



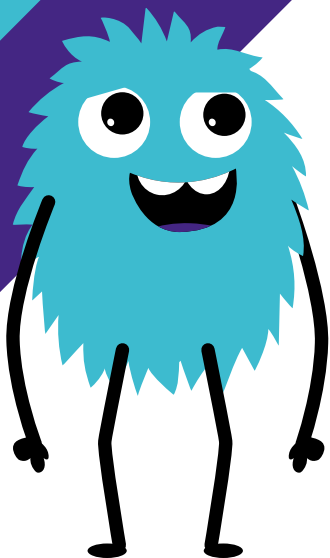
GROWTH

SECONDARY ACTIVITY PACK

11-20 March 2022

britishscienceweek.org

A range of activities to be run
with students up to the age of 14



Delivered by



Supported by



This activity pack is a one-stop shop to support you during **British Science Week**, and you can use it all year! Feel free to adapt or extend any of the activities to suit your students' needs or the curriculum you are delivering.

When developing this pack, we looked for activities which promote cross-curricular learning and break down the stereotypes surrounding science, technology, engineering and maths (STEM). We therefore encourage you to use British Science Week as an opportunity to link STEM to other curriculum subjects and to your students' own backgrounds, lives and interests.

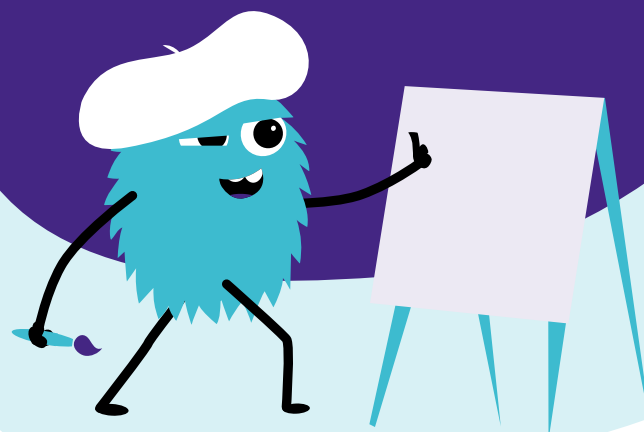
This year, we have included activities for students to complete in any setting, whether that's their school, a club, an organisation or at home with their families.

Find an activity near you

You can either create your own activity, or see what activities are happening near you. Last year we reached more than 100,000 people. Help us make British Science Week 2022 even bigger and better! Visit [sciencelive.net](https://www.sciencelive.net) 🌟 to find science activities in your local area.

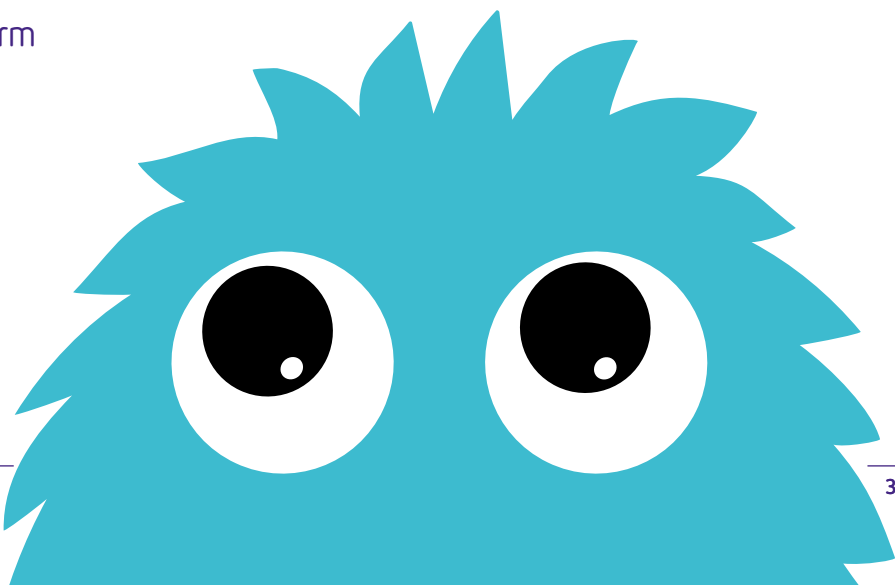
Enter our poster competition

Why not ask students to design a poster based on any of the activities in this pack and enter it into our poster competition? Simply look out for the activities marked with the paintbrush symbol shown opposite! The theme for this year's poster competition is 'Growth', and you can find more information on how to enter on **page 31** and at britishscienceweek.org/plan-your-activities/poster-competition 🌟.



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INTRODUCING THE THEME

The theme this year for British Science Week is 'Growth'! Introduce the theme to students in a fun, imaginative way to get them excited about the week ahead. Check out some ideas below:

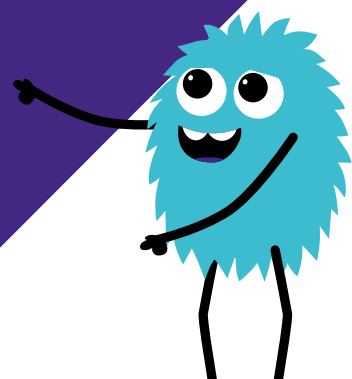
- **Share your brilliant activities, vlogs or images on social media!**
Join the conversation or see what's happening during the Week by tagging the British Science Association (@ScienceWeekUK ✨) and using the hashtag #BSW22.
- **Try a game,** give an audio-visual presentation, explore a mystery or special object, or create a pop-up display which communicates the theme of 'Growth'. These are great options to use as fun warm-up activities, and are a fantastic way to start British Science Week.

- **Encourage students to come up with an acrostic poem** for GROWTH by asking them what comes to mind when they hear it. You can even turn their acrostic poem into a jingle which you can sing with them throughout the Week to help them remember their ideas.
- **Engage students** by discussing how growth is part of people, plants, animals, materials, countries and other things in their everyday lives. What are good examples of growth?
- **Invite a special guest** or someone from the school community to share with students their own experience of growth (for example, how they started their career and gained their expertise), showing how great things can start from small beginnings. [See page 5 ✨](#) for information on how to get volunteers.

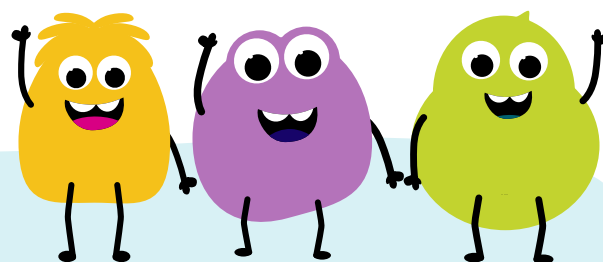
Here are some other ideas to include at the beginning of British Science Week.

- **Tell students about the plan for the Week** and give them a challenge related to the theme. If you are sending home a family experiment, maybe you could introduce or demo it at your setting first.
- **Growth is all around us.** What are examples of good and bad growth? Is there any way you can encourage conversations about this with students?
- **Launch the poster competition** and let parents know about this. [See page 31 ✨](#) of this pack for more details.

GROWTH



MAKING THE MOST OF VOLUNTEERS



While face-to-face engagement with external visitors is now possible, don't forget that there are still opportunities to get volunteers and presenters to engage with students online.



STEM Ambassadors are volunteers who offer their time and enthusiasm to help bring science and technology subjects to life, and to demonstrate their value to young people. It is now possible to request both in-person and remote STEM Ambassador support, meaning that Ambassadors from across the UK can inspire young people wherever they are.

Find out more and make a request for STEM Ambassador support at stem.org.uk/stem-ambassadors/find-a-stem-ambassador 🖱️.

You can also look for presenters and volunteers via *Science Live* (sciencelive.net 🖱️) or ask parents if they work in STEM-related jobs to describe what they do in more detail.

You could also try some of the following things.

➤ **Kick off British Science Week with a career talk** or demo from an inspiring volunteer to engage the students. The volunteer could highlight how they grew to be an expert in their field, or what significant contributions they have made to bring about that growth.

➤ **Schedule two or three different guests** for careers talks during the Week, if possible, to get students anticipating who the next guest will be and what they do. These sorts of experiences can inspire students to think about what they want to be in the future. Remember, they are never too young to explore their career options!

➤ **Where available, choose volunteers/ambassadors** who challenge stereotypes the students might have absorbed, and promote positive attitudes towards science, like female engineers. Let the volunteers/ambassadors share how their job is making

a difference in the world, or an anecdote about science activities they loved to do as a child.

➤ **Book your visitors early** (as many speakers get booked up during British Science Week). Have a clear idea of what you want them to do and communicate this with them ahead of time.

Volunteers come from a range of careers and experiences, from engineers, designers and architects to scientists and technicians, so get students looking forward to inspirational career talks which broaden their choices and develop their job interests!

Visit the *Inspiring the Future* website (inspiringthefuture.org 🖱️) for some helpful ideas for using volunteers, some of which may be transferable when using remote engagement.

BRITISH SCIENCE WEEK AT HOME

Do you want to help students carry on participating in British Science Week at home, but are not sure how? Here are our **top tips for engaging parents and carers with the Week.**

- **Make the most of parent newsletters,** the Parent-Teacher Association (PTA) and chat group and text messaging services if you have them. Let all the parents know at least a month in advance of the Week what you have planned, and how you'd like them to be involved. They might be able to collect or donate materials for use during the Week, and if you want them to get involved in any experiments at home they may need time to plan and collect materials themselves. The PTA may be able to support you financially to run activities during the Week or help to drum up parent volunteers.
 - **Get parents thinking** about how their own jobs might link to STEM subjects and encourage them to chat with their children about this. You could do this via a newsletter or send students home with activities they can do with their parents, which may then lead onto further conversations. (See page 11 🦋 for a great take-home activity.)
 - **Encourage exploring outdoors,** in the community or in local cultural spots. This could be anything from going on a nature walk around local parks, to spotting STEM in action on the streets around students' homes. Many of our CREST activities (collectionslibrary.crestawards.org/#11-18 🦋) are quick and easy to do as fun outdoor challenges too.
 - **Send an experiment idea home** during the Week to perhaps spark mealtime discussions around science. Try to make it as low-resource as possible. It can help if it's something the students have tried or seen at school first so that they feel like the 'experts' when they do it at home with family, allowing them to lead the learning. We have a range of science-based home activities requiring few resources in the CREST at home collection at collectionslibrary.crestawards.org/#11-18 🦋.
- In addition to this pack,** there are lots of other useful ideas for take-home activities from series such as this one from *The Royal Institution*: rigb.org/families/experimental 🦋.





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GATHERING RESOURCES FOR THE CLASSROOM OR HOME

- **If you can, try to collect materials all year round** that can be cleaned for use during British Science Week.

