLS SUPPORTED

Problem solving, creativity

RESOURCES AND PREPARATION

For testing apparatus:

- Shoebox
- Hairdryer
- Hospital mask
- Cardboard
- Aluminium foil
- Black pepper (or similar small particles, such as fine sand) NB: care will be needed when using dusts
- Other materials to be used as a filter (e.g. insect mesh, old T-shirts of varying thickness)

Per mask:

- A transparent two-litre drinks bottle
- Scissors
- A dust mask (available online at DIY stores, or health supply stores)
- Elastic bands
- Rubber foam (available online or at hardware stores)
- PVA glue

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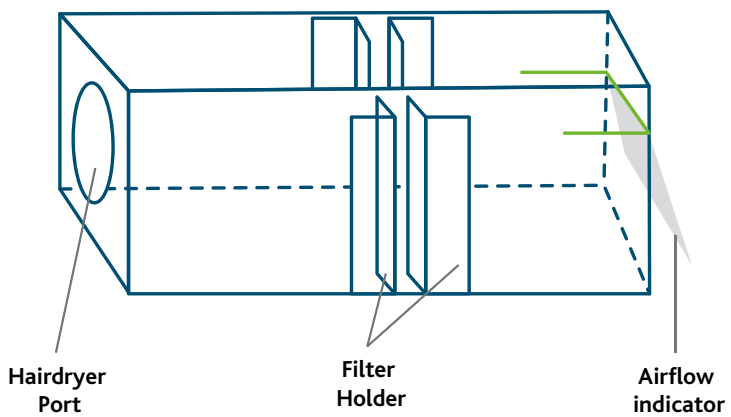
Before the activity, the Club leader should construct the testing apparatus as follows:

1. Cut a hole in the end of a shoebox. The hole should be sized so that the narrow end of a hairdryer fits into it.
2. Cut a large square out of the opposite end of the shoebox so that it is mostly open.
3. Glue a piece of aluminium foil to the outside top end of the shoebox from step 2, so that it hangs in front of the hole. This will indicate the amount of air flow.
4. Fold the extra cardboard into L-shaped pieces and tape these to the inside of the box, so that they hold the hospital mask (the filter).
5. Position the hairdryer through the first hole using a clamp and stand.
6. Set a large collecting container on its side at other end of apparatus, to catch particles as they fly out of the box.



CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

3 A breath of fresh air

TIPS

- For best results (and for continued use of the hairdryer), make sure the hair dryer does not overheat.
- If rubber foam is difficult to acquire, you can use several layers of tape around the edges of the mask.
- In order for students to quantify the effectiveness of their filter, they should weigh out the same amount of pepper for each test, and then weigh the amount that is blocked by the filter. They can then calculate the percentage of particles blocked with each filter.

DELIVERY

1. Explain that an asteroid impact with Earth would throw a lot of dust and gases into the air. This polluted air could irritate people's airways. Describe some of the lung conditions that humans could develop as a result of this.

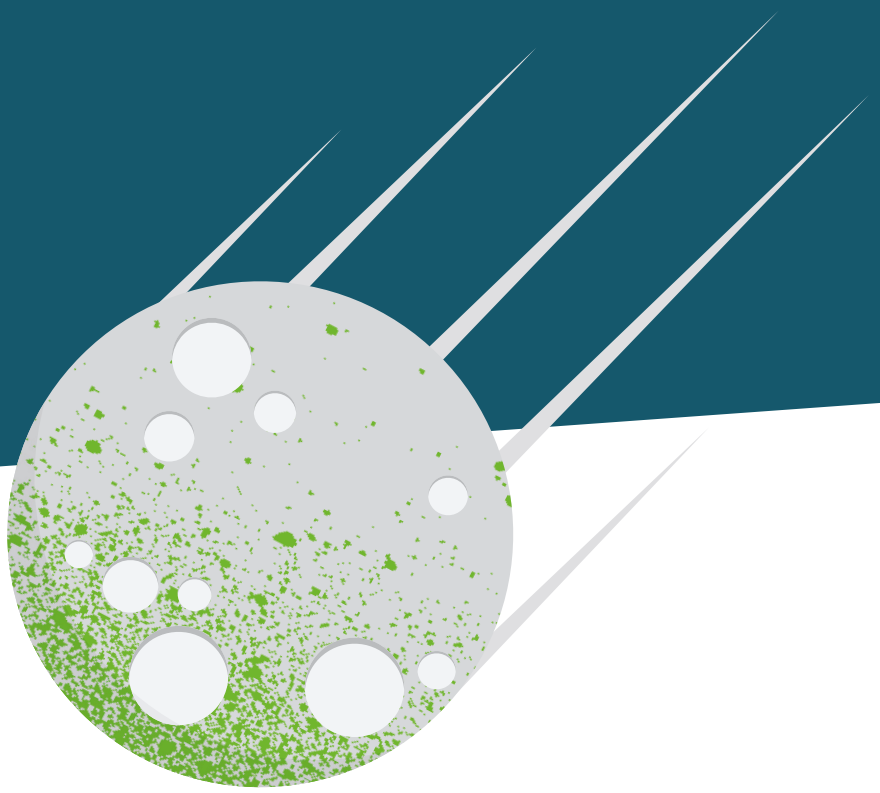
   Asthma, COPD and numerous other lung conditions have been shown to be caused by increased levels of pollutants in the air. After a large meteorite strike, the air could be so polluted that people with weaker lungs and airways, such as children, the elderly and people with pre-existing lung conditions, could die very quickly.

2. Explain how the air we breathe travels down the trachea to the lungs. Our lungs can clean themselves when faced with some pollution, but there are limits.

3. Tell them that black pepper (or sand) will be used as the pollution particles, and show them the apparatus you will use for testing. Demonstrate how particles can move through air with the testing apparatus. With no filter in place, sprinkle the pepper (polluting particles) in front of the hairdryer and let it blow the particles through the apparatus. Without the filter, particles will make their way to end of the box and into the collecting container.

4. One way we can protect ourselves from damage to our lungs is to create an extra air filter to clean the air before we breathe it in. We can do this using gas masks.

5. After finishing their product, students can test the effectiveness of their filter using the apparatus put together by the Club leader. They can then try out other materials to test their effectiveness.



HEALTH AND SAFETY:

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

Remind students not to touch the tip of the hairdryer, as it may be very hot.

Make sure all glue has dried and all fumes have dissipated before trying on the mask.

The edges of the plastic can be sharp. Cover them with tape before testing the fit to avoid cuts.

Do not allow the students to test the effectiveness of the masks on themselves, as a faulty mask could lead to lung damage. Be sure to explicitly express the need to use the apparatus to test the masks.

Dusts created will need to be cleaned up using a damp cloth and disposed of via normal refuse.

DIFFERENTIATION IDEAS

Support: prepare some of the materials beforehand, or provide templates that allow the students to focus on finishing their project.

Challenge: ideas for early finishers:

1. Try out other types of filters. These filters need to:
   - be designed to fit in their own gas mask
   - allow enough air to pass through
   - be tested in the testing apparatus at least once
2. Make their product look more attractive and work out ways to make their mask sturdier. In a situation where they would have to wear such a mask regularly, it would be important to have masks that can survive being removed and put on again.

EXTENSION IDEAS

1. Students can research or brainstorm ideas for making more advanced filtering systems that can be joined to their mask using a rubber hose. What kinds of filters would be needed to protect us from harmful gases?
2. Demonstrate what real lungs look like.

USEFUL LINKS

How to make a gas mask
www.wikihow.com/Make-a-Gas-Mask

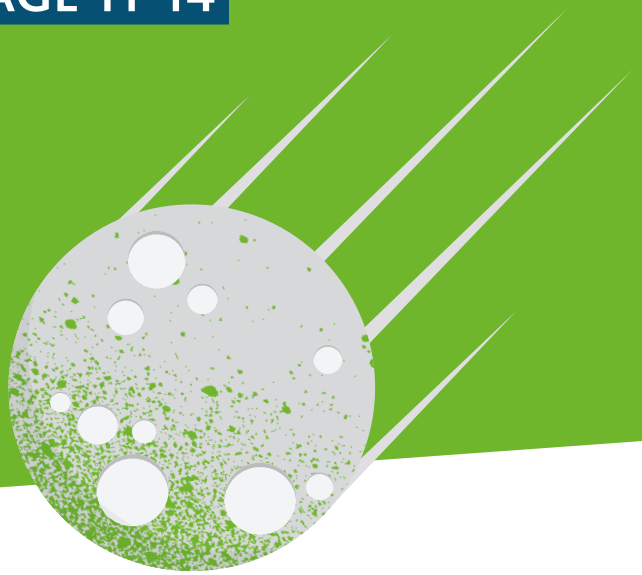
How to make an air filter
http://totobobo.com/blog/2015/10/project-oxygen-water-bottle-air-filter/

Creating an air filtering system
www.teachengineering.org/activities/view/cub_enveng_lesson07_activity2

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

3 A breath of fresh air



Briefing

An asteroid impact would throw a lot of dust, particles and harmful gases into Earth's atmosphere, polluting the air we breathe. This polluted air can irritate your airways, making you feel out of breath quickly. Over longer periods of time, breathing this polluted air could even increase the risk of serious, deadly lung conditions. In order to survive after the apocalyptic meteorite strike, you'll need to find a way to filter the air before you breathe it in!

YOUR TASK **Protect your lungs against those polluting particles thrown up by the meteorite by making your very own gas mask!**

Phase 1 – Making your mask

1. Use a permanent marker to draw a line 3cm from the bottom of your bottle, then, using scissors, cut the bottom off.

2. Use a marker to draw a 'U' across the front of the bottle, cap side down. This 'U' shape needs to fit snugly across your face, stopping roughly at your temple and below your chin, (see diagram). Leave 12–13cm between the bottom of your cup and your chin. Cut along your outline with your scissors. Some important tips for this step:

   - Start smaller than you think you need – you can always cut more away later.
   - The edges of the plastic can be sharp. To avoid cutting your skin, cover the edges with tape before testing to see if your gas mask fits.
   - The bottle should fit snugly across your face, no gas should be able to sneak in around the sides.

