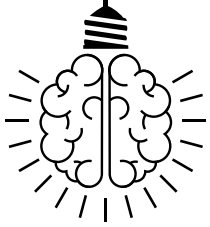
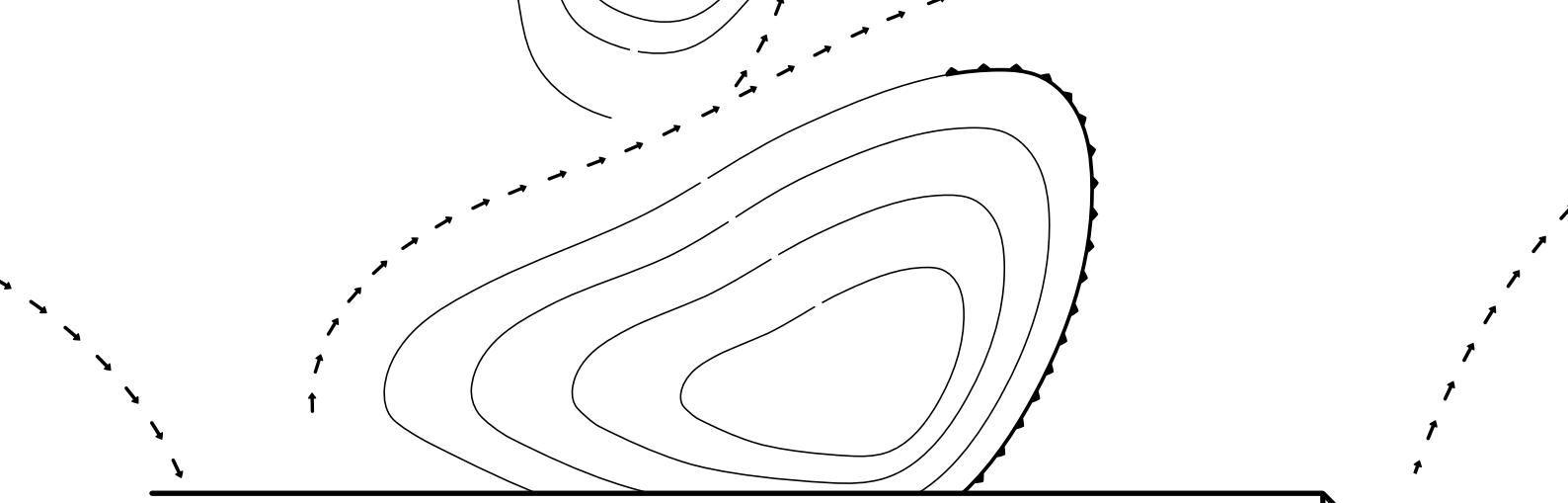
Learning notes

- explore five of the key stories



Discover ideas, activities and opportunities to learn more about the science and technology covered in this edition of Catalyst magazine.

Contents



Learning notes

Make your own cloud in a bottle

Main Article: **What have the oceans got to do with the weather?**

Peter's articles on the environmental impact of the oceans discusses how water droplets form clouds, and now it's time for you to make your own!

Learning Task:

The article talks about how changes in air temperature and pressure can cause a cloud to form. This is your challenge today, by using an empty bottle, some warm water and a thermometer if you have one, can you make a cloud in a bottle?

You will need:

- 0.5-1.5 litre clear plastic bottle with a lid
- warm water
- matches
- small thermometer (to fit in the bottle – optional)

1. Put the thermometer in the bottle (if you have one), and put the lid back on. Give the bottle a squeeze and you should see the temperature rise as the pressure increases.
2. Add a few drops of warm water, then place the lid back on tightly. Shake the bottle around to ensure there is water vapour in the bottle. The more you shake it, the more it evaporates and the more vapour you will get.
3. If the water is too hot then condensation will form on the inside of the bottle. This is not what you want so try it again with slightly cooler water.
4. Squeeze the bottle again. You should see the temperature rise again but no clouds forming (just yet).
5. Unscrew the lid, but don't take it off yet. Light a match, blow it out and hold the smoking end at the mouth of the bottle. Remove the lid for a few seconds and replace.
6. Squeeze the bottle again a few times. Squeeze it quite hard for a few seconds then release.
7. A cloud should appear as you release the bottle.

Take your learning further:

Now having made a cloud form in your bottle, using the article can you think of the answer to these questions?

- Why did no cloud form the first time you squeezed it before you lit the match?
- Why could a cloud form after you had lit the match?
- Why does the temperature increase when you squeeze the bottle?