Alternatively, check to see whether there is a scrap shop/store/club open in your local area. These shops are often membership based and can provide a brilliant, inexpensive or free resource for card, fabric and other bits of material.

These things can be turned into rockets, cars, spaceships – you name it, the students will think of it! Look at childrensscrapstore.co.uk ✨ to find a UK directory of scrap stores.

- **Encourage students to take and share photographs** when out and about to foster discussion and raise their level of understanding about the growth of plants,

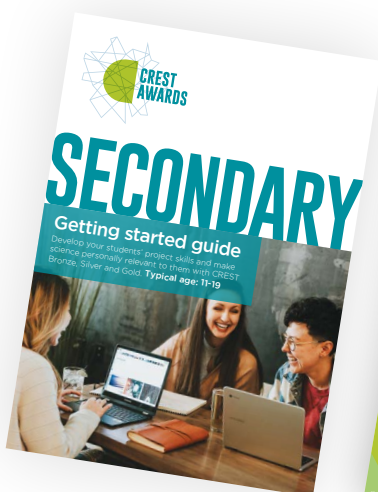
building structures and so on. The more colourful, the better!

- **Collect fiction books and reference books** around the theme of Growth to create a themed library.

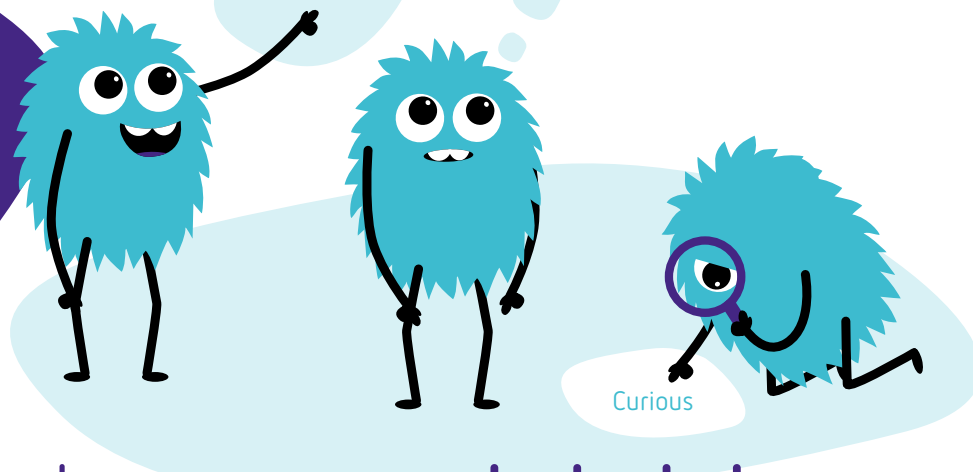


The exploration and curiosity don't have to end once British Science Week is over! Some of the following ideas could help you to expand the learning beyond the Week.

- Get students to take part in a CREST Award. CREST is a scheme that encourages young people to think and act like scientists and engineers. To achieve a CREST Award, students complete hands-on projects to suit their abilities, interests and age groups. Take a look at the secondary-level Bronze, Silver and Gold projects at secondarylibrary.crestawards.org 🚀
- Consider sharing your British Science Week learnings by running a Continuing Professional Development (CPD) session for other teachers in your school or, where relevant, academy chain. Think about incorporating the Science Capital Teaching Approach into your methods. Find out more at bsa.sc/UCL-science-capital-teaching-approach 🚀
- If you have the opportunity, consider running a STEM club or curiosity lab. You can find supporting resources at stem.org.uk/stem-clubs 🚀



UNLOCKING SKILLS



A fantastic way to **encourage students to take an interest in STEM** is to introduce transferable skills used by those working in STEM-related jobs.

These skills will strengthen positive attitudes and reduce stereotypes of those working in the field.

You could, for example, engage students in this *STEM Person of the Week* (nustem.uk/stem-person-of-the-week ✨) activity from NUSTEM at Northumbria University. Ask students to identify what attributes people working in STEM need. These might include being observant, creative, patient, good at communication, or curious. Look out for the skills set tags for each activity in this pack.

See the table below for the complete list of skills developed by NUSTEM to use as a talking point or to share with other teachers. Or, as a little bit of motivation, why not award each

of the students with a certificate for a STEM skill which they demonstrate very well during the Week?

Get students leading the way

A great way to encourage students' interest in STEM is by letting them lead the way. Here's how you can help them along:

➤ **Encourage students to run their own activities** during British Science Week. They could either run activities for other members of the class or run some CREST at home activities with their family, taking photos to present back to their class. Check out the CREST resource library (secondarylibrary.crestawards.org ✨) for inspiration.

➤ **Get students to run their own CREST projects** and then use them as inspiration for a mini science fair in class. We have lots of handy CREST resources at library.crestawards.org ✨.

➤ **Ask students to research** how growth has influenced the way we live our lives today, and then write a report for the school newsletter or website.

➤ **Encourage students to design and create their own display**, such as a display of scientists through time. This could be a photo exhibit that emphasises the diversity of scientists, and which helps to overcome the 'scientist in a white lab coat' stereotype.

Observant	Open-minded	Committed	Tenacious
Creative	Imaginative	Patient	Collaborative
Resilient	Communicator	Passionate	Organised
Curious	Self-motivated	Hard-working	Logical

FUTURE JOBS

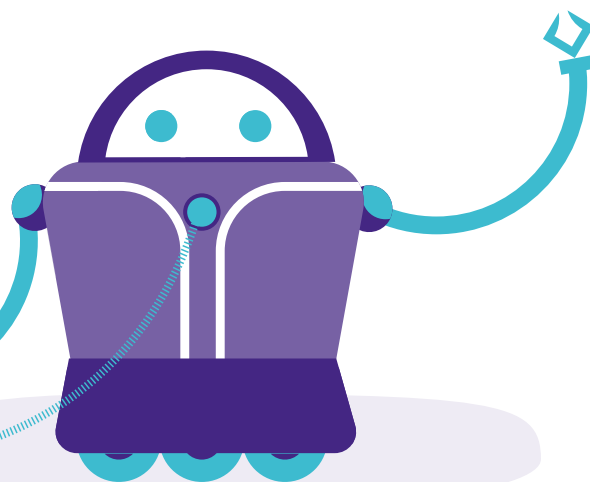


It is difficult to imagine a career sector which won't be affected by these major industrial trends: an **ageing society**, **artificial intelligence**, **clean growth** and **the future of mobility**.

In this activity, you will explore how one career sector might be affected by one or all of these global trends. You will make recommendations about the changes needed in your chosen sector which could possibly lead to the growth of new industries or technologies.

🕒 2+ hours

Skill set: Communicator, curious, self-motivated



Kit list

Computer (optional)

Internet access (optional)

Instructions

- 1 Select a career sector to focus on. Keep it broad rather than specific to a job. For example, you could choose healthcare, agriculture, construction, or TV and media – whatever you are most interested in.
- 2 Research your chosen sector. Find out what its purpose is, how many people are employed in this area, the latest technology being used and the impact of the sector on the environment. You could focus on a few key jobs and use a careers website to help you.
- 3 Consider how the global trends might impact on jobs and ask yourself some questions.
 - Will some jobs be replaced by machines?
 - What kind of environment will people work in?
 - If people are living longer and there are more older people, what problems and opportunities might there be?
- 4 Search for evidence to support your ideas. You could use scientific magazines such as *New Scientist* and *Wired* to search for relevant articles.
- 5 Ask your teacher to help you to contact someone in a relevant job who you can interview. Prepare a list of questions which will enable you to learn more about their current job and how they think it will change in future.
- 6 Reflect on what you have found out from your research and from your interview. Consider the following questions.
 - What are the new opportunities and challenges in this sector?
 - How do you think it will look in ten years' time?
 - What is the wider impact of your research? What changes do you think need to happen to help your chosen sector to prepare for the future?

Next steps

This activity can be put towards a **CREST Bronze Award**. For more information, go to crestawards.org/crest-bronze. 🚀

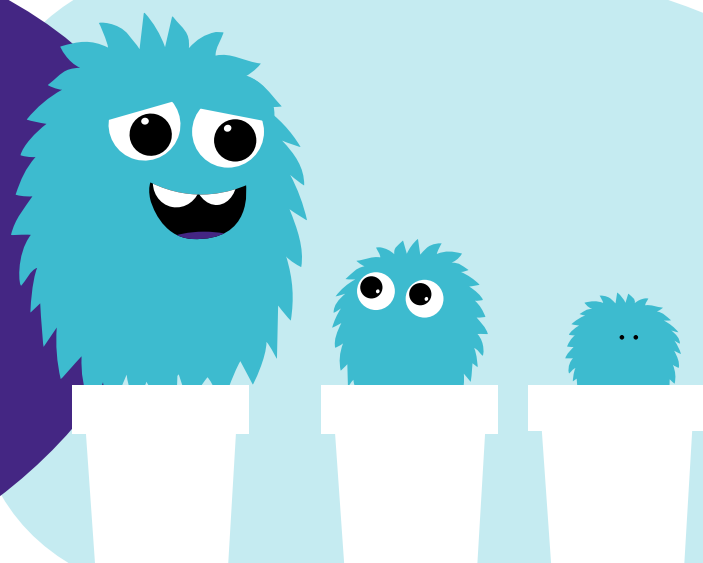
Take it home:

PLANT GROWTH AND NUTRIENTS

A plant's growth rate is affected by different factors like light, temperature, moisture and soil nutrients. In this activity, you will investigate how the nutrients in compost affect the rate of the growth of seedlings.

🕒 2+ hours

Skill set: Observant, organised, patient



Kit list

Seeds: radish or lettuce because they grow quickly

Seed trays

Soil

Compost

Propagator lid or makeshift propagator (optional)


Instructions

- 1 Prepare your seed trays with different combinations of compost and soil.
- 2 Plant your seeds in the seed trays, following packet instructions. Water them and place them in a well-lit location.
- 3 You can help the seedlings to grow by using a propagator lid to maintain humidity. Alternatively, you could use makeshift propagators such as a simple polythene bag inflated around the seed tray, or a plastic bottle cut in half to provide a close-fitting lid.
- 4 Ensure that the soil/compost in the trays remains moist – trays without covers will need regular watering.
- 5 Remember that you want your tests to be fair so make sure all your seeds are in the same conditions of light, temperature, moisture and so on.
- 6 Keep a daily record of the number of seeds that have germinated, plant growth, and observations about plant health such as colour and height. Decide what measurements to use as indicators of plant growth, such as plant height or the number and sizes of leaves.
- 7 You will need to make your measurements daily for about three to four weeks.
- 8 Choose at least two of your indicators of plant growth to plot as graphs to show how the different combinations of compost and soil affect plant growth.