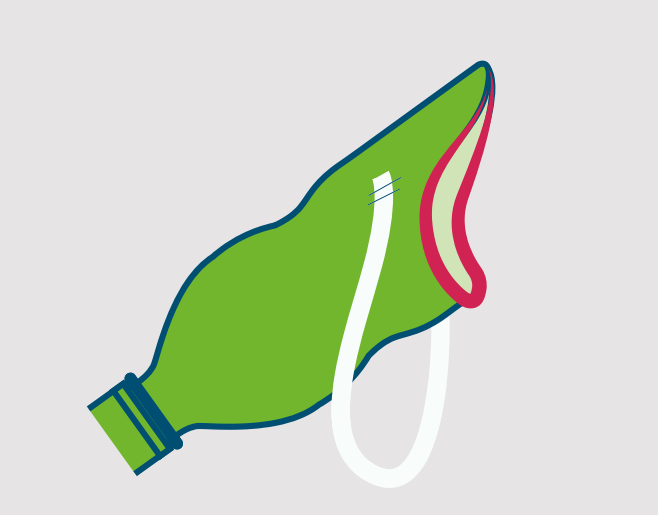
3. This 'U' is where your face will fit into the mask. To make the mask more comfortable, glue a strip of rubber foam around the edge of the 'U'. Take your time with this step, trying on your mask multiple times. The foam helps keep contaminated air out of the mask and away from your eyes and nose.

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

3 A breath of fresh air

4. Place your mask against your face. Ask a classmate to help you draw an 'x' on each side of your mask at eye level. Use these markers to guide where you staple the elastic bands to the mask.
5. Once you have stapled the elastic bands to the mask, you should be able to keep the mask on your face without using your hands.
6. You will use the hospital mask as a simple filtration device. Push the mask into the bottom to the bottle where the cap used to be, and use glue to stick the edges of the mask to the bottle so no air can move into the gas mask without going through the hospital mask first.



Phase 2 – Test the effectiveness of your mask

Now that you have finished your mask, it is time to test how effective it would be at keeping damaging particles away from your lungs!

1. The filter you have used is a medical mask. Your Club leader has prepared a testing apparatus. Insert the medical mask into the correct slot.
2. Turn on the hairdryer to act as the air flow. The aluminium should move in the air, showing that the air can move through the mask to allow you to breathe.
3. Sprinkle pepper particles at the start of the air flow so that it will blow the particles towards the filter.
4. Estimate how many particles were successfully blocked by your filter and how many made their way into the collecting tray at the end.

FUN FACTS

1. Gas masks are not just used after disasters. They are also sometimes used in laboratories to protect scientists who might get exposed to harmful airborne materials.
2. During the Second World War, the British Government thought that it was possible that some form of poisonous gas would be used during attacks on civilians. They decided to issue gas masks to everyone living in Britain, and by 1940 the Government had issued 38 million gas masks.

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

4 Extreme survivors

Objective

In this activity, students investigate several extremophiles to see what qualities would allow them to survive in the extreme conditions brought about by an asteroid impact. They will also search for water bears (tardigrades) under a microscope.

TOPIC LINKS

Biology: extremophiles, microscope skills, phenotypes

TIME

30 (up to 60 minutes if students collect samples themselves)

ESSENTIAL SKILLS SUPPORTED

Listening, teamwork

RESOURCES AND PREPARATION

- Moss and lichen samples
- Envelopes or beakers to carry the samples
- Light microscopes
- A sieve
- Cavity slides
- Cover slips
- Distilled water
- A pipette

Have the microscopes set up before the lesson for easy transitioning.

Note: Asteroids are rocky bodies in the solar system that orbit the sun. When an asteroid or a piece of an asteroid, known as a meteoroid, enters Earth's atmosphere, it is called a meteor. If part of this object makes it to Earth's surface, rather than simply burning up in Earth's atmosphere, it is called a meteorite. This should explain why different terminology is used throughout this activity.

DELIVERY

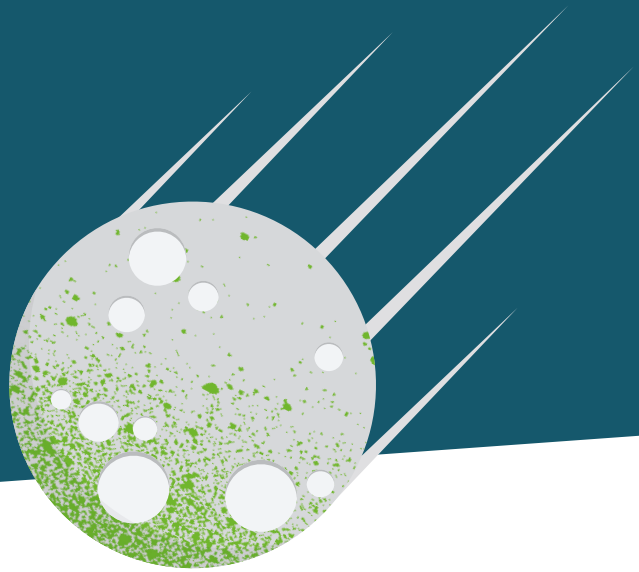
1. Explain to the students that there is a microscopic world all around us and that in this activity, they will discover the hidden world inside moss and water.

   Explain that while this hidden world is inhabited by tiny creatures, most of which we can't even see with the naked eye, it still holds many wonders. Do they believe that there are animals that can survive in the vacuum of space without a space suit? Do they believe that there are animals that can withstand temperatures up to 150 °C? Do they believe that one animal could live everywhere from mountain tops to the deep sea and mud volcanoes; and from tropical rain forests to the Antarctic?

2. Use the video link below (or something similar) to show the students what they will be doing and how to find tardigrades.

3. Students should hunt for the water bears themselves (the micro-animals can be found in moist, mossy environments) or have several moss samples already prepared. You can use prepared cavity slides with samples or let the students prepare their own.

4. Show the students how to use the microscope safely and allow them to discover tardigrades (and/or rotifers, nematodes, water mites and possibly other creatures).



HEALTH AND SAFETY:

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

Make sure that the children wash their hands thoroughly after touching the moss or lichen and explain to them the risks of not doing so.

Idea!

Invite a STEM Ambassador to run a discussion on how animals have adapted.

Incorporating Digital Skills

Consider:

- **Use of video to record experiments.**

DIFFERENTIATION IDEAS

Support: have several moss samples prepared and waiting under the microscope at the right magnification. The water bears might not be very active, so students will still need to search.

Challenge: Let students hunt for the water bears themselves; prepare empty envelopes or beakers in which they can carry the samples they find outside.

EXTENSION IDEAS

1. Ask students to make sketches of the organisms they find under the microscope.
2. Ask students to imagine the extreme environment on Earth after an asteroid impact. Based on what they saw and learned in this activity, can they think of the characteristics needed in order to survive in those conditions? After imagining these extreme conditions, students could create and present an imaginary animal with these characteristics.

TIPS

- **Allow students to take several samples of lichen and moss to increase their chances of finding tardigrades. If only a few groups find tardigrades, allow the other pupils the opportunity to view the micro-animals through the microscope.**
- **Provide a simple key to help the students identify the different organisms they may encounter.**
- **After soaking the moss/lichen, drain some away. The material just needs to be moist.**

USEFUL LINKS

- **How to find tardigrades**
  www.youtube.com/watch?v=ZuxwisK-8f8
- **How to find tardigrades in your own back garden**
  https://microcosmos.foldscope.com/?p=17901
- **National geographic article with information on the water bears**
  https://news.nationalgeographic.com/2017/07/tardigrades-water-bears-extinction-earth-science/

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

4 Extreme survivors

Briefing

Water bears (also known as tardigrades) are tiny, amazing creatures. They've been frozen and defrosted, put under extreme pressure, subjected to very high temperatures, and zapped with X-rays. They have even been sent into space! They come out alive and well every time. Also, you can find them almost everywhere – you just need to look very closely!

YOUR TASK **Observe these extreme survivors under the microscope!**

WHAT YOU NEED TO DO

1. Your Club leader may ask you to hunt for the water bears outside. The best place to start is near moist lichen or moss. Lichen grows on the shady side of trees. If you cannot find lichen-covered trees, a moist sample of moss should work just fine as well. Fill a beaker or cup with plenty of the sample and keep it wet.
2. Place a very small amount of your lichen or moss onto a cavity slide.
3. Add a drop of distilled water to make sure the water bears feel comfortable enough to move about, then add the cover slip.
4. Place your slide on the stage of the microscope.
5. Follow the steps to use the microscope as your Club leader has shown you. It may take some time before you find your own water bear, so be patient and keep your eyes peeled! (You might find some creatures other than tardigrades. These very tiny creatures are called micro-animals and they can usually only be seen using a microscope.)
6. Draw the creature you have found.

FUN FACTS

1. Tardigrades are mostly translucent (partially see-through), so it is possible to see their organs under the microscope's light.
2. 'Extremophile' is the word scientists use to describe an organism that can survive in very extreme conditions that would instantly kill most other forms of life.
3. Tardigrades are not the only extremophiles. Giant tube worms, for example, are particularly extreme in that they have no mouth or digestive tract. They don't need to eat because they carry bacteria in their tissues that provide food from the chemicals in the (extremely hot) environment. Look them up and learn more about Earth's amazing lifeforms.

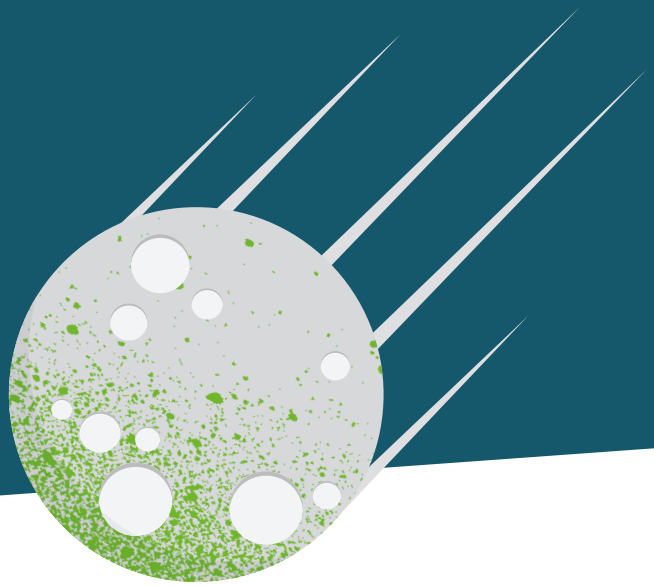
STEM CLUBS

NUMBER 1 FOR STEM

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

5 Surviving the nuclear winter



TOPIC LINKS

- Physics: generation of energy
- Engineering: designing a power plant

TIME

60 minutes

ESSENTIAL SKILLS SUPPORTED

Problem solving, leadership, teamwork

RESOURCES AND PREPARATION

- Clean tin can with one lid removed (available at any grocery store)
- Hammer
- Nail
- Wooden ruler or thin piece of wood of similar length
- Two rubber bands
- Medium-sized cooking pot (approx. 3 litres)
- Aluminium foil
- Stove or hotplate
- Clamp and stand
- Turbine/windmill – available at toy stores, or students can make their own with the following:
  - A paper towel tube
  - A large nail, 8cm or longer
  - A large wooden craft circle
  - Wooden craft sticks
  - Wood glue
  - A glue gun
- Scissors
- A permanent marker
- A stopwatch
- Oven mitts
- Safety glasses
- Optional: multimeter
- Optional: dc motor

Objective

In this activity, students simulate how energy is generated in geothermal power plants by making a turbine spin using steam (the turbine's movement can be compared to watermills to clarify how this works).