Take your learning further still:

There is a nice PhET simulation where you can look at the link between pressure, volume and temperature and learn more about the gas laws. That can be found **here.**

Or if you want to know more about the different types of clouds and how they form you can click **here.**

To find more experiments you can do with meteorological links, click **here.**

Learning notes

What's fog got to do with it? Using the WAQI website

Main Article: **Fire and the crazy world of air**

Learning Task:

Go to: World's Air Pollution: **Real-time Air Quality Index**.

- Click the icon that looks like a book with a pin in it on the right-hand-side – that should locate your nearest air quality monitoring station. If more than one pin appears on the map click the one closest to you.
- Scroll right down until you get to Air Quality Historical Data, and make sure you have PM2.5 data selected. This gives you data on particles that are 2.5 microns or less in width. Find a day in the past that has poor air quality – red or orange colour. Note down the date for that day.

Visit: **www.timeanddate.com** to find historical weather data for that day.

- Look for any links between the weather and data for that day.
- You may find that it was foggy on that day. Fog can create readings in particulate sensors that are abnormally high.

Take your learning further:

Have a look at other data, such as Ozone O3, Nitrogen Dioxide NO2, Sulphur Dioxide SO2, and Carbon Monoxide. Go back to the map and compare this data for different areas of the world.

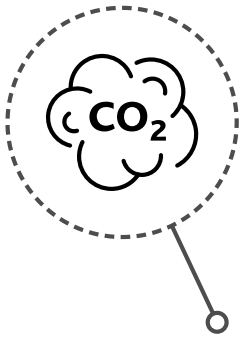
What are the most polluted areas? How does this link to the type of industry and population density in these areas?

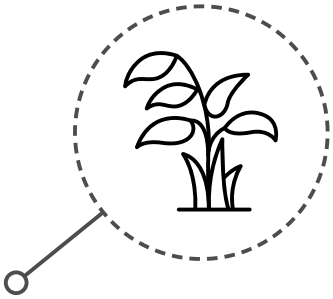
Take your learning further still:

- Find out how to build your own air quality sensor using a **Raspberry Pi**.

  Remember that air quality sensors used in the WAQI website are professionally calibrated, whereas a home-made one is not. If you are getting readings that are supposedly very high readings, it is most likely due to the calibration of the sensor and not the air quality itself.

- The Institute of Physics (IoP) have produced a video which asks the questions 'What if you could see the pollution around you?' Physicist Mark Richards has developed a way to measure pollution using ultra-violet light. Each pollutant has its own signature spectrum which can be analysed using his portable detector. He takes his detector to the roadside in London to measure the emissions from vehicles and uses GPS to create a pollution map. **www.stem.org.uk/rxzdp**





Learning notes

Can plants grow just as well without peat?

Main Article: **Protecting the bogs, for peat's sake!**

The author of this article talks about the importance of peatlands for storing carbon and how vital it is to protect them. He suggests that gardeners and horticulturalists should try to grow plants in composts that don't contain peat to stop peatlands being dug up and destroyed. Composts without peat, known as 'peat free' composts are not popular with some gardeners because they do not believe that they are as good.

Learning Task:

Investigate the germination, growth and health of plants grown in a range of composts and/or soil.

You will need:

- pots or planting trays
- compost 2-3 types – note: we do not recommend buying compost containing peat for this experiment, but if someone you know already has a bag of compost the chances are it will contain peat – check the label on the bag to find out.
- fast growing seeds – radish and lettuce are easy to grow, cheap and grow quickly and will give you fresh salad ingredients.
- light source (daylight or artificial lighting)
- weighing scales if you choose to measure dry mass.
- ruler and or graph paper for measuring plant height and estimating leaf area.
- optional: vermiculite or sharp sand, this will improve drainage making the composts better suited to growing seed, ensure you use the same mix of proportions for each compost.

1. Design your experiment thinking about how you are going to set up the trial, what variables need to be controlled and what you are going to measure and record.
2. Your seeds/plants will need to be kept moist with good lighting to get results. You will need replicates for each compost – we suggest a minimum of 5 seeds for each type of compost.
3. Prepare your composts and plant your seeds. Water them to make them moist and put them in the light.
4. Record each day the number of seeds that have germinated, plant growth - you need to decide how to measure plant growth, for example plant height, number and size of leaves or the dry mass of the whole plant after a certain number of days.

Health and safety - please seek advice from SSERC or CLEAPSS.