Interpret your results with the following questions in mind.

- Did the results agree with what you expected?
- Was there a pattern to your results?
- Were your results consistent enough for you to be able to make a conclusion?
- Which of the different ways of measuring plant growth do you think was the most suitable? Why?

Watch out


Always complete a risk assessment before you start your experiment. Use the Student Safety Sheets available at science.cleapss.org.uk/Resources/Student-Safety-Sheets  to help you to assess the risks (i.e., think about what could go wrong and how serious it might be).

Make sure you pick soil samples that are not contaminated, such as those containing dog muck or broken glass.

Ensure you do not eat and drink in science practicals.

Always wash your hands thoroughly after handling seeds and soil.

Next steps

This activity can be put towards a CREST Bronze Award. For more information, go to crestawards.org/crest-bronze .



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WECOUNT FOR NET ZERO EMISSIONS

In this activity, you will explore proportion and graphs, as well as data collection, through the concept of climate change. You will interpret graphs, have a go at creating a net zero scenario for 2050 and draw graphs to represent traffic numbers on your (school) street. You will then discuss local actions that can be taken, based on the evidence.

🕒 60 minutes

Skill set Communicator, observant, organised



Kit list

Internet and computer access for all students

Paper to draw graphs and write

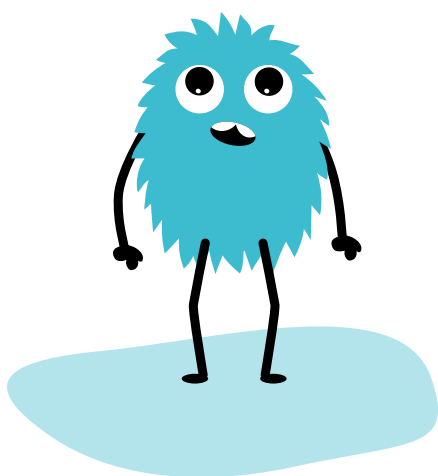


Instructions

- 1 Look at the graphs on the next two pages. Cover the answers to the left of the graph. What do these graphs tell us? Look carefully at the labels. Reveal the answers.
- 2 We need to create a behavioural shift away from cars, so that more people walk, cycle, scoot or take public transport. What type of information do we need to understand current road use and barriers to behaviour change?
 - What transport modes people take, and how frequently.
 - Where people use their car most, and for what type of activity e.g. shopping, work, education.
 - People's interests in taking alternative transport modes.
- 3 Digital sensors can help people to count transport, and car speeds, so that they can use this evidence to change certain behaviours. This is an example of Digital Engineering. Use the Telraam website ([Telraam.net/en](https://telraam.net/en) 🌐) to show active sensors. Zoom into one street and click more data, to show activity across a day, and a week.
- 4 Create a graph showing numbers of the different transport types you would expect to see on your (school) street over a one-week period. Think about the spread of different transport modes, and the days of the week and times of day that would be busiest and why. Once complete, explain your graph in a few paragraphs and present to the class. Are there any patterns among the graphs (e.g. high number of cars, low number of pedestrians, etc.)?
- 5 Create your future emissions scenario for 2050 here: bit.ly/my2050simple 🌐. First, reduce emissions in just the transport sector. Is this enough? Go back and make changes in each sector. Report on your results, explaining what decisions you have made to reduce emissions and capture carbon.
- 6 Record your ambition levels for each activity and then transfer it into this database to produce your graph: bit.ly/my2050complex 🌐. Report on results using mathematical concepts learnt in Step 1. Share your findings with the class.



>> WECOUNT FOR NET ZERO EMISSIONS



- 7 Discuss what you learnt from the scenario exercise. What can we do to reach the higher ambition levels for transport?

>> Next steps

- Further lesson plans are available from the WeCount or DETI websites below.
- By completing this lesson your school could be working towards Modeshift STARS accreditation. Find out more and sign up at modeshiftstars.org/education ✨.
- WeCount was a Horizon2020 funded citizen science project under grant agreement 872743. Find out more at we-count.net ✨.
- Next week, conduct a traffic survey for real. Either count manually throughout the week, or buy the kit for a Telraam to digitally count. Find out how here: bit.ly/WeCountSchools ✨.

🏠 At home

- Now you are aware of these issues, and the impact your/our school street is having on emissions, do you want to do anything about it? Who else is responsible for these changes? What changes do you think would be accepted by the residents/road users?
- Complete some graph exercises on growth and decay.

>> Career options

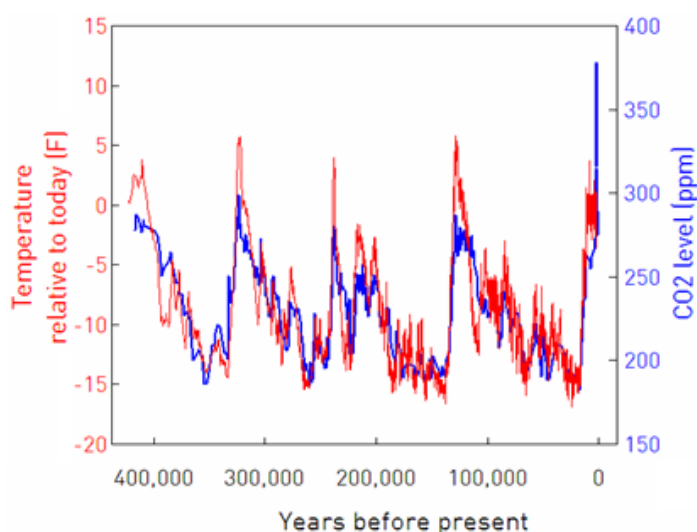
The initiative for Digital Engineering Technology and Innovation (DETI) aims to show how digital technology can be used to engineer a better world. Find out more at: digitaltrailblazers.co.uk/about ✨.

WHAT DO THESE GRAPHS TELL US?

Documenting climate change over time

- Temperature increases in line with atmospheric CO₂ concentrations. There seems to be a cyclical pattern every 100,000 years. However, in the last 100 years or so, temperatures and CO₂ levels have increased exponentially.
- Exponential means a rapid increase (growth) or decrease (decay) in the value of something. Exponential growth is expressed as $y = 2^x$. Y represents the y-axis, and x the x-axis. Add a minus before the x if it was an exponential decay.

Read more here: <https://bit.ly/tempco24000> ✨.



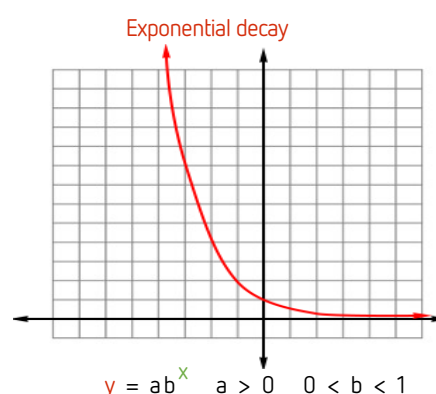
>> WHAT DO THESE GRAPHS TELL US?

Exponential decay

Examples of increase can include annual growth of:

- Money invested in a savings account with 2% interest, or the spread of infectious disease, like COVID-19.
- Examples of decay could be the annual decrease of a city population due to heavy pollution.

Test out the pollution example with your class by walking through these steps: bit.ly/expodecay

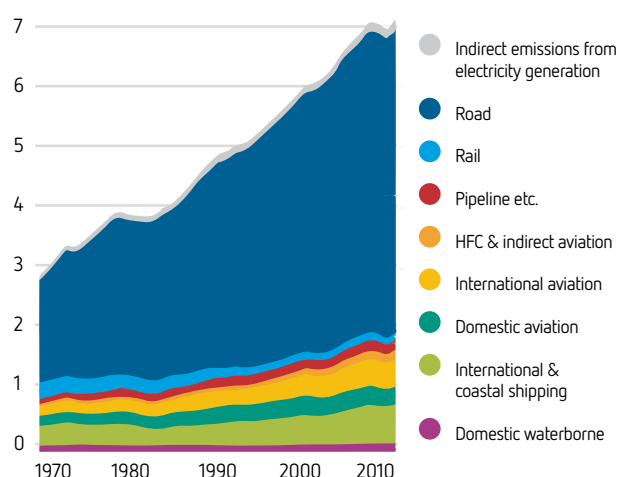


Where do transport emissions come from?

- This graph shows us that each year, transport emissions are increasing. However, road transport is increasing the most. What is the relationship?
- Answer: directly proportional. It is not exponential, but there is a significant increase over time.
- Can this keep growing? In theory, yes, but in terms of protecting the planet, no.

Did you know, transport is the largest emitting sector of greenhouse gas (GHG) emissions, producing 27% of the UK's total emissions in 2019.

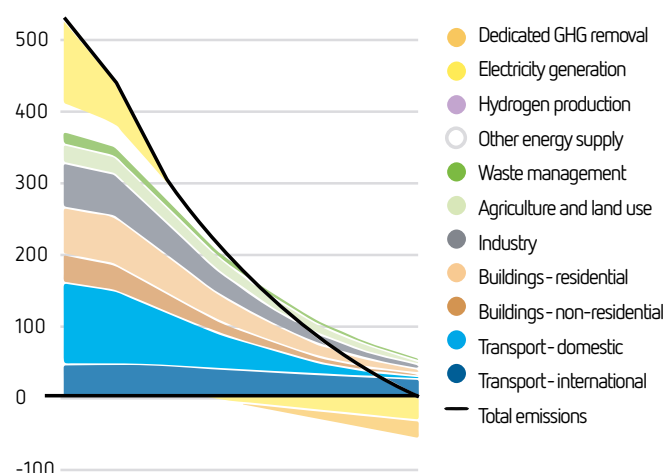
Read more here: bit.ly/emissionstransport



Greenhouse gas emissions by sector

- The graph shows how the UK could look in the future, giving an indication of the type of reductions we need to make. You can see that the biggest reductions need to come from transport.
- Specifically, it shows us what reductions we need from each industry sector to reduce total GHG emissions from its current level of 500 million tonnes CO₂ equivalent per year to Net Zero by 2050.
- Net zero means achieving a balance between the greenhouse gases we put into the atmosphere and those taken out (e.g. through tree planting).

Read more here: bit.ly/uknetzerograph



Summary

CO₂ and temperatures increase and decrease in a cyclical pattern every 100,000 years, however the pace of increase in the last 100 years has been exponential.

Emissions from transport are increasing significantly each year, suggesting it has a large bearing on the exponential rise we are observing. We need to reach Net Zero to prevent warming above 1.5

degrees, which could lead to runaway climate change. Some cities have pledged to reach Net Zero by 2030 – this would mean reducing the cars on our roads by 40% over the next decade.