HEALTH AND SAFETY:

It is the Club leader's responsibility to create a risk assessment for this activity, taking into account the group you are doing it with and according to CLEAPSS or SSERC guidance. More safety measures are mentioned in the Tips section.

Have at least one supervisor for each group of students working on this practical.

Students will be working with fire and boiling water, so the safety rules in the lab room may need to be repeated before the start of the experiment. Oven gloves are required when handling hot materials.

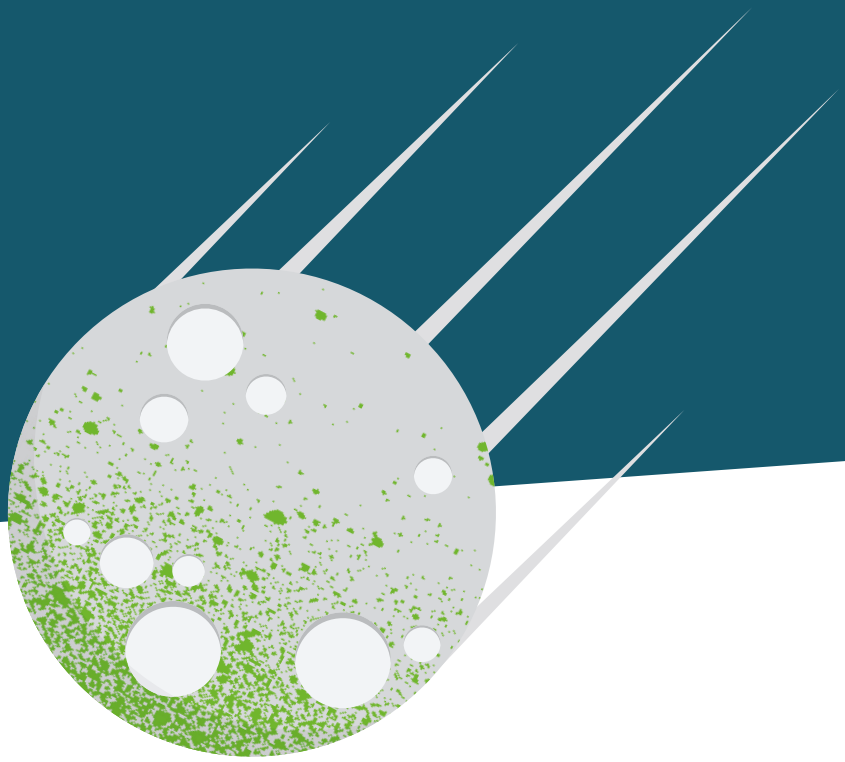
Cans must not be pressurised. Use a basic pressure relief valve (such as a loosely-fitted cork) to ensure that holes are not blocked.

DELIVERY

1. After the asteroid impact, dust would fill the skies and block out the Sun's warm rays of light, leaving the Earth a cold and dark place. Ask the class if they can think of any sources of heat other than the Sun.
2. Luckily, the Earth has a very hot core. Earth's hot, molten core could be used to keep humans warm, but it could also be used to provide us with clean, sustainable energy!
3. Geothermal energy is the heat energy generated and stored within the Earth (e.g. steam, magma, hot water), and geothermal power plants tap into these heat sources and use them to power electrical generators. Show students how turbines (which look like turbines) are used in real geothermal energy plants to produce energy, as they will use their own turbine (and count spins) to investigate how geothermal energy is produced. This useful YouTube video explains the process – https://www.youtube.com/watch?v=aJBpwiZBcDA
4. Refer to the Student guide for detailed instructions. If time permits, students can make their own pinwheels to use in their tests (see Preparation section of Student guide). If not, provide them with ready-made turbines and begin with Phase 1.
5. Show students the article 'The UK's first geothermal power project at United Downs, Cornwall, UK' – http://www.thinkgeoenergy.com/the-uks-first-geothermal-power-project-at-united-downs-cornwall-uk/

TIPS

- Perform this activity as a demonstration if there aren't enough supervisors for the pupils to complete the activity safely in groups.



DIFFERENTIATION IDEAS

Support: for less able students, turn this activity into a demonstration. Demonstrate how the steam from boiling water can make a turbine spin and follow the steps in phase 1 and 2 of the Student guide.

Challenge: ask the students to explain the use of power plants. They have seen in phase 2 that thermal vents produce energy, but ask them to reflect on their results from phase 3. Research question: 'Do power plants allow us to capture more energy?'

EXTENSION IDEAS

1. As an extension, investigate what happens when not all the steam from a reservoir is collected by the power plant, and some just escapes into the air. Very fast finishers could go back to their model and poke extra holes in the foil around the power plant. How does the extra air escaping affect the energy generated (number of spins) by the power plant?
2. This experiment could be further enhanced by demonstrating how electricity is produced. Attach a small motor to the wind turbine and attach a multimeter to the motor to record electrical output.

Idea!

Request a STEM Ambassador who works in renewable energy to talk about their job and how the sector has changed in recent years.

Incorporating Digital Skills

Consider:

- Website and online video research.
- Use 3d CAD and printing to design or build the turbine.

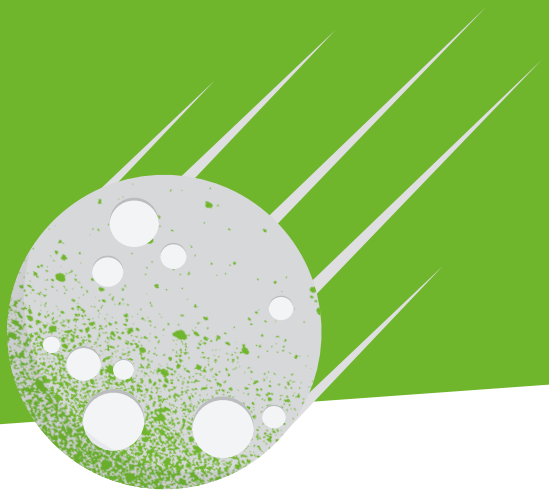
USEFUL LINKS

- Video explaining geothermal energy
  www.renewableenergyworld.com/geothermal-energy/tech.html
- Guardian article: Geothermal energy could meet a fifth of UK's power needs
  www.theguardian.com/environment/2012/may/30/geothermal-energy-uk-power
- Science Buddies project: The Power of Heat Is Right Under Your Feet!
  www.sciencebuddies.org/science-fair-projects/project-ideas/Energy_p023/energy-power/geothermal-energy
- BBC Bitesize page that describes how steam makes turbines spin to generate electricity
  http://www.bbc.co.uk/bitesize/ks3/science/energy_electricity_forces/energy_transfer_storage/revision/8/

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

5 Surviving the nuclear winter



Briefing

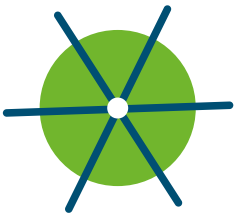
The dust thrown up by the asteroid impact will cause the Earth to have extremely cold weather for a very long period of time (up to 100 years). This is because the Sun will be blocked out by all the dust. In order to survive, humans might need to move to areas where the heat of the Earth can be used as a source of warmth and energy. Hydrothermal vents, which are places where water heated by the Earth's core is pushed to the planet's surface, would become popular places to escape the cold after a meteorite strike.

YOUR TASK **Build a model of a geothermal power plant to learn more about geothermal energy.**

WHAT YOU NEED TO DO

Preparation: making your own turbine

1. Push a nail through a cardboard paper towel tube approximately 2–3cm from the top. Spin the nail several times to create a large hole allowing the turbine to spin easily. A turbine looks similar to a windmill, but is used to generate electricity!
2. Glue a large craft circle to the head of the nail using a glue gun.
3. Glue cardboard or paper to each of the wooden craft sticks to create the blades of the turbine. You can choose the shape of the blades. Ask your Club leader for advice if you are unsure of how to get the best results
4. Use the wood glue to attach the wooden craft sticks to the back of the wooden circle. Space them evenly apart as shown in the image below.
5. Leave the materials to dry before attaching the turbine to the paper towel tube.



Phase 1 – Creating the Earth

Safety warning: this activity involves boiling water and hot steam. Work carefully and follow all safety procedures as instructed. Safety glasses must be worn at all times. Wear oven gloves when instructed.

1. Put your tin can on the table so that the open end is facing down. Using the hammer and nail, make a hole about 13mm wide in the centre.
2. Fill your cooking pot with 2 litres of tap water or until it is just over half full.
3. Take a piece of aluminium foil and place it over top of the cooking pot. Fold the foil down over the edges of the cooking pot so that the water is sealed in.
4. Take another piece of foil and place it on top of the first piece of foil. Fold the second piece tightly to ensure that when the water boils, no steam can get out from the edges.

Note: The foil-covered cooking pot models the Earth. The aluminium foil is the crust, covering the heat that is within the Earth.

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

5 Surviving the nuclear winter

Phase 2 – Creating the geothermal vent

Safety warning: From here on, you will be working with hot water and steam. Oven gloves and safety glasses should be worn when handling hot materials.

1. Use a nail to gently poke 3 holes in the centre of the aluminium foil pieces. They should all be able to fit under the can, so don't make them too far apart. Make sure that the nail goes through both layers of aluminium foil.
2. Turn the stove on medium to medium-high heat and place the cooking pot on top of the flame.

Safety warning: The heat setting should be hot enough to boil the water; however, make sure that the water doesn't boil so heavily that water hits the foil.