Take your learning further:

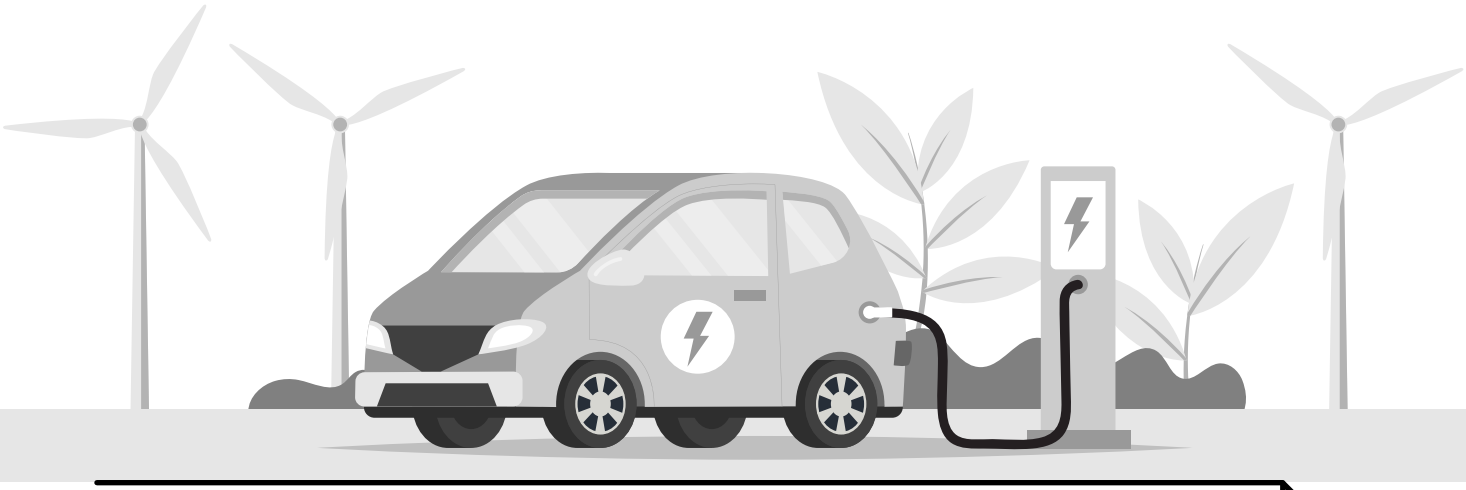
You can find teacher and student notes for a similar experiment that you could adapt for testing peat based and peat free composts, including information about how to measure dry mass **here.**

You can also find more suggestions on measuring and recording plant growth at this external link **Cornell Composting.**

CLEAPSS Student Safety Sheet Plants, fungi and seeds **external link.**

Take your learning further still:

Consider alternative growing mediums, do plants really need compost, could farmers use produce viable crop yields using different methods? Explore growing plants without soil or compost with this **Hydroponics resource.**



Teaching notes

Learning more about lithium-ion batteries

Main Article: **How will tomorrows lithium-ion batteries be better than todays?**

It is interesting to hear where research is going with lithium-ion batteries, but what is lithium and why are these batteries used in the first place?

Learning Task:

Use this **case study** to find out about the advantages of using lithium-ion batteries in a lawnmower.

Ask students to research lithium-ion batteries and to consider the following as they create a case for or against the use of lithium-ion batteries

- Which pollutants are reduced by using lithium batteries?
- Can you find out what damage these pollutants do to the environment?
- What do you think about the balance of the arguments for and against using these batteries?
- Write a conclusion giving your opinion and including which information you think is most persuasive to back up your thoughts.

Take your learning further:

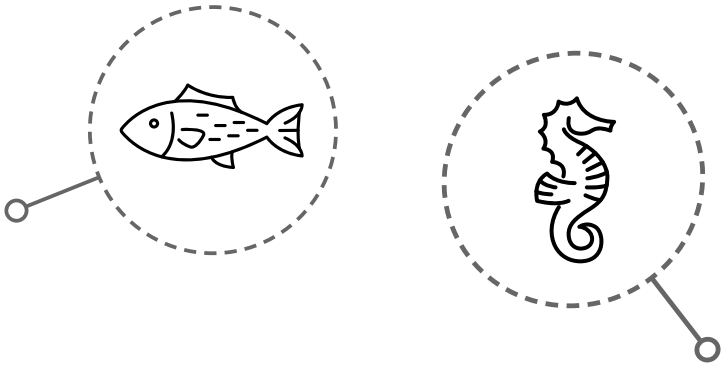
Use the student worksheet and article to find out more about lithium and how we can mine it.

There is also an **answer sheet** included so you can correct your answers and improve them further.

Now produce a fact-sheet about lithium and include some of the points you have learnt from the task. What else is lithium used for in real-life? Have you any lithium in anything you have in your home?

