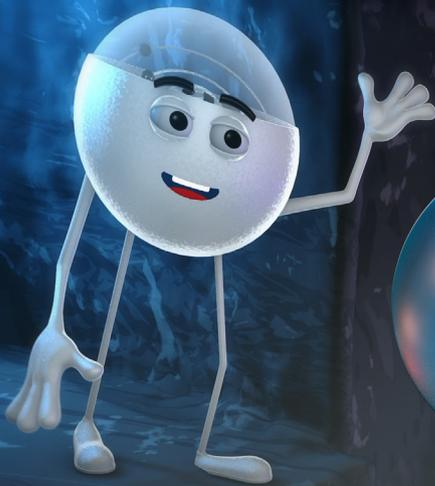


Miss MOLECULE & friends

Created in collaboration with



Episode 1 – Lithium



Key Stage 2 & 3
Lesson plan and
guidance

Miss MOLECULE
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 Cornish Lithium

Miss Molecule & Friends

Lesson Plan for Episode 1 'Lithium'

To watch the Miss Molecule animation, please visit: www.missmolecule.co.uk/watch

Overview

The UK has set ambitious targets to transition to a Net Zero economy by 2050. To help achieve these targets, we must change the way we source critical minerals such as Lithium. Critical minerals are used in many products that reduce carbon emissions for example batteries in electric cars and wind turbines. Currently Lithium is extracted abroad in countries such as Australia, China and Chile and production methods are energy intensive and highly unsustainable.

Recently, Cornwall has been found to have the highest concentration of Lithium in rocks in the whole of the UK, this is due to the large granite Batholith which extends throughout the County. Innovative extraction methods are being pioneered by companies such as Cornish Lithium and British Lithium, these methods are more sustainable than current methods and will produce a domestic supply of Lithium that can decrease the UK's reliance on external supplies and create jobs in local areas.

This lesson will be a resource for teachers to deliver themselves when best suited. It is designed to be inclusive of all learners with visual, audio and physical activities included and additional extra learning suggestions for further understanding.

Lesson Objectives

The lesson will enable students to:

- Identify what Lithium is, where it comes from, and its uses.
- Gain knowledge of sustainable mineral extraction and its importance in helping combat climate change
- How Lithium is being extracted in the UK by companies such as Cornish Lithium

Age

Upper Key Stage 2, Lower Key Stage 3 (9-13 years old)

Timings

45 minutes without the experiments, 1.5 hours with the experiments.

Resources (provided)

Animation (26 mins), Worksheet, Power Point (Experimental resources explained later)

Curriculum links (Upper Key Stage 2)

Science

- Materials (Rock)
 - Identification of rocks and minerals
- Materials (properties and shape)
 - Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution
 - Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating

Geography

- Physical geography, including: climate zones, biomes and vegetation belts, rivers, mountains, volcanoes and earthquakes, and the water cycle
- Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water

History

- A local history study

Lesson Plan (~45 minutes)

Starter / Introduction

How many minerals or metals can you name? How many things in your classroom have a mineral or metal in them?

Minerals can be for example Graphite (pencils), Lithium, Quartz, Arsenic
Metals can be for example Tin, Copper, Silver, Gold, Iron, Aluminium

Use the periodic table on Slide 4 to see how many metals or minerals the class recognise.

Resources:
Power Point

Time:
5 mins

Animation

Miss Molecule (a H₂O molecule) is the host of a new chat show series which will tell you about all the amazing natural resources we have in the UK! In this episode, she will be talking to 'Lithium' to find out what it is, where it comes from and how it can help reduce carbon emissions in the UK. She will also talk to two people working for a company called Cornish Lithium who will explain two different processing techniques of extracting Lithium in Cornwall.

Resources:
Animation
Worksheet

Time:
30 mins

The animation is 26 minutes long and can either be played in full or broken into sections as outlined below. The workbook has questions relating to each section and this can be completed at the end, or as the video is paused.

Start – 10.33 m (~10 mins)

Miss Molecule welcomes Lithium into her underground studio where we find out what Lithium is, how it was first discovered in Cornwall and why it is important in the transition to low carbon energy supplies and in new technologies.

10.33 m – 22.40 m (~13 mins)

Meet the team at Cornish Lithium! Zoe Richardson gives an insight into the hard rock mining happening at their Trelavour site and Lucy Crane talks about the work being done to explore for lithium in geothermal waters at their United Downs site.

22.40 m – end (26.00 mins)

Miss Molecule and Lithium then talk about all the amazing different renewable energies that are available in the Southwest, and the wider picture of creating a domestic supply of Lithium including job creation.

Plenary

Pop Quiz!

Ask students the questions on Slide 7 to consolidate their knowledge. Final question can be used to facilitate a debate.