3. Make one large mark on the back of one of the turbine spokes with the permanent marker. You need to be able to see the mark clearly while the turbine is spinning.
4. Wait for the water to boil. Hot air rises, which means that steam will move out of the cooking pot (i.e. the Earth's crust) through the gaps in the foil (i.e. the geothermal vents). When you see steam coming out of the hole and the foil cover is slightly inflated, you are ready to start the experiment.
5. Clamp the turbine to a stand so that it hangs parallel to the foil. Start high up above the pan over one of the holes, and move the turbine down slowly until it starts spinning.
6. Use a ruler and make a note of the height at which you are holding the turbine.
7. Note the location of the mark on the back of the turbine. Each time you see the mark reach that location again, the turbine has made a complete spin. The timekeeper will use the stopwatch to keep track of time and the mark you made on the turbine to count the number of spins. The counter will count the number of complete spins in 20 seconds. Record the number of complete spins in 20 seconds.
8. Repeat this twice more and record all the information. Holding the turbine over the bare foil represents the power of geothermal steam from the Earth without a power plant.

FUN FACTS

1. So, how do turbines like the one in this activity make electricity? Simply stated, a wind turbine works in the opposite way to a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind (or in the case of geothermal energy, steam) to make electricity. The wind turns the blades of the turbine, which then spin a shaft, which connects to a generator and makes electricity.
2. As geothermal energy is a form of sustainable energy, it is a field of work that is becoming more and more important. Geothermal engineers explore new ways to harness and use this technology by creating processes and equipment that convert thermal energy stored in the Earth into electrical power. Many new projects are under development that will significantly expand geothermal employment.
3. No sun, no warmth. When an asteroid hit the Earth 66 million years ago, it threw up enough dust and sulphur to block out the Sun for over 10 years. This sent the Earth into an ice age that scientists believe caused the extinction of the dinosaurs.
4. If the sun completely disappeared, the average temperature on Earth would drop to -0°C in about week. It would drop to around -73°C by the end of the first year.

Can you survive an asteroid impact?

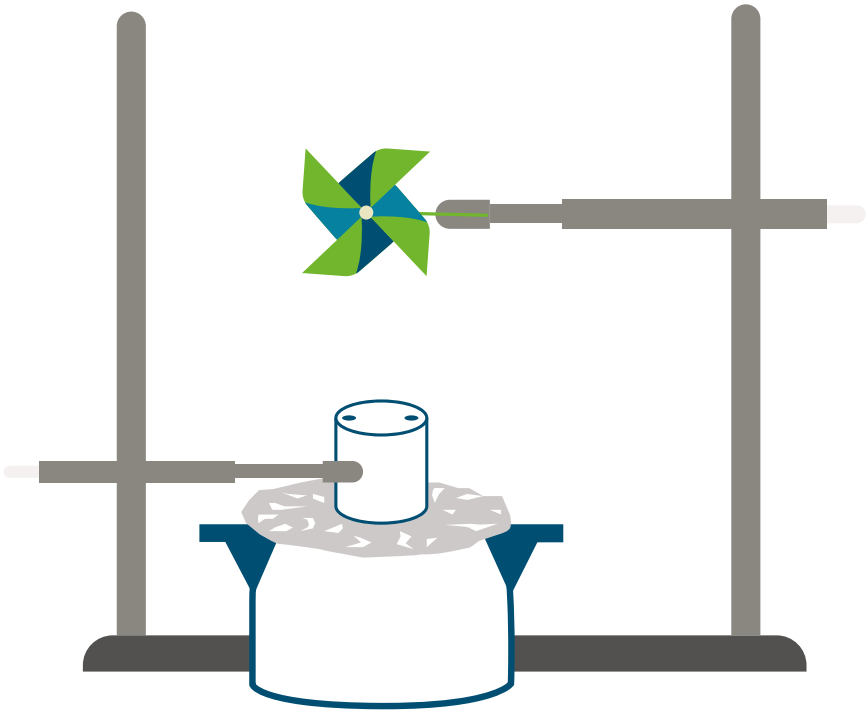
5 Surviving the nuclear winter

Phase 3 – Creating the geothermal power plant

Safety warning: From here on, you will be working with hot water and steam. Oven gloves and safety glasses should be worn when handling hot materials.

1. Place the can in a clamp and attach it to a second stand at the appropriate height so that it can rest above the hole in the foil (with minimal space between the foil and the can). Let it stand undisturbed for 30 seconds. The steam will collect inside the can, representing a power plant collecting steam from a reservoir in the Earth.

2. Place the turbine (still attached to the stand) above the can over both holes as shown in the diagram below. The turbine should be at the same height as in step 6 of phase 2 – use a ruler to find the correct height.



3. This is where you can start measuring how much energy your geothermal vent is producing! First, note the location of the mark on the back of the turbine. Each time you see that mark reach that location again, the turbine has made a complete spin. The timekeeper will use the stopwatch to keep track of time and the mark you made on the turbine to count the number of spins. The counter will count the number of complete spins in 20 seconds. Record the number of complete spins in 20 seconds in your lab notebook. In real life, the spinning turbine can generate electricity from heat that rises – the more the turbine spins, the more energy is generated.

4. Repeat twice more.

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

6 Artificial suns

TOPIC LINKS

Biology: plants

TIME

10–20 minute sessions spread out over 2–3 weeks

ESSENTIAL SKILLS SUPPORTED

Staying positive, creativity

RESOURCES AND PREPARATION (PER GROUP)

For the greenhouses:
- 3 light bulbs (full spectrum bulbs have best results)
- 3 desk lamps
- 3 light timers (if this is not available, turn the light on and off manually)
- 3 cardboard boxes that can hold several petri dishes each

Per group:
- A smaller cardboard box
- A cupboard that is kept closed and dark (no sunlight)
- A spot in the room that is in the sun during the day
- Watercress seeds
- 5 petri dishes
- Transparent acetate sheets:
- Red
- Blue
- Green
- Cotton wool
- Water
- Ruler
- Pens and paper

Objective

In this activity, students grow watercress in the sun, the dark, and in blue, red, and green artificial light to compare if/how quickly they germinate.

Note: Asteroids are rocky bodies in the solar system that orbit the sun. When an asteroid or a piece of an asteroid, known as a meteoroid, enters Earth's atmosphere, it is called a meteor. If part of this object makes it to Earth's surface, rather than simply burning up in Earth's atmosphere, it is called a meteorite. This should explain why different terminology is used throughout this activity.

DELIVERY

1. Ask students what plants need to grow.
2. Explain photosynthesis and that it requires sunlight to take place. Emphasise that chlorophyll inside the cells in the leaves of plants grabs sunlight and starts a chemical reaction that produces food for the plant. Plants also need carbon dioxide, water and nutrients from the soil.
3. Ask students to imagine how an asteroid impact would affect our Earth: dust blown up by the impact will block out the Sun, plants wouldn't grow as well, etc. However, perhaps (with science) we can find a solution for this problem.
4. Introduce the activity. Students will investigate if artificial light will be enough for watercress to grow, and exactly which colour of light would be optimal for their indoor greenhouse.

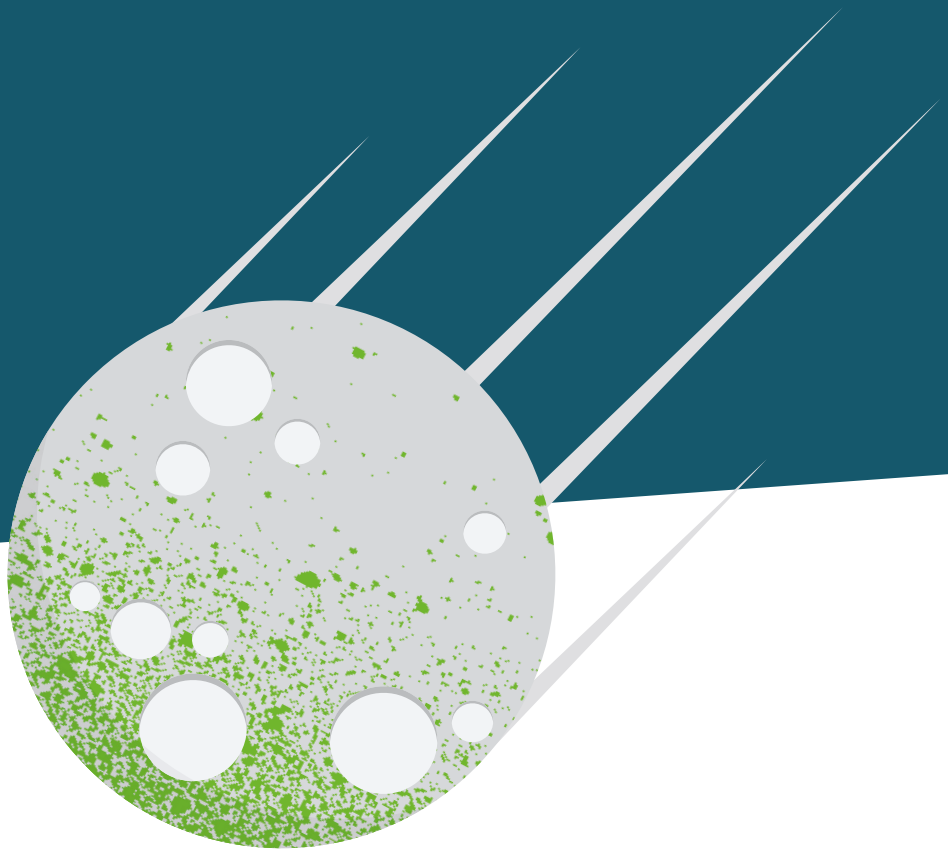
HEALTH AND SAFETY:

It is the Club leader's responsibility to create a risk assessment for this activity, taking into account the group you are doing it with and according to CLEAPSS or SSERC guidance.

Incorporating Digital Skills

Consider:

- **Use of video to record process to review later.**
- **Digitally record the results: table, spreadsheet etc.**



TIPS

- Prepare the large boxes that will act as the greenhouse beforehand. Demonstrate how the acetate sheets affect the colour of the light that is used in each separate greenhouse. The students will place their petri dishes in these boxes.
- As it will take several weeks to clearly see the plants germinate and grow, it is a good idea to combine this with other activities.
- If it is possible for the watercress to be watered at school, then let the projects stay there.
- Different wavelengths of light will have different effects on the growth of plants:
  - blue light (short wavelength) is good for foliage growth
  - red light (long wavelength) is good for flowering and fruiting
  - plants have little use for green wavelengths and reflect them back, which is why leaves appear green

Idea!

Invite a STEM Ambassador to talk about how they use hypotheses in their role and how they test them.

DIFFERENTIATION IDEAS

Support: only focus on the question: 'Which colour of light would be optimal for an indoor greenhouse?' This leaves out the comparison between the different conditions (dark, sun, artificial light).

Challenge: let students research the effects of different light colours on plant growth and ask them to write up a hypothesis where they back up their prediction using scientific knowledge.