GDP GORILLAS

Economists and politicians talk about economic growth all the time. Growth is normally seen as the ultimate goal of an economy. But is growth (measured by an indicator known as GDP) always the best way to assess our economies? In this activity, we will look at what this economic measure misses out on.

🕒 30+ minutes

Skill set Communicator, curious, collaborative

📦 Kit list

Access to a computer

Activity handout plus slides on *What is economic growth?*

ecnmmy.org/scienceweek2022 🌟

Optional prize for step 1

📖 Instructions

- 1 Test how good your attention is in a quick experiment! Watch the video 'The Monkey Business Illusion' youtube.com/watch?v=IGQmdoK_ZfY 🌟 while concentrating. Ensure you understand the instructions before you start! It can be fun to do this as a competition.
- 2 Did you spot the right number of passes? What did you think about what else happened?

Read through the slides

'What is economic growth?'
ecnmmy.org/scienceweek2022 🌟

Think:

- Why do you think we showed you this experiment?
 - What have you learned about how we pay attention to the economy?
- 3 Now watch another video 'Two monkeys were paid unequally' youtube.com/watch?v=meiU6TxysCg 🌟. Make sure you watch right to the end.
 - What was the effect of inequality shown in this experiment?
 - Does this seem important for society?
 - 4 Inequality and environmental damage are two examples of things that economic growth can distract us from. Read more about the issues on your handout.

5 Discuss:

- How much do these issues matter to you?
- Considering the 'GDP Gorillas', would you agree that economic growth is the best way to measure our economy?
- Can you decide as a group which out of the two is the most important issue? Or are both GDP Gorillas just as important as the other?

🗨️ Watch out

Make sure you're considerate of other people's views and arguments, and listen carefully to what others are saying. This activity shows just how important it is that we have a diverse set of opinions and viewpoints in economics.

➡ Next steps

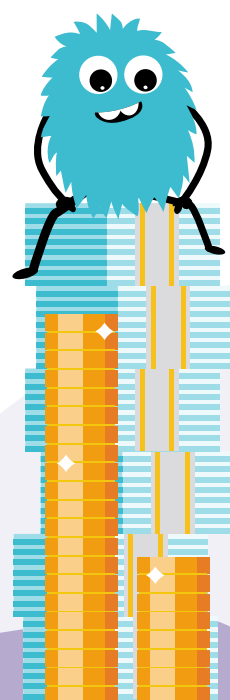
- Watch this video of a speech by a politician criticising economic growth as a way to measure the economy: cusp.ac.uk/themes/aetw/rfk-gdp50 🌟
- How did you feel while watching? Do you agree? Film your own speech and Economy will publish the best - see ecnmmy.org/scienceweek2022 🌟

🏠 At home

GDP doesn't help us measure the value of any work done for free, for example in the home. Try noticing the value of the 'services' in your home, for example, how long it takes to go grocery shopping and cook dinner. What do you think this is worth?

➡ Career options

Economics might seem like it's about money and maths, but actually it's much more like a conversation about what's fair and our future. Talking about how we measure the economy can help you become a local MP, politician or policy maker. Considering multiple viewpoints is essential in every career.





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PLANTS ON MARS: BUILD AN AUTOMATIC PLANT WATERING SYSTEM

In order for a mission to Mars to be successful, the astronauts will need to be as self-sustaining as possible. This includes recycling resources and growing their own food. In this activity, you will develop a system which would allow a computer to remotely monitor the welfare of a plant, and water it automatically.

🕒 3 hours

Skill set Logical, imaginative, tenacious

📦 Kit list

- Computer
- Arduino
- Breadboard
- Circuit cables
- Micro servo motor
- Humidity sensor
- Bottle
- Blu-tack
- Cable ties
- Watering tube
- Bucket
- Potted plant

📖 Instructions

- 1 This activity has detailed instructions found here stem.org.uk/system/files/elibrary-resources/2019/10/Plants%20on%20mars.pdf 📄
- 2 You may need to create an account to access the link.
- 3 Following the steps from the link, you will explore technology used in space through the Arduino tool. You will build an automatic watering system that measures soil humidity and waters a plant accordingly.
- 4 When you have finished, think about:
 - How could the system be developed to be an inclusive, autonomous system capable of monitoring and keeping plants healthy in a Martian environment?
 - Is there anything unique about the environment on Mars that we need to take into account?
 - Are there any other concerns with a mission to Mars?

⚠ Watch out

- Ensure you have a bucket to collect any water.
- Keep water and electronic devices at a safe distance.

➡ Next steps

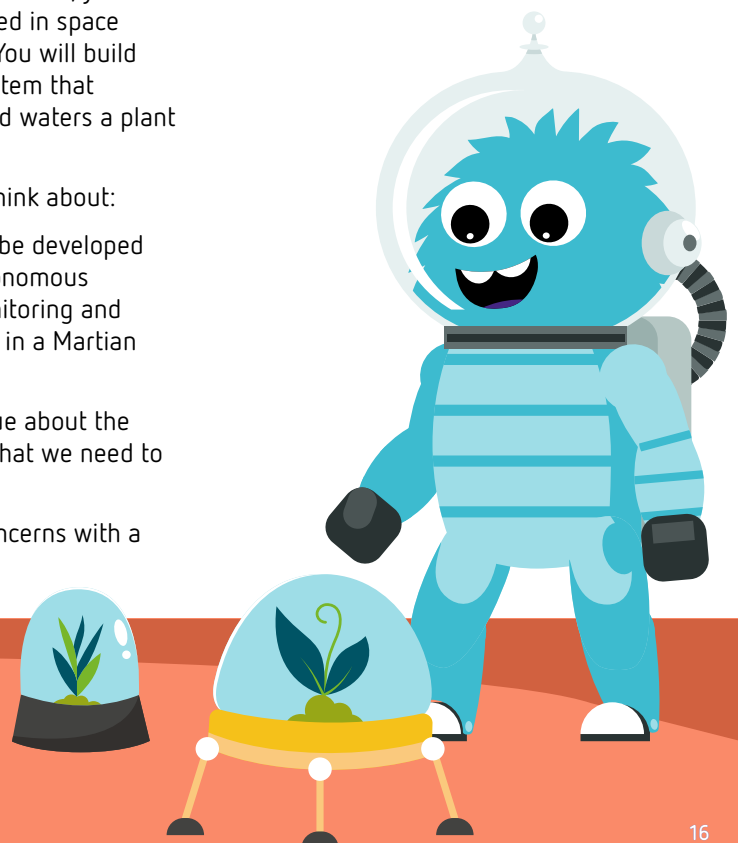
Meet Arduino! More Arduino activities from ESA esamultimedia.esa.int/docs/edu/T04.1_Meet_Arduino_C.pdf 📄

🏠 At home

Watch 'The Martian' movie to find out the unusual way Matt Damon's character astronaut Mark Watney grew his own food!

➡ Career options

You can explore your options from being an astrobiologist, a computer scientist, to an electrical engineer, or even a programmer.





BRITISH
SCIENCE
WEEK
2022



DREAMACHINE: SEEING WITH OUR BRAIN

This starter activity is linked to Dreamachine, an artwork exploring the power of our minds and how we see and experience the world around us differently. Our brains use rules and guesses to inform us what our growing bodies sense. This optical illusion, known as the Ames Window, plays around with the brain's knowledge of perspective.

🕒 30 minutes

Skill set Creative, curious, open-minded



Kit list

A4 paper

Trapezoid window
template

Thick A4 card

Scissors

String

Hole punch

Sticky tack or tape

Glue

Pencil or paper straw

Ruler

Colouring pens

Optional:
phone or tablet

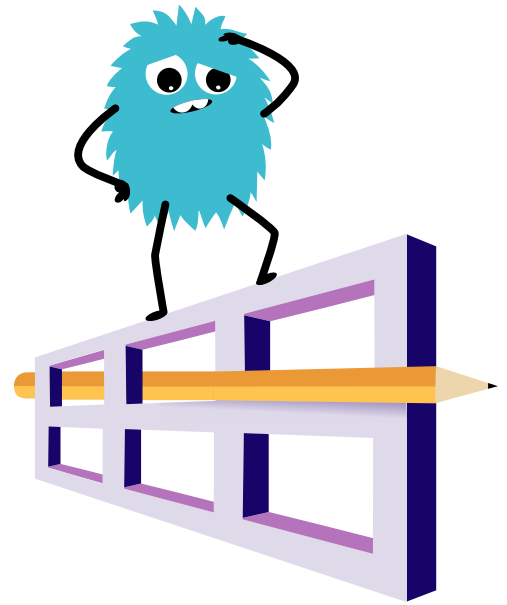


Instructions

- 1 Print or trace the window template on the next page twice. Glue to a thick card so it is the same on both sides then cut out.
- 2 Attach string to each corner of the window and hang it in front of a plain wall.
- 3 Make the window rotate by winding the string and letting go.
- 4 Stand far back and watch. Try looking with one eye closed or filming it.
- 5 The window is spinning 360° but to most people it looks like it is oscillating and changing direction! Although the window looks rectangular at a distance, it is really a trapezoid. If two things are the same distance away, but one is larger, the brain often guesses that the larger object is closer, even if it isn't.
- 6 Attach a pencil so it is inserted through one of the window holes and spin again. The pencil cannot really be passing through the window and turning in a different direction...so why does it look like it is?
- 7 Why do you think our brains make guesses about what we see?
 - Does this make you think that what you see is unique to you?

dreamachine

LEARNING
UNBOXED
CREATIVITY IN THE UK



- Might we never see the world the way it really is?
- How do you think this might relate to other ways you encounter the world?



Watch out

- Be careful when cutting out the centre holes of the window.
- Make sure you find a safe and stable place to hang your window, such as a doorframe, table edge or securely attached wall shelf.



Next steps

- This is just for starters! Explore a range of optical illusions and perception explorations through the Dreamachine resources, a major schools programme for 2022 focused on our sense of self, how our brains help us perceive the world and how we connect to others.
dreamachine.world ✨
- Check out illusionsindex.org ✨ for more illusions.