Resources:
Power Point

Time:
5 mins

Activity (~45 minutes)

Explore different methods of separation and where they are used in Lithium extraction. The activities are designed to be used with resources that are easily accessible, see the resources list below. There is a recording sheet at the back of this lesson plan that you can either print out or use on screen.

The aim is to complete each experiment to find out which extraction method works best at separating iron filings from the water. *We are substituting Lithium for iron filings!*

Magnetic

The hard rock process of extracting Lithium uses traditional processing; crushing, size separation, froth floatation and magnetic separation as the final step to reach a mica concentration before the hydrometallurgy processing to reach a battery grade lithium product.

1. Fill the plastic bottle up with water, make sure you have the lid!
2. Measure out 50 grams of iron filings in a small cup/jug and tip them into the water
3. Secure the bottle with the lid
4. Use the magnet to move the iron filings around, what happens when the magnet gets close?
5. Can you try to separate the water from the iron filings by tipping out the water?
6. Collect the iron filings in a cup (placed on the scale already)
7. Weigh the iron filings on the scale to see how many you collected
8. Record your findings on the sheet

Sieving

Direct Lithium Extraction (DLE) is based on separating the Lithium compounds from the geothermal water using membranes (or filters) which selectively remove only the lithium.

1. Fill the bottle up with water
2. Measure out 50 grams of iron filings in a cup/jug and tip them into the bottle of water
3. Give the bottle a shake to mix the water and iron filings
4. Place the coffee filter into the funnel
5. Place the funnel over another container and hold above (large enough for all the water to be tipped into)
6. Pour the water/iron filing mix into the funnel to separate the mix
7. Once all the water has gone through the funnel, weigh the iron filings to see if you have captured them all!
8. Record your findings on the sheet

Evaporation

Although this process is not directly linked with Lithium extraction in the UK, some places like California bring water up from deep underground which contain Lithium, evaporate the water from the saline solution before separating the Lithium from the salt. This process is energy

intensive and not very sustainable.

*This experiment will take a few days to complete

1. Using a bowl or bottle with a lid, mix the water, salt and iron filings together
2. Pour the mix into a small container with no lid
3. Place the container in an area that will be warm. A window sill is perfect or in the winter somewhere near a radiator!
4. Wait a few days to see what happens
5. After a couple of days, you should be left with just the salt and the iron filings. (Tip: Place the magnet into a small plastic bag, it will be easier to get the filings off the magnet)
6. Use a magnet to separate the iron filings from the salt
7. Weigh the iron filings
8. Record your results on the sheet

Recording & Analysis

After you have completed each experiment, use the recording sheet to record and analyse your findings to see which experiment worked best at separating the iron filings from the water,

Resources

The experiments can be done in groups to reduce the amount of resources you need, or just completed by the teacher. Several of the resources can be used over for each experiment complete evaporation last.

Magnetic

1 x 1L bottle with lid
1 x 50 grams of iron filings
1 x Weighing scale
Plastic cups/jugs
1 x magnet

Sieving

1 x 1L bottle with lid
1 x 50 grams of iron filings
1 x filter paper (coffee filter paper is fine)
1 x funnel

Evaporation

1 x 1L bottle with lid
1 x 50 grams of iron filings
1 x larger tub/container
1 x magnet
1 x 50 grams of salt
1 x Weighing scale

Extras

Additional time can be spent on extra activities at the discretion of the teacher to further student's learning of the subject.

1. Create a poster explaining all the benefits of Lithium, its uses and how it is extracted
2. Write a news article for your local newspaper on Lithium

Some useful links for more information of Lithium/metals

<https://cornishlithium.com/>

<https://www.visualcapitalist.com/all-the-worlds-metals-and-minerals-in-one-visualization/>

<https://hackaday.com/2022/02/09/mining-and-refining-lithium-powering-the-future-with-brine/>

<https://minerals-matter.co.uk/>

Watch more Miss Molecule's episodes online! www.missmolecule.co.uk

Recording Sheet

After completing each experiment, write your findings in the table below, and then rank them on which experiment separated the most filings from the water.

Experiment 1 Magnetic	Weight (grams)	Ranking (1st, 2nd 3rd)
Experiment 2 Sieving	Weight (grams)	Ranking (1st, 2nd 3rd)
Experiment 3 Evaporation	Weight (grams)	Ranking (1st, 2nd 3rd)

Which experiment got the most filings out of the solution?

Why do you think this one worked the best?

If you were going to extract a lot of Lithium, which technique would use the least energy and water? Explain why.

Which technique was the most challenging and why?

**Thanks for completing all the experiments,
Lithium is pleased to be getting 'out 'n'
about!**