EXTENSION IDEAS

1. Students can explore just how much our food chains rely on plants as primary producers. Attempt a world-building task where students come up with a food chain without plants. How would this food chain work, and what primary producers are involved to provide the necessary energy to the rest of the food chain?

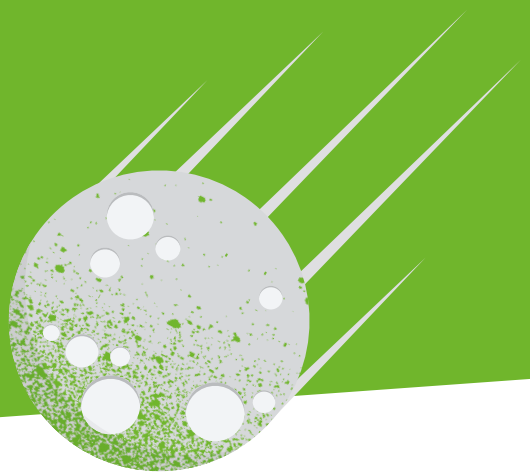
USEFUL LINKS

- Web content that describes characteristics of plants and photosynthesis
  http://www.biology4kids.com/files/plants_main.html
- Web content that explains food chains and the role of plants as primary producers
  http://www.geography4kids.com/files/land_foodchain.html
- Web content that describes the difference between photosynthesis and chemosynthesis
  https://oceanexplorer.noaa.gov/facts/photochemo.html

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

6 Artificial suns



Briefing

Without sunlight, there can be no photosynthesis. Correct? Well, not quite! As a matter of fact, it is possible to use incandescent light bulbs to simulate the light of the Sun. As well as this, biologists have found that different colours of light have different effects on the growth of plants. In this experiment, you will compare how well plants can grow in three different conditions:

- **in the sun (before the asteroid impact)**
- **in the dark (after the asteroid impact)**
- **in three different colours of artificial light**

YOUR TASK **Could artificial 'suns' in indoor greenhouses be used to grow food after an asteroid impact?**

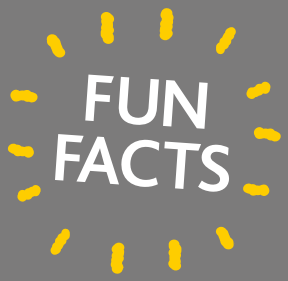
WHAT YOU NEED TO DO

1. Label each petri dish with the type of light it will receive (no light, sunlight, blue light, red light or green light).
2. Put a layer of cotton wool in each of the dishes.
3. Place watercress in each dish. Make sure you use the same amount of cress seeds, for example 10 per Petri dish.
4. Water each of the petri dishes with equal amounts of water (a sprinkle of 'rain' is enough).
5. Place the petri dishes in their appropriate 'greenhouses'. Each of these boxes will need to be placed in a room that is usually kept quite dark (completely out of the sun light) and will be bathed in light of only one colour.
6. Take the petri dish labelled 'sunlight' and put it in a place with lots of bright sunlight: perhaps on a windowsill. (If you cannot leave your project at school, you will need to place it on a windowsill at home).
7. The final petri dish will be placed in a dark place, like a cupboard.
8. You will need to water each of your petri dishes every 1 or 2 days. Make sure to give every petri dish the same amount of water each time to keep the experiment fair. The cotton should be damp, but not soggy. If it feels dry, give it a little sprinkle of water.
9. The watercress should germinate in 2–5 days, depending on location and conditions. Monitor their daily growth for two weeks by:
   - measuring the height of each sprout
   - writing down observations about the colour of each sprout
10. Put your information in the table below, then analyse the results.

QUESTIONS

1. Can you describe what the results in your table tell you?
2. Did your results surprise you?
3. Do you think that greenhouses with artificial light could produce the crops we need after an asteroid impact? If so, which colour of light would you suggest using? Why?

		Sun	No light	Artificial light		
				Blue	Red	Green
Week 0	Observations					
	Height (mm)					
Week 1	Observations					
	Height (mm)					
Week 2	Observations					
	Height (mm)					



1. For a long time, people have believed that talking to plants helps them to grow. This might have less to do with them enjoying our conversations, and more to do with all of that carbon dioxide we breathe over them as we chat. Remember, carbon dioxide is essential for photosynthesis!
2. Some organisms live deep in the ocean and can survive perfectly well without light from the Sun. For example, deep sea vents are home to creatures that survive by working with bacteria. The bacteria create food from chemicals given off by the sea vents rather than the Sun. These bacteria (known as chemobacteria) then provide food for larger organisms.
3. Scientists are preparing for situations like an asteroid impact. They have huge, underground storage facilities where seeds from around the world are collected and stored. These seeds could be used by survivors to grow new crops.
4. Botanists are scientists who study plants. They discover how we can turn plants into food, medicines and useful materials.

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

7 Your own telescope

Objective

In this activity, students become amateur astronomers by creating their own telescopes.

Note: Asteroids are rocky bodies in the solar system that orbit the sun. When an asteroid or a piece of an asteroid, known as a meteoroid, enters Earth's atmosphere, it is called a meteor. If part of this object makes it to Earth's surface, rather than simply burning up in Earth's atmosphere, it is called a meteorite. This should explain why different terminology is used throughout this activity.

TOPIC LINKS

- Physics: astronomy
- Design and technology: working with materials

TIME

60 minutes

ESSENTIAL SKILLS SUPPORTED

Problem solving, staying positive, aiming high

RESOURCES AND PREPARATION

For each telescope:

- 2 sheets of corrugated paper
- 2 magnifying glasses of different sizes
- PVA glue
- Scissors
- Pencil
- Ruler
- Duct tape

DELIVERY

1. Explain that with just a simple telescope, anyone can search for the amazing, astronomical objects that move through our sky. Using basic equipment and some clever calculations, people can track objects as they move through our solar system or galaxy and work out where they will go next. They can even figure out if an object is on a collision course with Earth!
2. If students have looked through a telescope before, ask them to share their experiences.
3. Explain that students will be making their own telescope in this activity.
4. Taking it a big step further: you can now build your very own powerful telescope at home – http://www.iflscience.com/technology/you-can-now-build-your-very-own-powerful-telescope-home/. This link shows that it is becoming possible for people to create powerful equipment at home. The Ultrascope mentioned in this article is a telescope with an open source design that can be downloaded and constructed inexpensively (at 200 pounds) at home. This links the activity to possibilities within advanced design and technology as well as computing (the Ultrascope in the video is guided by an Arduino that tells it what to do and when to take photos).

HEALTH AND SAFETY:

It is the Club leader's responsibility to create a risk assessment for this activity, taking into account the group you are doing it with and according to CLEAPSS or SSERC guidance.

Remind students that they should NEVER use the telescope to look directly at the Sun. Explain that this could seriously damage their eyes.

TIPS

- This telescope can also be made using convex and concave lenses, if these are more readily available. This link on building a home telescope is helpful www.savvyhomemade.com/building-a-homemade-telescope/.
- Ask students to use their telescopes to take photos of the moon and bring in their best shots the following week.
- Ask students to look at some of the links mentioned below for additional resources.

Incorporating Digital Skills

Consider:

- **Use of video to record process to review later.**
- **Research telescopes using the internet.**
- **Use 3d CAD and printing to design or build a telescope housing.**
- **Build an Ultrascope guided by an Arduino.**

DIFFERENTIATION IDEAS

Support: help students find the correct distance for the two magnifying glasses to be in focus.

Challenge: students could investigate different materials to use as the tube of their telescope. Can they find a better material?

EXTENSION IDEAS

1. Join a citizen science project – https://www.asteroidmission.org/get-involved/target-asteroids/ – that contributes to our understanding of near-Earth asteroids. There are prerequisites for participation, including the need for appropriate observing equipment (telescope 8" or larger, CCD camera, computer with internet connection, and astrometry software).

Idea!

Request a STEM Ambassador in the aerospace sector to run a Q&A session.

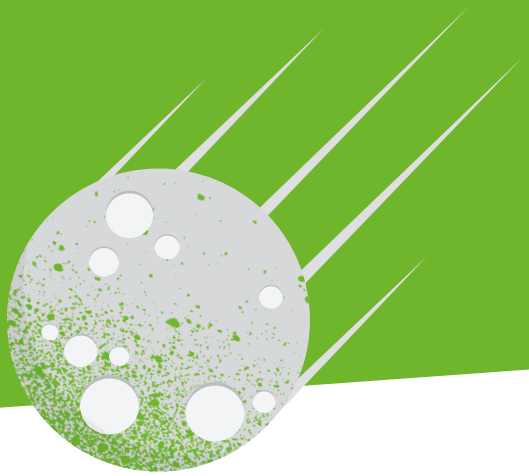
USEFUL LINKS

- Asteroid mappers (Vesta edition) allows you to look at high resolution images that were taken of the asteroid named Vesta and start mapping the features.
  https://cosmoquest.org/x/blog/2012/09/announcing-asteroid-mappers/
- The Sky is Falling! Or is it? This website discusses how serious amateurs can look for meaningful ways to use their equipment to contribute to astronomical knowledge.
  http://blogs.discovermagazine.com/citizen-science-salon/2017/08/29/the-sky-is-falling-or-is-it/#.We4yvjDfO00
- OSIRIS-REx The OSIRIS-REx spacecraft is traveling to Bennu, one of the most potentially hazardous asteroids with a relatively high probability of impacting the Earth late in the 22nd century.
  https://www.asteroidmission.org
- Facebook page of OSIRIS-REx.
  https://www.facebook.com/OSIRISREx/
- Spaceguard Spaceguard UK operates the Spaceguard Centre (located in Knighton, Powys, UK) from where it provides timely information to the public, press, media and education about the threat of asteroid and comet impacts, and the ways in which we can predict and deal with them.
  https://spaceguardcentre.com/about-us/
- Making a telescope by Practical Physics
  http://practicalphysics.org/making-telescope.html
- You can now build your very own powerful telescope at home
  http://www.iflscience.com/technology/you-can-now-build-your-very-own-powerful-telescope-home/

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

7 Your own telescope



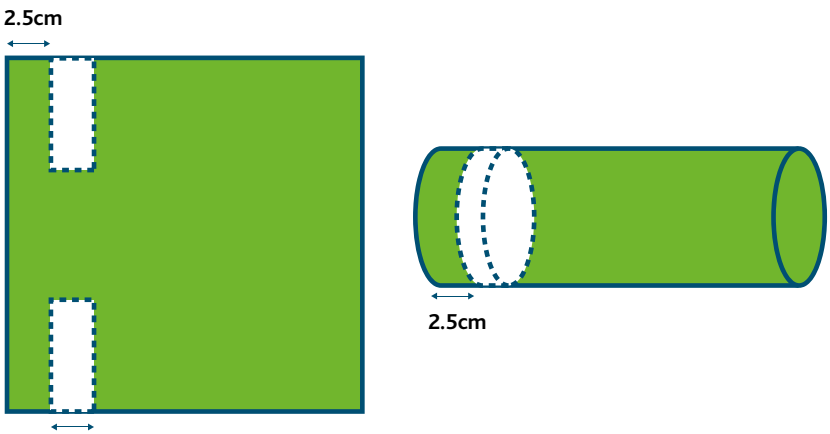
Briefing

The best way to survive an asteroid impact is by stopping it from happening in the first place! To do this, you first need to spot the asteroid that's on a collision course with Earth and calculate its orbit around the Sun. Then you can figure out how to knock it off course and save humanity!