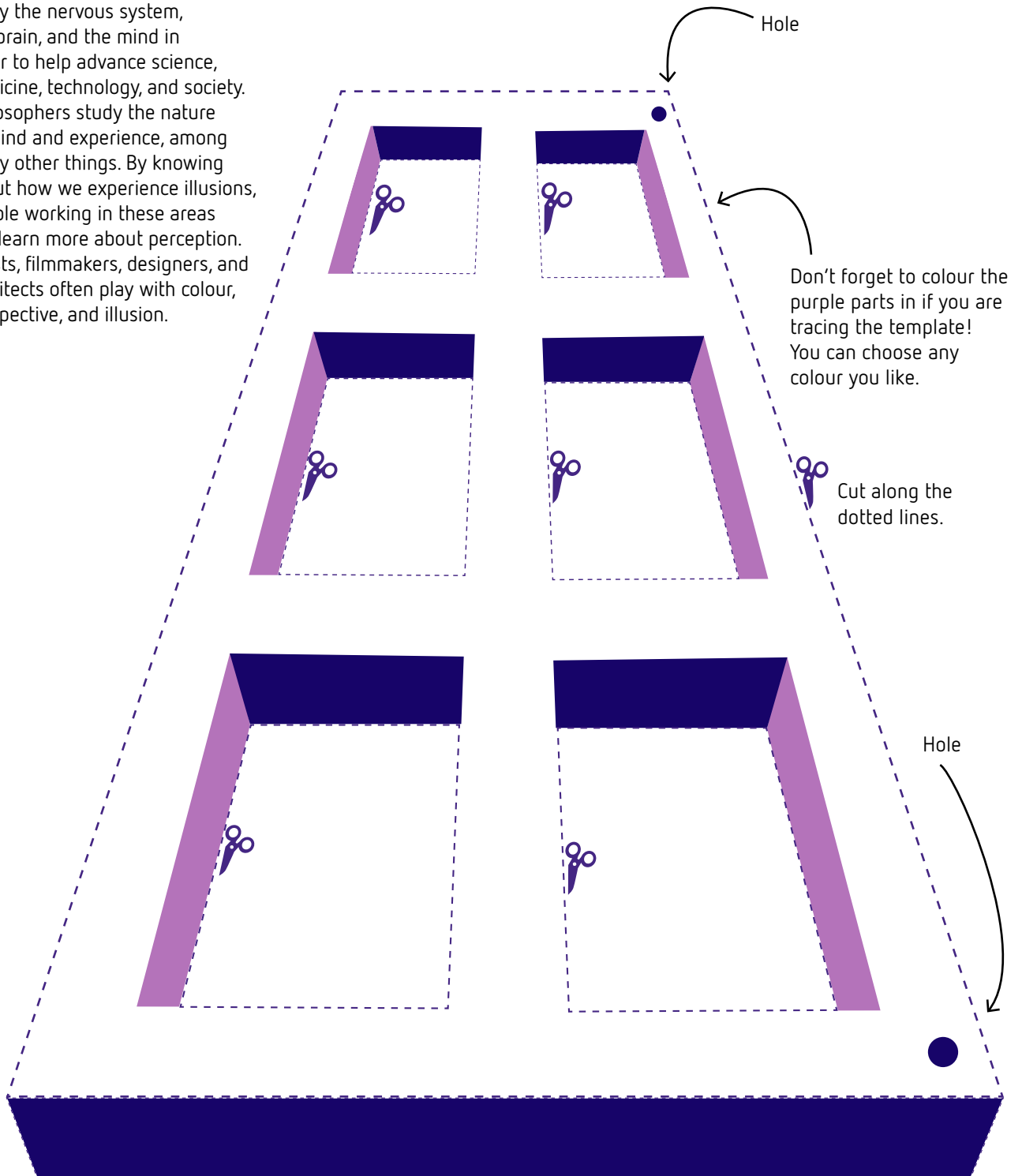
At home

Show family and friends the illusion. Does everybody see the same thing? Ask each other about why some people see things differently to others. What other examples does it make you think of?

>> DREAMACHINE: SEEING WITH OUR BRAIN WINDOW TEMPLATE

>> Career options

Neuroscientists and psychologists study the nervous system, the brain, and the mind in order to help advance science, medicine, technology, and society. Philosophers study the nature of mind and experience, among many other things. By knowing about how we experience illusions, people working in these areas can learn more about perception. Artists, filmmakers, designers, and architects often play with colour, perspective, and illusion.





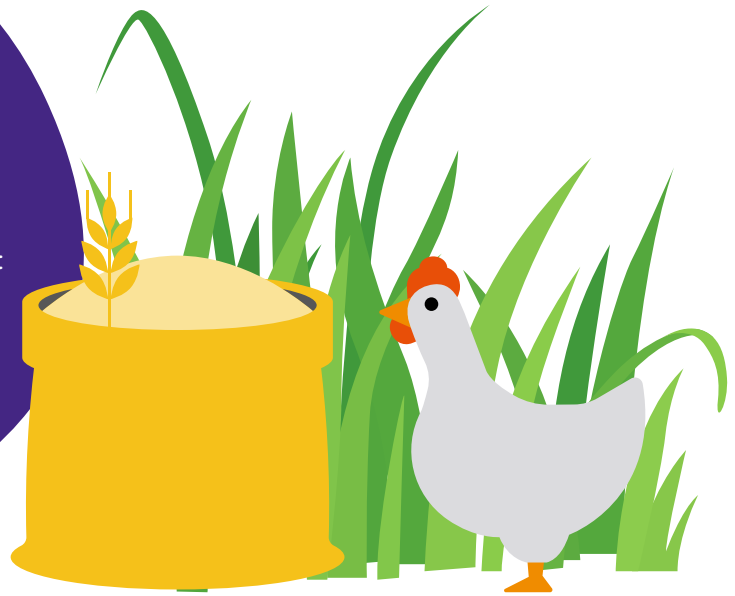
BRITISH
SCIENCE
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2022

CONSCIOUS CONSUMERS

As humans, our food choices have massive effects on habitats of animals and plants. Humans represent just 0.01% of all living things, but we've caused the loss of 83% of wild mammals and half of all plants through farming, logging and urbanisation. In this activity, we will rethink our place in the food web!

🕒 30 minutes

Skill set Creative, curious, open-minded



📦 Kit list

Pens

Paper

Colouring pencils/
pens

Computer/laptop/
tablet/phone with
internet access

📖 Instructions

- 1 Look at the facts on the next page to see how much human food choices shape which species are most dominant on Earth.
- 2 Now it's time to take the plant food web challenge!
- 3 Draw three menu boxes like the examples on the next page to create a menu for the day.
- 4 Use the species levels in the food chain table to see how you score on the food chain and on the number of plants you eat.
- 5 Go online for recipe ideas to maximise your plant score. If you choose meat or fish ingredients, investigate what they like to eat!
- 6 There's an extra bonus for eating a bigger range of coloured plants, so add colours to your boxes to represent the colours in your meal!

The Conscious Consumers project was designed for the Food and Farming Discovery Trust by: The SAW Trust, LEAF Education, and Youth STEMM Award.

The Conscious Consumers project was funded by: Chadacre Agricultural Trust.

➡ Next steps

Build your understanding of our impact on the planet by checking out the Conscious Consumers resources to delve deeper into the topics of food miles, plant-based diets, personalised nutrition, animal welfare, climate change and rewilding. It's very complex but the choices we make as consumers can make a difference!

ysawards.co.uk/2021/10/22/1228 ✨

🏠 At home

Why not dust off your cookery skills and put your menu to the test! Could you eat 30 different plants a week?

➡ Career options

Feeding a growing population while limiting the impacts of climate change, protecting biodiversity and improving human nutrition requires scientists from different disciplines to work together with farmers to find sustainable solutions. From ecology, computer modelling, robotics, biology, engineering, agriculture and economics, there's a wealth of opportunities for creative individuals!



>> CONSCIOUS CONSUMERS ACTIVITY SHEET

In this table, species in a simple food chain or web are given a position based on their diet.

The Food Chain table

Level 1 Producers who make their own food (**plants, algae**)

Level 2 Herbivores who eat plants (**primary consumers**)

Level 3 Carnivores who eat herbivores or their products – eg, milk (**secondary consumers**)

Level 4 Carnivores who eat other carnivores (**tertiary consumers**)

Level 5 Apex predators have no predators (**at the top of the food chain**)

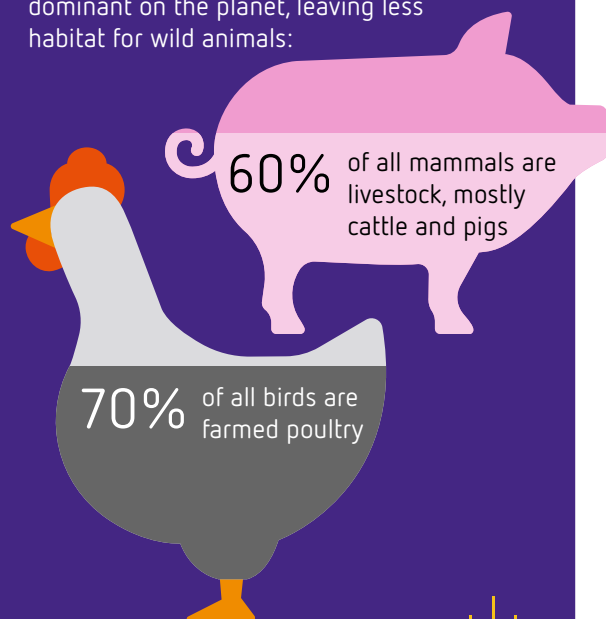
Omnivores

eat a truly mixed diet putting most of them in **Level 4** but with the ability to eat plants & animals.

Eat a typical diet in the UK and you are closer to pigs in the food chain than lions!

Fact 1:

As consumers of meat, we have shaped which animals are most dominant on the planet, leaving less habitat for wild animals:



Fact 2:

There are ~400,000 plant species on Earth, around 300,000 of which are edible...



To feed a growing population and help wild plants and animals survive we need to think about our diet! Eating more plants can be excellent for our health. Some people are championing the challenge to eat 30 different plants a week!

Plant food web challenge



Breakfast

Orange juice, cornflakes, milk, banana

Food chain levels: 2/3

No of plants: Three



Lunch

Chicken, mayo, lettuce, tomato & cucumber sandwich

Food chain levels: 2/3/4

No of plants: Four



Tea

Vegetable curry & rice (red onion, pepper, carrot, courgette, garlic & aubergine), strawberries

Food chain levels: 2

No of plants: Eight



BEAN HERE, DONE THAT, GOT THE LEAVES

We know that when seeds germinate they grow roots and shoots, but which do they grow first? Do seeds from the same batch all grow at the same rate or is there variation? Does each seedling grow at the same rate or do they grow more during hours of daylight?

🕒 20 minutes

Skill set Curious, observant, patient



⚠ Watch out

- Don't be tempted to use garden soil as a substitute for the compost as it may be contaminated with animal droppings.
- Wash your hands thoroughly after handling compost and beans.