Take your learning further still:

- Find out about Saiful Islam, a scientist whose career has been in computer modelling looking at the materials used in products like these cutting-edge batteries and fuel cells. **www.stem.org.uk/elibrary/resource/36775**
- Listen to The Life Scientific podcast featuring Jim Al-Khalili talking to Professor Clare Grey about the batteries that could power our future. For the last two decades she has researched the precise chemistry of the rechargeable lithium-ion battery: **www.bbc.co.uk/programmes/b09tdr0r**



Teaching notes

Thinking about the carbon cycle in different contexts

Main Article: **Why is that man going into the sea holding a garden rake?**

This article explains the important role of ocean seagrasses in the carbon cycle. Often, we only think about land-based organisms when studying the carbon cycle, but thinking about the carbon cycle in different contexts could be a useful way to develop understanding.

Learning Task:

Watch the video **carbon cycle game** that explains how to model the carbon cycle on an alien planet (note it is called atmosphere game in the resource, but it is about the carbon cycle).

Download the carbon cycle game board and play the game. Use information from the seagrasses article to adapt the board game to play as an ocean seagrass carbon cycle game.

Take your learning further:

Research more about seagrasses – why they are not seaweeds, their role in the carbon cycle and biodiversity by exploring **Sea grasses and seagrass beds**, Smithsonian, 'Ocean: Find Your Blue' and **Neptune's Flowers** another Catalyst article on seagrasses.

Take your learning further still:

Use a carbon dioxide sensor attached to a datalogger or hydrogen carbonate indicator to measure changes in carbon dioxide levels surrounding plant material as described in activity 5 **here** or for more details see **SSERC's Limiting factors in photosynthesis carbon dioxide external link.**

REC
HD 2K 4K FPS 60
1/100 F2.8
R3h30m

Learning notes

Discovering careers

Main Article: **Save the world – the best way you know how**

This edition of Catalyst focuses on climate change. Written by experienced individuals who use STEM subjects to understand the consequences, offer solutions and pose questions.

Each author whether engineer, scientist, meteorologist, filmmaker, or student share a combined passion to effect change. Ensuring that each person who reads their articles can make informed decisions about climate change and what they could do to help.

Learning Task:

The authors have varied career paths, often switching careers, or discovering ways to combine their expertise and knowledge with a career that brings them satisfaction and success.

Here are three questions to consider and discuss with friends, teachers, and family.

1. Which of the articles appealed to you the most?
2. What about it inspired you?
3. Which author has a career you could you see yourself doing and why?

Take your learning further:

Find out more about the STEM related careers in this edition of Catalyst or jobs that appeal to you. Here are some suggestions:

- Research the role of the author whose job appeals to you the most. What do you need to do to have a similar career?
- Find out about the organisations the authors work for or have worked for. Can you see yourself working for those organisations?
- Research a career you are interested in and consider the subjects you need to study in school. Do you work towards a place at university or look for an apprenticeship? Is there another route you could take?
- Think about getting experience related to the role or project: summer placements or volunteer with similar organisations or projects. If you try it out you'll know if it's for you.

Take every opportunity to do research, ask around and seek advice. The more you find out, the easier it will be to choose the right path for you. And remember, it's ok to change your mind and try something different, just ask our authors.

Take your learning further still:

The following websites have useful information about environmental linked careers or have general careers information and guidance.

National Careers Service - Environment and land: **nationalcareers.service.gov.uk/job-categories/environment-and-land**

Environmental careers and how to get one: **targetcareers.co.uk/careers-advice/choosing-your-career/894159-environmental-careers-and-how-to-get-them**

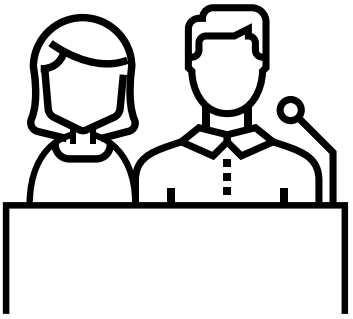
Top 10 Green Dream Jobs: **www.thebalancecareers.com/top-green-dream-jobs-4154258**

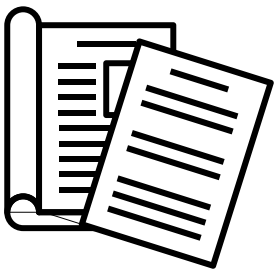
STEM Learning: **www.stem.org.uk/stem-careers**

Bring a STEM Ambassador into your classroom

We have a network of over 30,000 inspiring STEM Ambassadors who volunteer their time to inspire the next generation in STEM.

Find out more about how you could bring a STEM Ambassador into your school or college: **www.stem.org.uk/stem-ambassadors**





Thank you

We hope you enjoyed Catalyst, and matching learning notes. If you have any feedback, or ideas for topics you'd like to see covered in future editions, please email:

catalyst@stem.org.uk

Join us on Twitter **@STEMLearningUK**

Visit our website **www.stem.org.uk/catalyst**