YOUR TASK Make a telescope so you can search for incoming asteroids!

WHAT YOU NEED TO DO

1. Gather your materials.
2. Hold the larger magnifying glass in front of you at arm's length and point it at some spot in the room. The image of the object through the lens should look blurry. Place the second, smaller magnifying glass between your eye and the first magnifying glass. Move the second glass forward or backward until the image comes into sharp focus. (Notice that everything appears larger and upside down!) As you look at objects that are closer by or further away, you may notice you need to adjust the position of the second, smaller magnifying glass.
3. Wrap the paper around the larger of the two magnifying glasses. Once you are sure that it is pulled tight, mark the diameter on the paper with the pencil.
4. You will need to cut off the excess paper. To do this, measure along the edge of the paper from the mark made in step 3. Then leave another 4cm of paper from the mark – this extra 4cm will be used to securely glue the paper around the edge of the magnifying glass. Use a ruler to draw a line along the paper, and use scissors to cut off the excess paper.
5. Before you roll up the tube, you should create a slot for the first magnifying glass. Use a ruler to measure the thickness of the magnifying glass and write this value down.
6. Draw lines for the slot 2.5cm from the end of the paper as is shown in the diagram below. Do not cut all the way through the tube. The slot should be able to hold the large magnifying glass, and should be as wide as the measurement from step 5.



STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

7 Your own telescope

7. Take a second piece of corrugated paper, and repeat steps 3 and 4 for the smaller magnifying glass.
8. Roll up both your sheets of paper into tubes of the correct diameter, and glue the edges of the paper together (this is what the extra 4cm of paper are for). Place the two magnifying glasses in their slots and tape them in with the duct tape.
9. Slide the second tube into the first. You should have enough space between the tubes to alter the distance between the two magnifying glasses. If there is too much space between the two tubes, add some corrugated paper to the outside of the smaller tube to give it a tight fit.

You can now use this telescope for looking at things farther away, although it will be difficult to view the stars clearly. However, this type of telescope is great for viewing the moon! Just remember to **never** look directly at the Sun.

FAST FINISHERS: It is possible to build a **very powerful** telescope at home – http://www.iflscience.com/technology/you-can-now-build-your-very-own-powerful-telescope-home/. For this, you will require some expensive materials, starting with a 3D printer, as well as a lot of time. Developed at the London-based Open Space Agency (OSA), the Ultrascope is a telescope with an open-source design that can be downloaded and constructed inexpensively at home.

Investigate the Ultrascope and compare it to the telescope you made in your STEM Club.

FUN FACTS

1. There are scientists whose job it is to spot and track asteroids for companies like NASA.
2. According to asteroid specialists, if we had enough time to prepare, we could actually change an asteroid's orbit around the Sun to stop it colliding with Earth.
3. The images you see in a telescope will be upside down because astronomers don't care about up and down in space (there is no up or down in space, after all). You could use two prisms to correct the image, but you will have to re-position the lenses.
4. You can use the camera on your phone to take photos of the night sky and search for asteroids! The best way to search for asteroids is by taking images from the same locations every night at the same time for several days in a row. In your photos, you should look for objects that change position – these will be asteroids!
5. Are telescopes just for seeing what's in space? The Jodrell Bank Centre for Astrophysics is part of the University of Manchester. It hosts the 76m wide Lovell Radio Telescope, which is the third largest telescope in the world! It spends its time listening to space and the noises (radio waves) that are given off by objects in space. Pulsars are very dense neutron stars that release pulses of radiation – and you can listen to what they sound like – http://www.jb.man.ac.uk/pulsar/Education/Sounds/. The closest pulsar to Earth is 424 light years away and has the catchy name PSR J0108-1431!

- Jodrell bank website – http://www.jodrellbank.manchester.ac.uk
- time-lapse – https://www.youtube.com/watch?time_continue=7&v=8L7JWrQ0bzg
- sounds of pulsars – http://www.jb.man.ac.uk/pulsar/Education/Sounds/

STEM CLUBS

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

8 Simulating a meteorite impact

Objective

In this activity, students investigate how the size and speed of a meteorite would affect the amount of damage it causes when it hits Earth. Crater diameters and debris ranges are simulated using sand as the Earth's surface, and differently sized objects will represent the different possible meteorites.

Note: Asteroids are rocky bodies in the solar system that orbit the sun. When an asteroid or a piece of an asteroid, known as a meteoroid, enters Earth's atmosphere, it is called a meteor. If part of this object makes it to Earth's surface, rather than simply burning up in Earth's atmosphere, it is called a meteorite. This should explain why different terminology is used throughout this activity.

TOPIC LINKS

- Physics: calculate the effect of a meteorite impact based on its size and speed

TIME

30 minutes

ESSENTIAL SKILLS SUPPORTED

Listening, speaking, teamwork

RESOURCES AND PREPARATION

- A sandbox
- A ruler
- Flour
- Dry pudding mix or cocoa powder
- Several objects that can act as asteroids (rocks, balls and marbles of various sizes with similar weights)
- Optional: electric balance
- Optional: drafting triangle

Prepare the models of the Earth before the session starts:

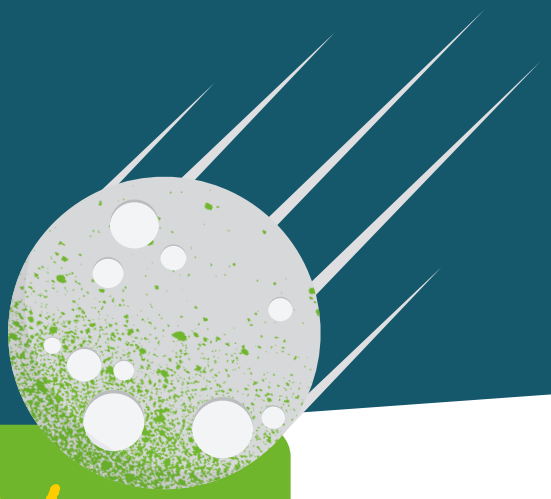
1. Fill the tray with 2–3cm flour.
2. Cover that layer with a dusting of the cocoa powder using a sifter. This layer will represent the top level of 'dirt' on Earth's surface.

DELIVERY

1. Get students thinking about what kind of impact a meteorite would have. What kind of hole would it leave? What shape would the hole be? What would happen to the meteorite?
2. Ask them to consider what factors might affect the size of the crater created by an impact (the angle it hits, the composition of the meteorite and its size can all affect the scale of the crater). What would be the most disastrous meteorite that could strike Earth?
3. Explain to students that you can model the effect of a meteorite impact using flour and cocoa powder as the Earth's surface, and objects as the meteorites.
4. Assist students as they work through the Student guide.
5. After students have finished modelling, have a group discussion:
   - **a.** What do their results tell them?
   - **b.** What other factors can they think of that might affect the size and depth of meteorite craters?
   - **c.** How would they be able to investigate this using their model?
   - **d.** Based on their results, can they explain why it is important to detect asteroids that are on a collision course with Earth early?

HEALTH AND SAFETY:

It is the Club leader's responsibility to create a risk assessment for this activity, taking into account the group you are doing it with and according to CLEAPSS or SSERC guidance



Incorporating Digital Skills

Consider:

- Excel to record results and present in a chart.

Idea!

Invite a STEM Ambassador to talk to students about how they use physics and calculations to make predictions.

TIPS

- Explain how the simulation works to the whole class before the first group starts their simulation to help them decide the best way to model the effects of the impact.
- Let the students work in small groups with each model. If there are not enough trays, other groups could be trying out the computer simulation while they wait for their turn.
- When renewing the model, simply add a new dusting of cocoa powder after smoothing the surface of the mixture.

DIFFERENTIATION IDEAS

Support: give students model heights for the Option A activity (e.g. 40mm, 80mm, 120mm, 160mm).

Challenge: students could investigate the effect of size and height of drop in different combinations to find out what creates the biggest crater. Fast finishers could investigate the effect of the angle of the drop (use a drafting triangle).

EXTENSION IDEAS

1. Students can record their results and produce a news report warning viewers of the threat of the asteroid that is making its way toward Earth. They need to clearly describe what their results tell us and could include the importance of evacuation. The simulations in the Useful links section might be useful for this.
2. Get students to investigate whether different types of ground or rock would affect crater size. What would happen if the meteor landed in water?

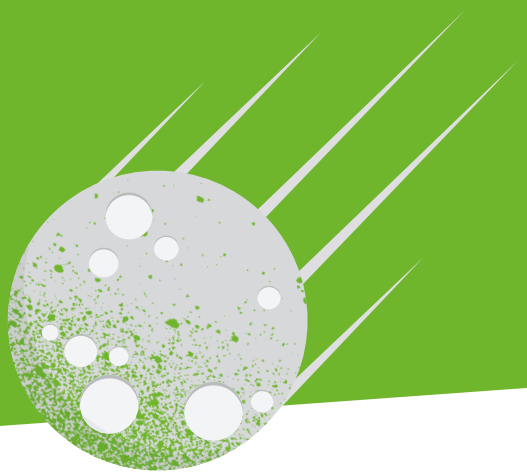
USEFUL LINKS

- What if an asteroid hit the Earth? How Stuff Works
  https://science.howstuffworks.com/nature/natural-disasters/asteroid-hits-earth.htm
- Impact Earth! Simulation (complex)
  www.purdue.edu/impactearth/
- Killer Asteroids simulation (simpler)
  http://www.killerasteroids.org/interactives/impact/index.php
- Make craters with mini meteors
  www.scientificamerican.com/article/make-craters-with-mini-meteors-bring-science-home/

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

8 Simulating an asteroid hit



Briefing

An asteroid is on its way to Earth, and researchers are frantically trying to estimate just how much damage will be done. The sooner they know, the sooner people can be evacuated from any towns that will be affected. Several things affect the scale of a meteorite impact. You are tasked to investigate one of these factors and share your findings.