🧰 Kit list

Transparent beaker glass or clear plastic such as for drinking cups (these can be re-used many times)

Paper towels

General purpose compost

Beans – sold as seeds

30cm rulers

Tablet/smartphone (optional)

i Instructions

- 1 Fold the paper towel to form a cylinder that will fit vertically into the beaker. It should fit snugly. The top of the cylinder should align with the top of the container.
- 2 Fill the centre of the cylinder with compost.
- 3 Now take two or three beans and insert them between the paper towel and the beaker so they are about halfway down. They should be clearly visible and held in place.
- 4 Water the compost but don't let it become waterlogged.
- 5 Label the beaker and leave it in a sunny place. Observe changes over the next couple of weeks.
- 6 Observe and record changes including lengths of roots and shoots. They could be photographed (include a ruler in the shots).
- 7 Compare the seedlings and consider the variation.
- 8 Graph the data against time and decide if the growth rate is constant.

➤ Next steps

Variation is an important idea in Science at KS3 (and beyond). The Collins KS3 Lab Book has details of a range of experiments, including another one on variation in seedlings.

🏠 At home

- Think about how you could make a timelapse video of the seedlings growing.
- Research the term 'tropism' and consider how the seedling knows the direction the root should grow in.

➤ Career options

Horticulturists have a strong interest in understanding how plants grow and how to get the best crop. Plant breeders study the characteristics of plants and breed new varieties to develop desirable traits. Plant geneticists are interested in variation amongst similar plants. Variation is important to enable plants to respond to changing conditions.



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EVERYTHING'S CONNECTED

All living organisms are social creatures. Whether living alone, in family groups or existing as part of a supercolony, we all rely on, and are impacted by, interactions with other organisms and our environment. In this activity you'll explore these connections, grow and map new ones, and uncover your own ecological networks.

🕒 30 minutes

Skill set Collaborative, logical, open-minded



Kit list

Paper

Pens

Pencils

Ruler

String or twine

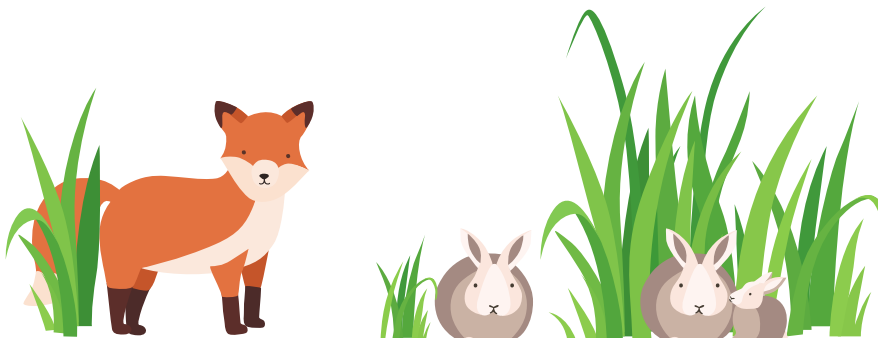
Blu-tac

Optional: Thumbtacks
and a corkboard



Instructions

- 1 Let's begin with simple interactions. All animals need food to survive whether they're hunting, foraging, or growing it themselves. These differences impact ecological networks in different ways and determine how the biodiversity of an ecosystem will grow and change over time.
- 2 Think of three animals, an interaction each has with its environment, and the subsequent impacts on their ecological network. Map these relationships on paper or use twine to build a physical ecological web.



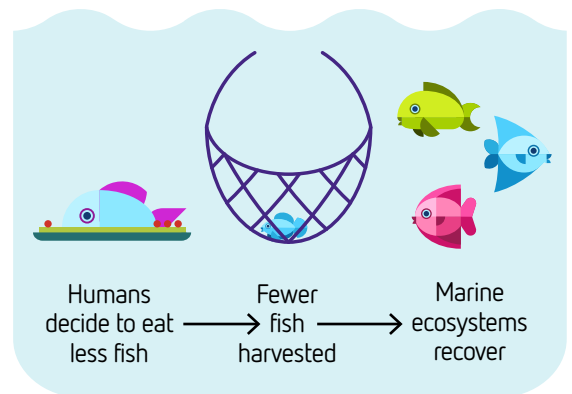
Foxes
eat rabbits

Rabbit
population declines

Plant growth
increases,
supporting larger
rabbit population
next year

Leeds Museums
& Galleries

- 3 Humans make lifestyle choices not directly tied to our survival, allowing for more complex communities, but also more complex impacts on the ecological networks we belong to.
- 4 Consider interactions at an individual level, community level, and species level, mapping the networks like before, to explore how the growth of our own communities impacts the growth of our planet's biodiversity. Can you discover how interactions link together to form larger webs, or even loop back on themselves?



Watch out

Ecological interactions and impacts make good discussion topics. Avoid conflict by listening to other people's views, being understanding and allowing real learning to flow.



Next steps

You can learn all about how animal lifestyles inform ecological networks, create feedback loops and affect community growth by going to [MyLearning.org](https://www.mylearning.org) and searching for 'ecology'.



Career options

If you enjoy nature and have keen interest on the relationships between living things and their environment, you can pursue a career as an ecologist or a research scientist.

CLIMATE CHANGE CAREERS

Did you know that as climate change is escalating, the demand for careers that are helping to fight it is also growing? Many universities now offer degrees in environmental sciences and many career routes now include options to help protect the environment. In this activity, you will find out more about jobs in the environmental sector that you might enjoy, from renewable energy engineering to sustainability management.

🕒 30 minutes paper activity +
30 minutes to discover more on the webpage

Skill set Committed, passionate, tenacious

Kit list

Pen

Pencil

Internet access

Instructions

- 1 Think of climate change causes, effects, and solutions. How is climate change affecting the planet? Fill in the mind map on [page 24](#) and add your ideas.
- 2 What careers might support fighting climate change? There are some examples shown in the word cloud on [page 25](#). Pick three that sound interesting, then research them using the websites below and fill in the table on [page 25](#).

Some careers are in well-established jobs, for example an engineer that specialises in developing cars that produce no CO₂ emissions (a clean car engineer). Whereas, some careers are in totally new areas, such as conservation science.
- 3 Think of your own strengths, skills, interests and qualities that would help you choose a career you enjoy and thrive in. Have a look at the examples listed on [page 24](#) and circle the ones you think apply to you. There's space to add your own if you'd like to. What do you need to do to achieve your goals? Fill in the table with your thoughts and ideas.

Next steps

Make Happen is part of the Office for Students' Uni Connect programme, unlocking opportunities for young people by helping them make informed choices about their education and future. Make Happen brings schools and colleges in Essex, UK together with universities and other local educational partners to raise awareness about higher education, and to help them support their students.

At home

Discuss one of the jobs you learned about with your friends, parents and carers. Are there any other jobs in the word cloud that they haven't heard of before?

Career options

Think of what YOU are interested in and the positive impact your career can have on the world!

It's ok if you haven't discovered what career path you'd like to follow yet, but hopefully this activity will give you some inspiration. Exploring careers is a long-term activity, it takes time to explore your strengths and understand your goals. As you are searching, think about what sounds interesting to you, and if you would enjoy using the skills involved in each job.

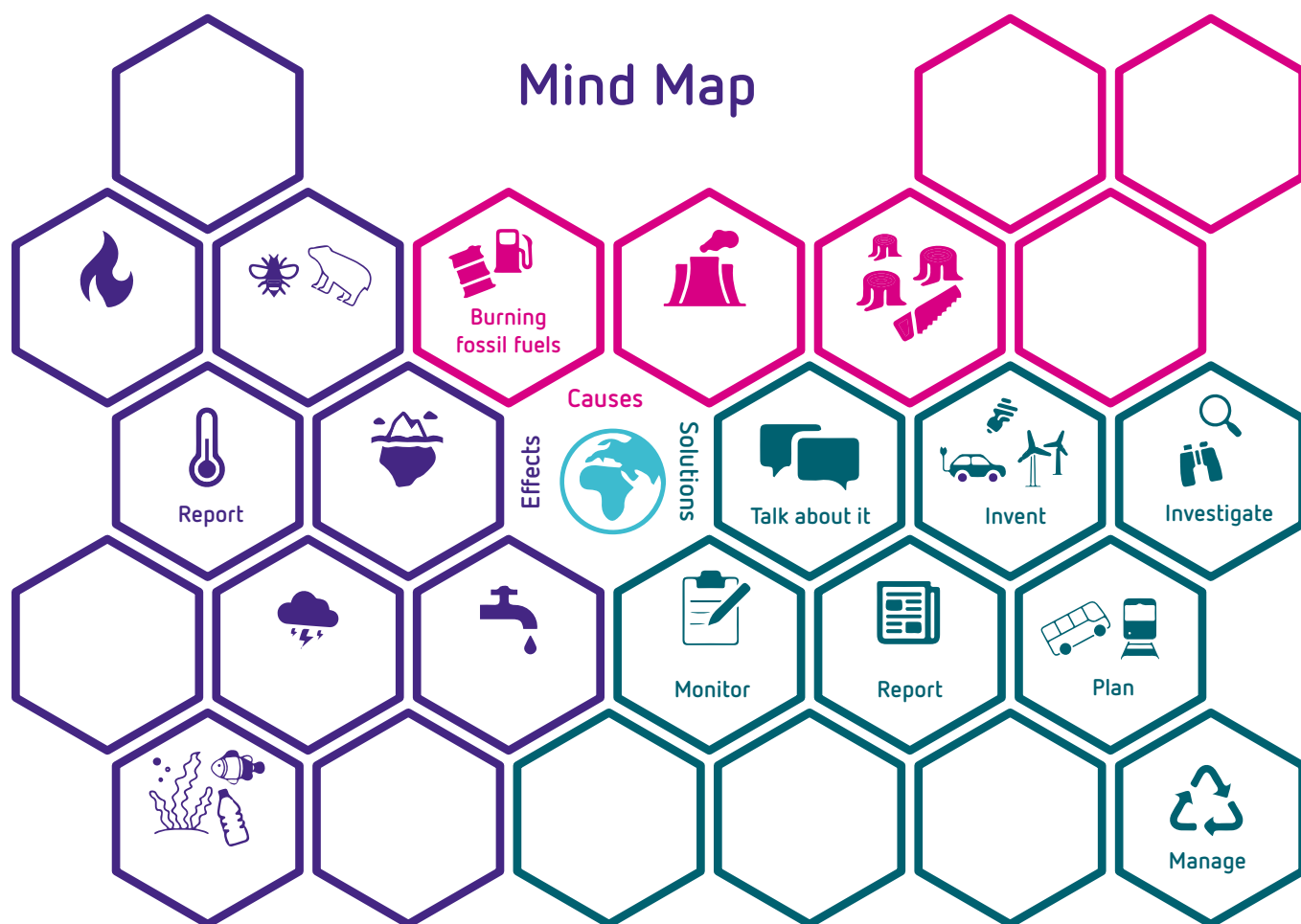
You can find information about different jobs and careers on websites such as: prospects.ac.uk/job-profiles

ucas.com/explore

ucas.com/further-education/find-career-ideas

makehappen.org/guides/british-science-week-2022

>> CAREER AND CLIMATE CHANGE ACTIVITY SHEET



Your strengths, skills and interests

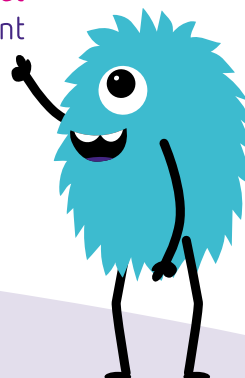
teamwork kindness ambition time management
 creative thinking report writing helpfulness resilience
 problem solver good listener caring curious
 well organised communicative experimental dedication
 open minded planning logical researching sources
 reasoning design negotiating attention to detail
 investigating constructing an argument debating
 calm under pressure positive attitude leadership
 friendly self motivated reliable independent