YOUR TASK

Research the effect of meteorite velocity (speed) or size on the size and depth of the crater it would create – your findings might save lives!

WHAT YOU NEED TO DO

Choose one of the options below and follow the steps. Record your results in the table.

Option A: the effect of the meteorite's velocity (height of the drop):
The height from which you drop your model meteorite will affect its speed when it reaches your model Earth.

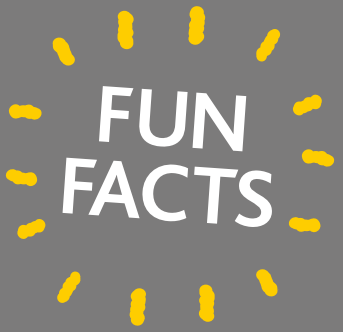
1. Make sure your meteorite's landing site is smooth.
2. Use the ruler to measure the various heights you will need to drop your model meteorite from.
3. Drop (don't throw!) the model meteorite. After it lands, use the ruler to carefully measure the diameter and depth of the crater (the hole in the sand) that was created. Write your results in the table.
4. Make your 'soil' smooth again, and repeat this step from the same height. Record your results, and calculate the average diameter and depth for this distance of the drop.
5. Repeat steps 1 to 4 for your other chosen heights.

Height (cm)	Crater diameter (cm)			Crater depth (cm)		
	Trial 1	Trial 2	Average	Trial 1	Trial 2	Average

Option B: Effect of size

1. Make sure your meteorite's landing site is smooth.
2. Gather the four objects that will act as your asteroids. For each of them, you need to measure the diameter. Record this information in the table below.
3. Use the ruler to measure the height you will drop your model meteorites from. You can choose the height, but be sure to write it down and keep it consistent in every test.
4. Drop (don't throw!) the first model meteorite. After it lands, use the ruler to carefully measure the diameter and the depth of the crater (the hole in the sand) that was created. Write your results in the table.
5. Make your 'soil' smooth again, and repeat this step for the same object. Record your results, and calculate the average diameter and depth for this model meteorite.
6. Repeat steps 1 to 5 for the other model meteorites provided.

Meteorite diameter (cm)	Crater diameter (cm)			Crater depth (cm)		
	Trial 1	Trial 2	Average	Trial 1	Trial 2	Average



1. According to Killer Asteroids (http://www.killerasteroids.org/impact.php) if a stony meteorite with a diameter of 2km hit London, it would leave most of the UK and Western Europe with first degree burns. Luckily, we know that this won't happen any time soon!
2. Asteroids and meteorites can be made up of porous rock, which is much lighter than solid rock. Porous meteorites would do less harm to the Earth than solid blocks of space material.

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

9 An apocalyptic meal

Objective

Students create their own menu based on foods that are easier to grow and farm with decreased sunlight after a meteorite impact.

Note: Asteroids are rocky bodies in the solar system that orbit the sun. When an asteroid or a piece of an asteroid, known as a meteoroid, enters Earth's atmosphere, it is called a meteor. If part of this object makes it to Earth's surface, rather than simply burning up in Earth's atmosphere, it is called a meteorite. This should explain why different terminology is used throughout this activity.

TOPIC LINKS

Design and technology: Nutritional values of food

TIME

40 minutes

ESSENTIAL SKILLS SUPPORTED

Listening, speaking, creativity

RESOURCES AND PREPARATION

- A3 paper (various colours)
- A4 paper (various colours)
- Coloured pens and pencils
- Laminating film

DELIVERY

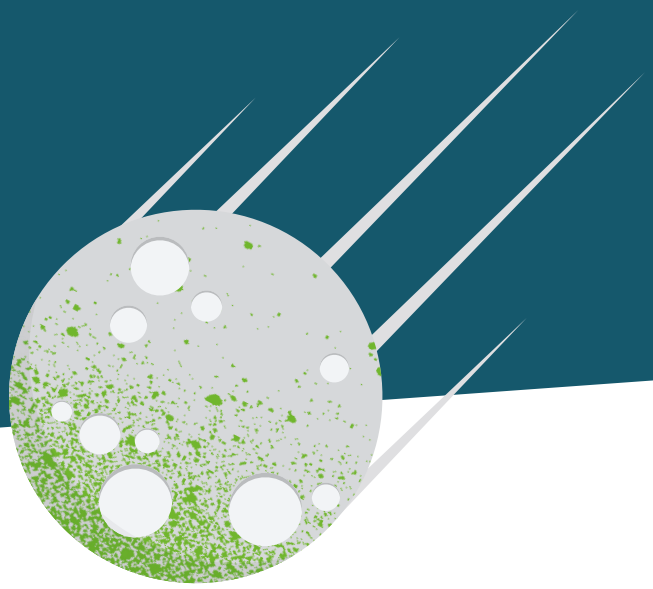
1. Ask the students to think about a world without enough sunlight for plants and crops to grow. We still have shops and some food that would last for a while, and greenhouses would provide some food using artificial light. However, cattle farmers would be out of business since there would not be enough grass and grain for such large animals to eat.
2. Ask if the pupils can think of solutions to these problems.
3. Introduce the idea of entomophagy – the practice of eating insects. Unlike with large cattle, insects do not require a lot of resources for us to feed and farm them. They also contain a lot of protein, making them a good substitute for beef. Ask if any students have ever eaten insects before, or if they have seen them in the shops.
4. Show them a list of edible insects (www.ediblebugfarm.com/blog/edible-insects-list/)

Idea!

Request a STEM Ambassador to talk about nutrition and run a discussion with students about eating insects in the future.

HEALTH AND SAFETY:

It is the Club leader's responsibility to create a risk assessment for this activity, taking into account the group you are doing it with and according to CLEAPSS or SSERC guidance.



Incorporating Digital Skills

Consider:

- **Use of video to record process to review later.**
- **Log ingredient data in a table.**
- **Use software apps to design a menu.**

TIPS

- **Prepare and bring in packaging from foods that students are familiar with and let them check the nutritional labels to assess their nutrient intake.**

DIFFERENTIATION IDEAS

Support: ask students to list the things they usually eat on a daily basis and discuss how insects could be included (e.g. cricket stir fry, mealworm burgers, chocolate and ant pancakes). Guide them through the calculations for the nutrient content in their meals.

Challenge: create a competition where the most nutritious and appealing menu wins. Add a stretch goal where advanced students consider which nutrients are not mentioned and might be missing from their insect menu.

EXTENSION IDEAS

1. This task can be extended by asking students explore the importance of the macronutrients in their diet as well as the importance of vitamins and minerals. What happens when we have nutrient deficits for each of these nutrients?
2. Ask students to research different diets (Palaeolithic, vegan, Mediterranean) and assess their health benefits/risks.

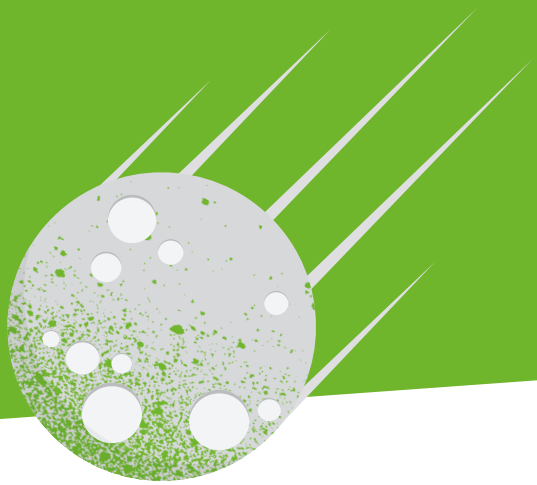
USEFUL LINKS

- **Could insects be the food of the future?**
  https://allyouneedisbiology.wordpress.com/tag/diet-based-on-insects/
- **Bugs on the menu**
  http://bugsonthemenu.com/intro
- **The nutritional value of insects**
  http://www.menshealth.co.uk/food-nutrition/healthy-eating/the-nutritional-value-of-insects
- **Webpage with a list of the top 50 edible insects**
  http://www.ediblebugfarm.com/blog/edible-insects-list/

STUDENT GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

9 An apocalyptic meal



Briefing

After billions of years drifting through space, an asteroid has finally reached Earth and rained destruction on the planet in the form of meteorites, having a terrible effect on the environment. Almost immediately, the number of crops and plants we can grow falls dramatically. This is because the Sun is blocked out by dust and gases. What will you eat while you wait for the disaster to blow over?

Growing vegetables in greenhouses is one option, but where will we get our protein? Farm animals will find it hard to survive as we won't be able to grow enough food to feed them. Sure, you could eat eggs, lentils and nuts, but there might be a better solution… Insects!

Insect farming is the practice of raising insects for human consumption. Insects bred in captivity do not need a lot of space and are very high in protein. Unlike with farm animals, insects can be farmed indoors and they do not require a lot of resources to feed and farm them, making them a good substitute for animal protein.

YOUR TASK **Create your own nutritious menu based on insects and vegetables!**

WHAT YOU NEED TO DO

Use the list of insects and their nutritional values below. With your team, create an interesting and tasty breakfast, lunch, and dinner incorporating as many crunchy critters as you can! You have two goals:

Goal 1: make your menu healthy and nutritious

Calculate the nutritional values in terms of protein, fat, and carbohydrates for every meal. You are aiming to make the menu filling and healthy. Over the three meals, you should provide at least the following in terms of nutrients:

- protein: 45–60 grams
- fats: 60–80 grams
- carbohydrates: 200–220 grams

Goal 2: make your menu interesting and appealing

Each of the insects has information regarding their nutritional content. For the first couple of insects, some additional information has been added to help you come up with tasty ideas of how to prepare insects for the best results.

Of course, you may add some other ingredients to your menu. When you do this, make sure you check the nutritional content of these ingredients and include it in your calculations.