Your career goals

Steps to take in order to achieve your goals

CAREER AND CLIMATE CHANGE ACTIVITY SHEET

Zoologist
Clean car engineer*
Water engineer Quarry manager
Environmental lawyer Minerals surveyor
Agronomist Environmental health practitioner
Nature conservation officer Bioclimatic architect
Marine biologist Environmental education officer
Horticultural consultant Forester Farm manager
Ecologist Commercial horticulturist Town planner
Water quality scientist Geophysicist Civil engineer
Amenity horticulturist Plant breeder Site chemist
Sustainability and Climate Change Manager Vet
Climatologist Soil scientist Flood risk consultant
Environmental engineer Conservation scientist
Transport planner Sustainability consultant
Geomatics surveyor Oceanographer
Environmental Campaigner
Mining engineer
Energy engineer
Recycling officer
Hydrologist



Title: Bioclimatic architect

Purpose: To design buildings in harmony with natural surroundings and use of means like solar radiation and air flow for heating and cooling.

Some day-to-day duties:

- Produce detailed workings, drawings and specifications
- Specify the nature and quality of materials required
- Keep within financial budgets and deadlines
- Assess the impact on the local environment

How to get it: Through studying to become an architect at university, or an architecture apprenticeship. Alternative routes also include practice based qualifications.

Average salary: £40,000 with 5 years of experience

Title:

Purpose:

Some day to day duties:

How to get it:

Average salary:

Title:

Purpose:

Some day to day duties:

How to get it:

Average salary:

Title:

Purpose:

Some day to day duties:

How to get it:

Average salary:



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INVESTIGATING URBAN NATURE

As towns and cities grow we need to find ways to support the needs of humans, while allowing urban biodiversity to flourish for the benefit of everyone. In this activity you will become a scientist by making observations of nature in your neighbourhood and telling the Natural History Museum what **you** think the most important scientific questions are for us all to answer.

🕒 30 minutes

Skill set Creative, curious, observant



Kit list

Notebook and pen or device to record your ideas while outside

Computer access to the NHM question submission portal and 'Asking scientific questions' resources
nhm.ac.uk/bsagoexplore 🖱️



Instructions

- 1 Get to know your urban nature by finding any small green space in your neighbourhood. Look closely for a few minutes for all signs of life (e.g. plants, insects). Make a note of what you've seen in your notebook or device.
- 2 Next, note down any evidence of humans influencing nature, positive or negative. The impacts can be big or small (e.g. building roads, flower beds).
- 3 Discuss with a friend what benefits having more plants and animals in your neighbourhood could have for nature, and for people. Note down how you think we should balance that with making space for the things that people need.
- 4 Finally, can you think of any scientific questions you could test to find out how we can create a space where humans and nature thrive together? To help, you can use our guide and examples of what makes a good scientific question here:
nhm.ac.uk/bsagoexplore 🖱️



Watch out

Look but don't touch! Urban nature, for example trees, can be exposed to many pests and diseases. Try to avoid spreading any of them by not touching plants or animals, and cleaning your shoes.



Next steps

Tell the Natural History Museum at nhm.ac.uk/bsagoexplore 🖱️ what you think the most important questions are that we should be asking about urban nature.

Go to our website nhm.ac.uk/schools/explore-urban-nature.html 🖱️ to learn more about the challenges urban nature is facing, and what you can do to support it.



At home

What could you do in your community to advocate for urban nature? Are there local conservation organisations you could join, or groups you are a part of that you could encourage to act sustainably?



Career options

Many jobs in the future will require an understanding of how to collect data and use it to make decisions about how to balance human needs with those of wildlife in towns and cities. Governments, technology companies, environmental charities, and scientists are just a few examples.

GROWING SPAGHETTI TOWERS

There is an increase in the construction of skyscrapers and high-rise buildings to accommodate the growing population and rapid urbanisation in most cities. This activity will introduce the basic design and engineering principles mainly used in constructing buildings. How tall can you build your building?

🕒 15-20 minutes

Skill set Collaborative, creative, tenacious

Kit list

A packet of dried spaghetti

A packet of mini marshmallows for each pair/group

Paper

Pencils for sketching designs

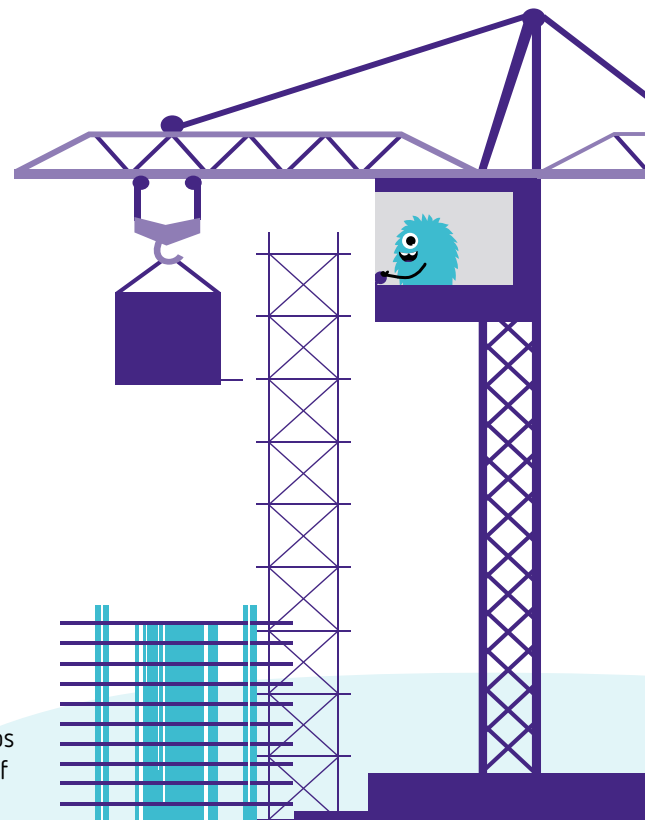
Optional tower decoration

Instructions

- 1 You will be working in pairs or small groups to design and build the tallest tower out of dried spaghetti and marshmallows. Think about the 'building materials' you have been given. What are the properties of the spaghetti and the marshmallows? What could they be used for?
- 2 Roughly sketch a design for your tower – how will you ensure the tower is strong enough to grow tall? Think about strong shapes such as triangles, how will you reinforce your structure?
- 3 Once you have agreed on your design, start building. Do you need to make any modifications to your design once you started construction?
- 4 If you have time, you may like to add paper decoration to your tower. Once complete, the tower will need to stand for at least 30 seconds. You can break the spaghetti and/or marshmallows into smaller pieces if that helps your design.
- 5 Take a deep breath and admire your spaghetti tower construction!

Watch out

- The marshmallows can get sticky. Wash your hands after construction.
- Spaghetti can be sharp. Be careful when using to avoid any injuries e.g. eye injury.
- Do not eat the marshmallows in this activity.



➤ Next steps

We would love to see your spaghetti towers. Please take a photo of your tower and email the image to spaghetti@petroc.ac.uk, then log onto our website petroc.ac.uk to see the towers built by others during Science Week 2022.

At home

Think about the buildings you pass on your way to/from school.

- How are they reinforced?
- What makes them strong?
- How are they designed? How are they built?
- How can they grow so tall?

➤ Career options

You can take a number of qualifications or higher-level apprenticeships if you wish to pursue a career in this area, for example an Higher National Certificate in construction. There are a huge number of jobs available such as architectural technologist, building surveyor or structural engineer.

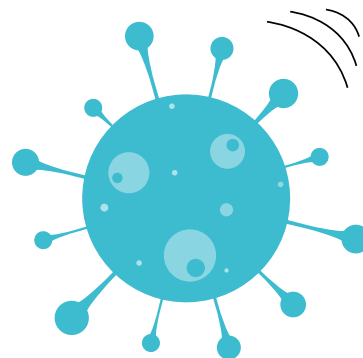
DEVELOPING MEDICINES

In this activity you will meet Jasbinder and Anna, two Roche employees, who will introduce how the body defends itself against pathogens, and how scientists use these natural methods to develop medicines. Then through a practical group activity, you will see how quickly pathogens can spread.

🕒 20 minutes

Skill set Logical, observant, self-motivated

Roche



Kit list

Scrap paper

Pens

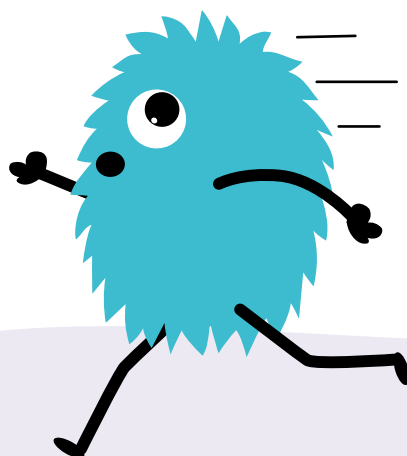
Crossword
puzzle sheet

Room space or
chat feature for
Transmissions activity

Instructions

Start by watching the Developing Medicine supporting video: stempointeast.org.uk/education/secondary/resources/secondary-school-resources-roche where the Roche team explain how pathogens grow and spread diseases.

- 1 You will need a pen and some paper to help you answer the questions that Jasbinder and Anna ask you while you watch. Sometimes your teacher will pause the video and give you further instructions.
- 2 Now it's time to play Transmission. In this activity, you will see how quickly pathogens can spread.
- 3 At the start, everyone in the class will be given a coloured piece of paper – one person will be red, and the rest will be green. It is important to not tell anyone else your colour before the activity starts.
- 4 Follow the instructions through the video and listen for the word TRANSMISSION.
- 5 At the end, Jasbinder and Anna will help you discuss transmission of pathogens and disease growth before you complete a crossword to check what you have learnt.



Watch out

- Please make sure you follow the latest social distancing measures set down by your school, if there are any.
- When moving around the classroom to play Transmission, be careful of furniture and other people.
- This activity can also be completed remotely, just listen to the alternative instructions in the video.

Next steps

Why not try more exciting activities introduced by real employees at Roche at stempointeast.org.uk/education/secondary/resources/secondary-school-resources-roche

At home

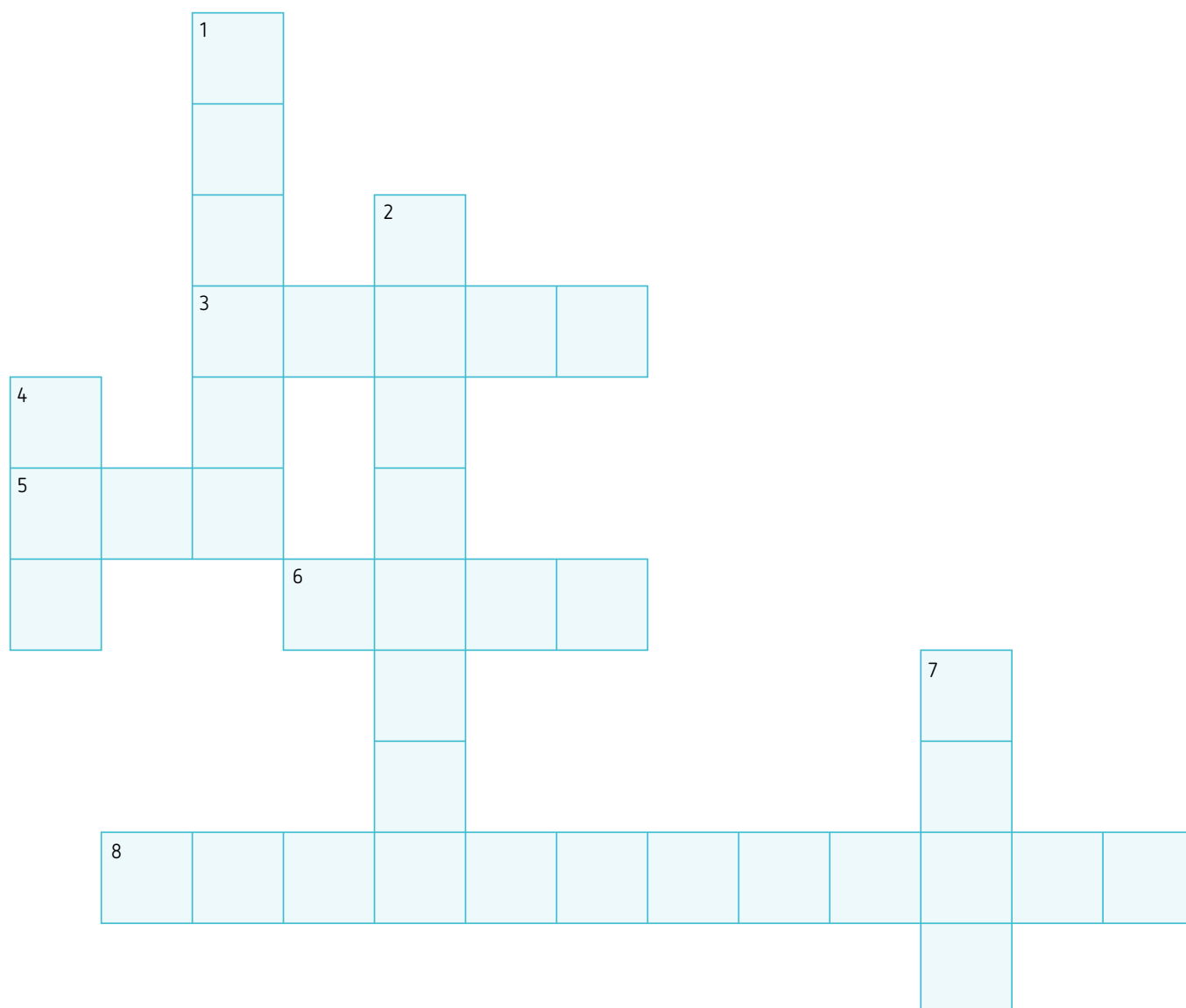
Taking what you have learnt, why not explore your home, and think of adjustments that can be made to minimise the spread of pathogens.

- After you have watched the film, create a presentation that explains how pathogens grow to share what you have learnt with someone at home.

Career options

At Roche, many people have a career that plays a role in developing medicines. This includes (among many others!) researchers, scientists, health economists, drug safety experts and staticians.

>> DEVELOPING MEDICINES DEVELOPING MEDICINES VIRTUAL WORKSHOP CROSSWORD



Across

3. Defence mechanism released from eyes
5. Sneezing and coughing transmit pathogens through this
6. If this is uncooked infection can spread
8. The action of a pathogen moving

Down

1. Another organism spreads the disease
2. Harmful organism
4. Our ears produce this sticky substance
7. The largest defence barrier, it secretes hormones

DESIGNING YOUR ECO-FARM

Growing food contributes hugely to climate change and biodiversity loss in the UK and globally. Sustainable farming methods, however, can produce less greenhouse gases, protect and restore nature, and improve soil and water quality. Through this activity you will design your own eco-farm that helps the planet while feeding the population.

🕒 30 minutes

Skill set Creative, open-minded, resilient

📦 Kit list

WWF resource sheets

www.wwf.org.uk/get-involved/schools/resources/food-resources 🌐

WWF YouTube video – Sustainable farming Netherlands

youtube.com/watch?v=mxl-QUzfY4E 🌐

📖 Instructions

- Using the worksheet, connect the scientific terms to the correct definitions.
- Look at the food web and label the producers, primary consumers, secondary consumers and tertiary consumers.
- The population of yellowhammers has had an outbreak of disease.
 - Name one other species that may face a decrease in population because of this.
 - Name one species that may increase in its population size.
- Look at the trophic level diagram and the corresponding food chain.
 - In which trophic level does the barn owl belong?
 - Why are trophic level diagrams triangular in shape?
- Some farmers use pesticides to discourage slugs from eating their lettuce crops.
 - How can the pesticides used to target slugs cause problems for predators like the barn owl?
 - How might pesticides cause problems for kingfishers living in nearby freshwater habitats?

- Many farmers in the UK have started to plant wildflowers on their farms.
 - How can planting wildflowers increase the biodiversity of a farm?
 - How might this benefit farmers in the future?
- Design your own eco-farm using the resource sheets.
- If you have time, watch the Netherlands farming video. How does precision agriculture in the Netherlands reduce the impact of farming on the environment?

➤ Next steps

Monitor and record your local biodiversity by conducting a biodiversity survey of your school grounds or local green space using the **Our Planet LAB Toolkit** at www.wwf.org.uk/sites/default/files/2020-03/OurPlanetLAB_Toolkit.pdf.

Find further education resources on climate change, food and sustainability at: www.wwf.org.uk/schools

🏠 At home

Research one of the following farming practises being used in the UK, and create a leaflet to explain how this practise works and how it benefits our UK biodiversity: agroforestry, managing hedgerows, establishing wildflower meadows.

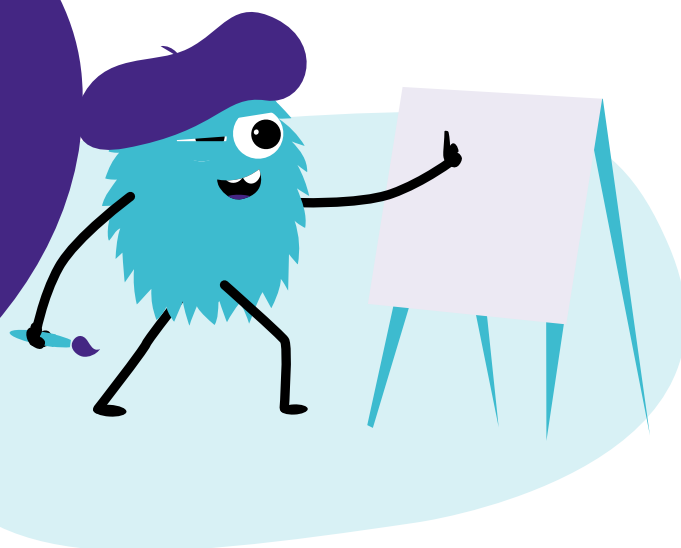
➤ Career options

There are lots of different careers and jobs that relate to farming, landscape management and sustainability including being a farmer, forester, environmental scientist, soil scientist, environmental engineer, environmental consultant, agricultural consultant, policy advisor, ecologist, arboriculturist, hydrologist, wildlife conservation officer, sustainability officer, responsible investor, land use officer and environmental educator.



POSTER COMPETITION

Students can get creative and enter the British Science Association's annual, UK-wide poster competition! They can make a poster about any version of 'Growth' that they like and be in with the chance of winning an array of prizes. The activities found in this pack, marked with a paintbrush symbol, could all be used as a source of inspiration to get students started.



Kit list

Paper (A4 or A3)

Creative materials such as:

pens
pencils
scissors
glue
watercolours
paints
crayons
felt
thread
wool
foil
clay
string
beads
stamps
foam
pompoms



Instructions

Encourage students to think about different areas of growth so they can come up with ideas to include in their poster. Here are some points and questions to get you going.

- **Get students to think about their personal experience of growth** – from growing their own cress plants to overcoming a challenge that they thought they could not do! How has it helped them to become stronger, braver, kinder, or more accomplished?
- **How do students think the world has grown?** You could help them to consider population growth, plant growth, economic growth or even the growth of cities and society. What is an example of good growth?
- **Can students think of people who have helped or inspired them to grow?** Perhaps they could create a portrait of them to show this?

From the learning of new skills to the development of places and ideas that enable us to do things more efficiently in our everyday lives, growth is everywhere!

Making the poster

Once they've done the thinking, it's time for students to get creative! Posters must be A4 or A3 in size and you'll need to be able to take a photograph of each one so it can be sent to us online for judging. Students can use pop-up pictures, pull out tabs or use materials such as pencils, paints, crayons and paper to create their posters.

Submitting the poster

Posters will be judged on creativity, how well they fit the theme and how well they have been made or drawn. Once a student's poster is complete, take a photo of it and complete the online form to submit it as an entry.



Next steps

Celebrate! For more details, along with the full set of poster competition rules and tips, check out our website: britishscienceweek.org/plan-your-activities/poster-competition 🌟