YOUR INGREDIENTS:

Crickets

Good for:	Healthy bones and teeth (four of these contain as much calcium as a cup of milk)
Taste:	Nutty, with a hint of menthol
Tip:	Stir fry with oil and garlic
Protein (g per 100g):	21
Fat (g per 100g):	6
Carbohydrates (g per 100g):	5

Ants

Good for:	Growth and repair (they are a good source of protein and iron)
Taste:	A hint of smoky bacon
Tip:	Melt some chocolate and add these ants for a different kind of chocolate bar
Protein (g per 100g):	14
Fat (g per 100g):	4
Carbohydrates (g per 100g):	3

Mopani worms

Good for:	Growth and repair, as they are a good source of protein (3x more than beef)
Taste:	Salty, like chorizo sausage (and similar texture to tofu)
Tip:	Boil a cup of worms and add them to a curry with vegetables of your choice
Protein (g per 100g):	21
Fat (g per 100g):	9
Carbohydrates (g per 100g):	3

Mealworms

Protein (g per 100g):	20
Fat (g per 100g):	13
Carbohydrates (g per 100g):	7

Water beetle

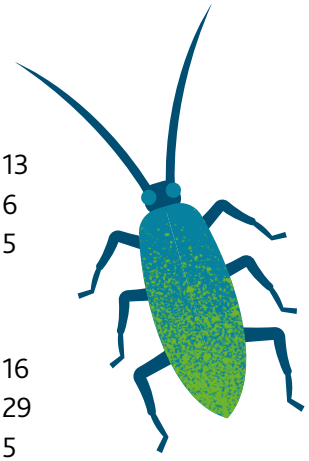
Protein (g per 100g):	16
Fat (g per 100g):	29
Carbohydrates (g per 100g):	5

Cockroach

Protein (g per 100g):	13
Fat (g per 100g):	6
Carbohydrates (g per 100g):	5

Witchetty grub

Protein (g per 100g):	16
Fat (g per 100g):	29
Carbohydrates (g per 100g):	5



FUN FACTS

1. Some insects can be almost 70% protein and have a high fatty acid content.
2. Farming insects requires significantly less water than farming cattle. With food and fresh-water shortages looming, bugs might just be the superfood we've all been waiting for.
3. There are many edible ants, and most of them have completely different flavours. Leafcutter ants (Atta spp.) in Colombia and Brazil taste like a mixture of bacon and pistachio nuts. The lemon ants (Myrmelachista schumanni) of the Amazon are so named because of their citrus taste.
4. Food science is the applied science devoted to the study of food. It is a discipline in which the engineering, biological and physical sciences are used to study, among other things, the principles of food processing, how to improve food for consumers, and health issues related to food.

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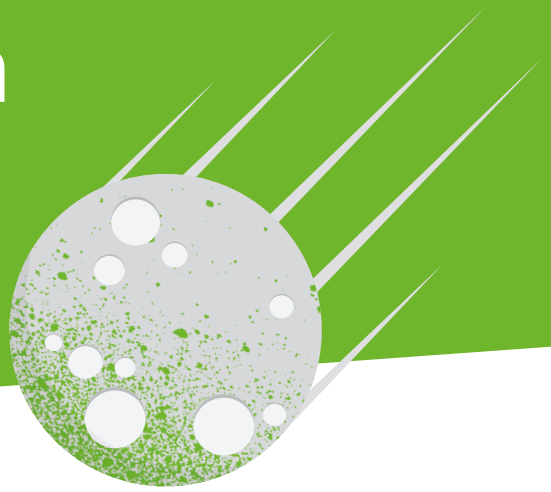

YOUR MENU:

Breakfast

Name: .....

Description of the dish:

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.....

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Nutritional value of the dish:

Total amount of protein (g): .....

Total amount of fat (g): .....

Total amount of carbohydrates (g): .....

Lunch

Name: .....

Description of the dish:

.....

.....

Nutritional value of the dish:

Total amount of protein (g): .....

Total amount of fat (g): .....

Total amount of carbohydrates (g): .....

Dinner

Name: .....

Description of the dish:

Nutritional value of the dish:

Total amount of protein (g): .....

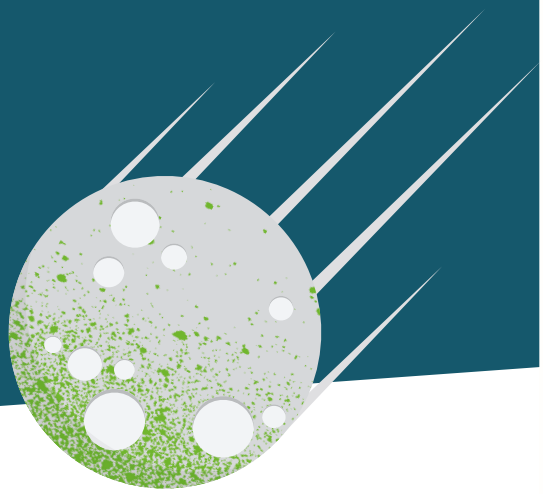
Total amount of fat (g): .....

Total amount of carbohydrates (g): .....

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

11 Get CREST Discovery Awards



By completing all nine activities in this resource pack, your STEM Club members can get a CREST Discovery Award.

ABOUT CREST

CREST is a scheme that inspires young people to think and behave like scientists and engineers. It is student-led, flexible and trusted. 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 DISCOVERY AWARDS

It's easy to get your members' Discovery Awards, simply:

1. Sign-up for a free account - https://my.crestawards.org/
2. Have each member complete a CREST Awards Discovery Passport
3. Create a project eg. "Asteroid Impact", "Desert Island" or "Zombie Apocalypse"
4. Upload names
5. Upload two or three passports and any accompanying work
6. Assess individuals, have they:
   a. Completed around five hours of work on the project?
   b. Participated fully in the project?
   c. Reflected on their learning?
7. Type in your delivery and payment details.

TAKING THEIR WORK FURTHER

If members want to take activities further, they can work towards a CREST Bronze or Silver Award.

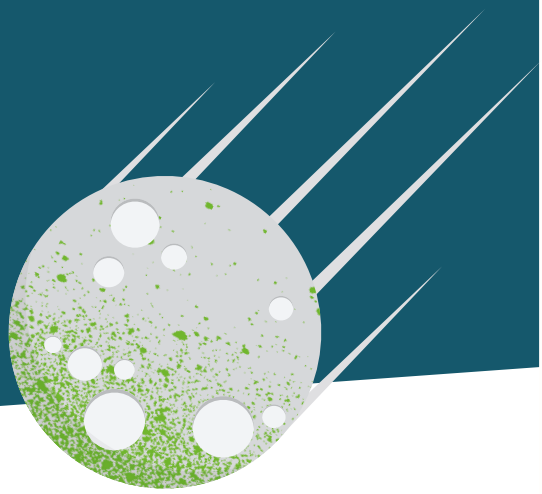
CREST Bronze Awards require around ten hours of enquiry, project-based work, and Silver Awards require thirty hours of work at GCSE or equivalent standard. Using one of the activities for inspiration, they choose a question or topic to investigate.

Guidance on how to run CREST Bronze and Silver Award projects is available on the CREST Awards website www.crestawards.org.

CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

Can you survive an asteroid impact?

10 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.

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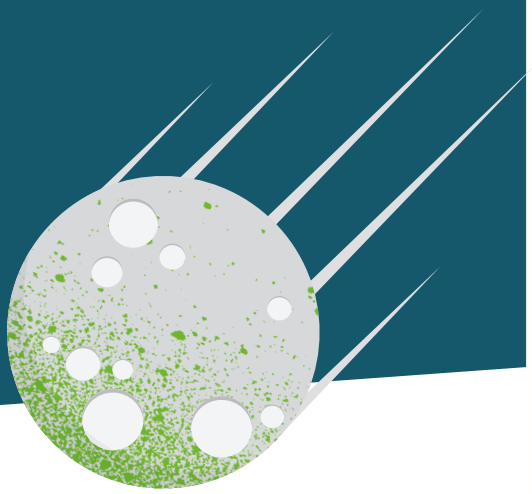
10 The Skills Builder Framework



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

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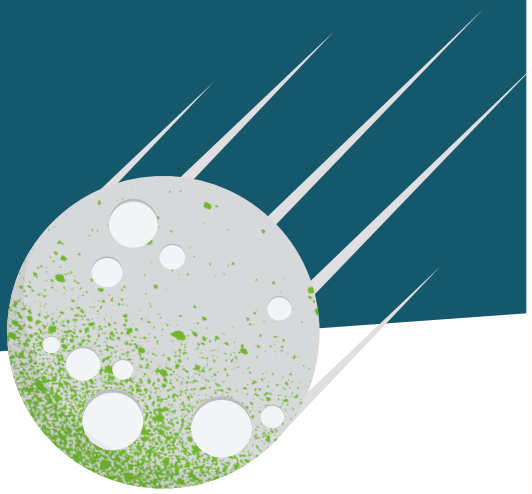
Can you survive an asteroid impact?

12 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.

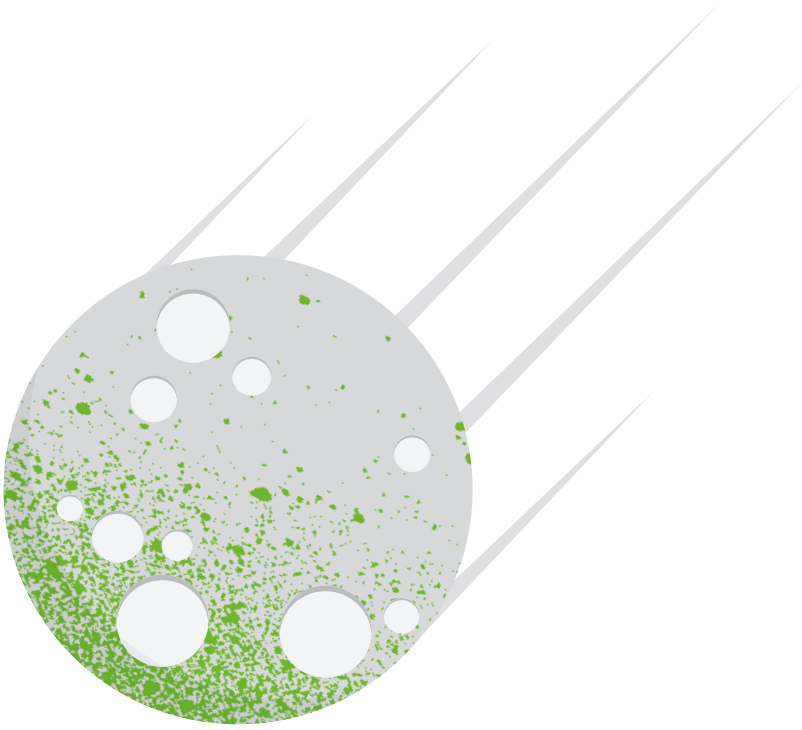
Within the guides opportunities are signposted, these aren't the extensive list. You may find alternative Digital Skill provision. Remember you know your pupils and what equipment and skillsets staff are equipped with. This could be a great opportunity to investigate staff CPD.

STEM CLUBS

NUMBER 1 FOR STEM

STEM Clubs Programme, led by STEM Learning

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**