

Teacher's Pack

**STEM
BOX**

Wind Power in Falkirk

Digital Version Here



Great Place^o



**Practical
ACTION**

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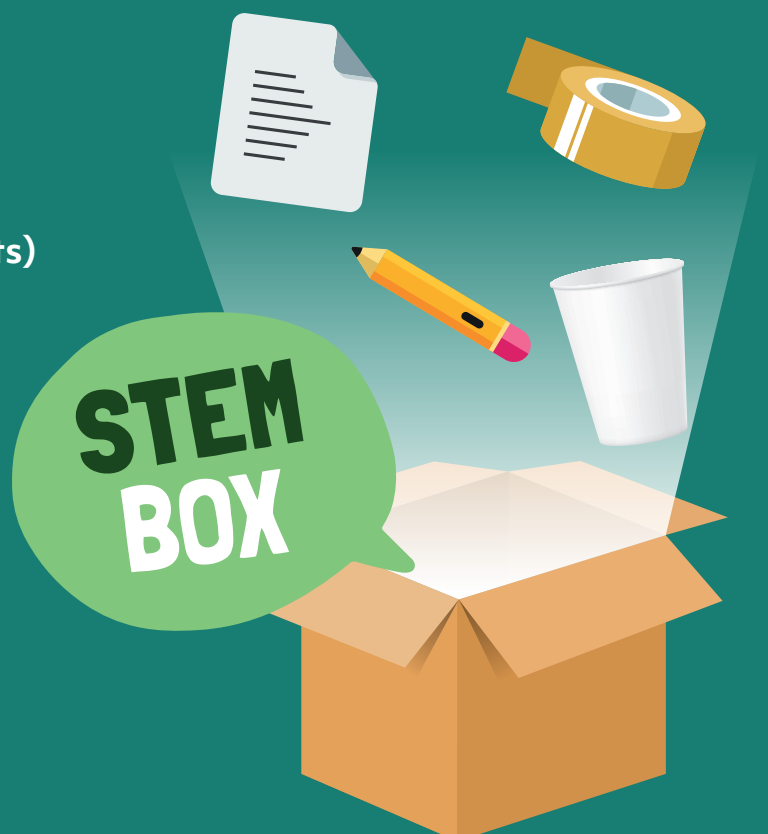
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Introduction

Welcome to the Wind Power in Falkirk STEM Activity Box

Inside this Teacher's Guide you will find all the information you need to deliver a jam-packed STEM lesson with a hands-on activity, local heritage links and future career inspiration for your pupils! The learning materials included are best suited to pupils aged 8-14 years.

This document also doubles up as a digital resource. By following the below code you can access the digital version and display the information and images on your interactive whiteboard.

You can use the resources any way you please! In addition to the core lesson and activity there are plenty of optional extras, extension ideas and links to external resources to use at your disposal.

In order to get the maximum from your STEM box, we have suggested two ways of using the resources, depending on the time you have available.





Option 1: 1 lesson (55–60 mins)

- 0-5 mins STARTER: Two truths and a Lie?
- 5-20 mins MAIN LESSON:
Energy, Power & Electricity
Wind Farms in Falkirk
Coal: Powering the Industrial Past
- 20-25 mins STEM Story Challenge - introduce main hands-on STEM activity
- 25-50 mins Pupils carry out activity and demonstrate wind turbines
- 50-60 mins Plenary: pupils compare results between groups and reflect



Option 2: 2 lessons / double lesson (approx. 110 mins)



- 0-5 mins STARTER: Two truths and a Lie?
- 5-20 mins MAIN LESSON:
Energy, Power & Electricity
Wind Farms in Falkirk
Coal: Powering the Industrial Past
- 20-35 mins Group or Whole class activity: Coal vs. Wind Energy
- 35-45 mins Pupils share results and discuss
- 45-55 mins STEM Heritage Quiz
- 55-60 mins Could watch <https://www.youtube.com/watch?v=vmM5kO2PjCo>
to introduce next activity
- 60-65 mins STEM Story Challenge - introduces main hands-on STEM activity
- 65-85 mins Pupils design, create and test their wind turbines
- 85-95 mins Pupils prepare presentation to class
- 95-105 mins Pupils present in groups to class
- 105-115 mins Plenary: pupils compare results between groups and reflect



Teacher Evaluation: we would love to hear what you think! Once you have used the materials in this box, please follow this link to let us know how it went:



Wind Power in Falkirk: Lesson Objectives



To understand that **electricity** today is **generated** in **power stations** from **renewable** and **non-renewable energy sources**



To identify and evaluate some of the **advantages** and **disadvantages** of wind farms in my local area



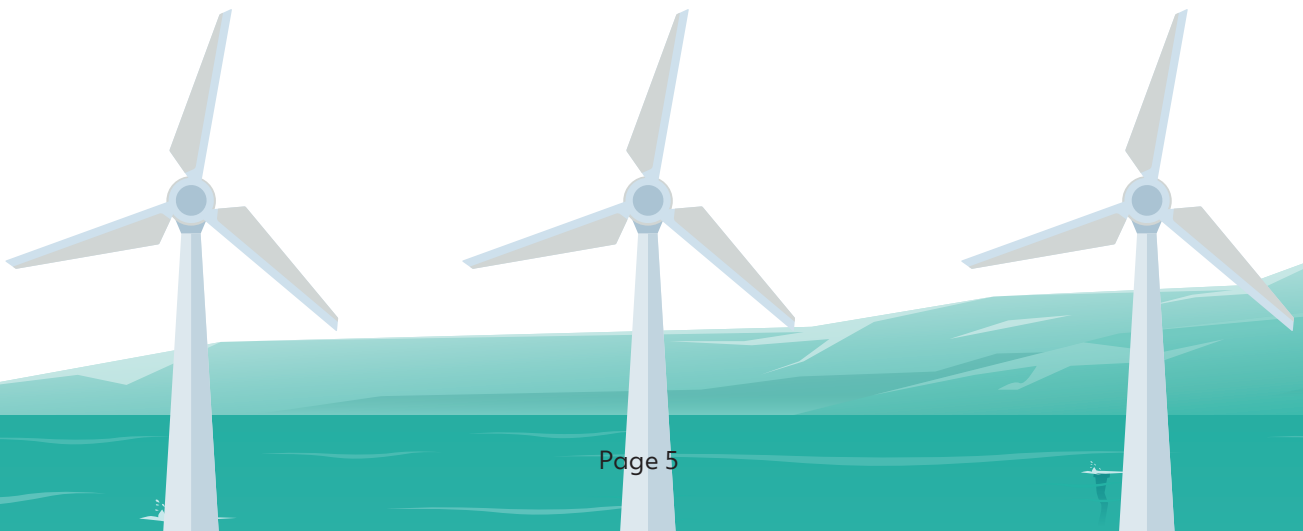
To begin to make comparisons about the use of **coal** and **wind** as **energy sources**



To consider the **legacy** (good and bad) of **coal mining** in the Falkirk area



To have a greater awareness of current and future **higher education, training and career opportunities** in green/**renewable** energy in the wider Falkirk area



Potential Curriculum for Excellence links

Through exploring non-renewable energy sources, I can describe how they are used in Scotland today and express an informed view on the implications for their future use.

SCN 2-04b

By investigating renewable energy sources and taking part in practical activities to harness them, I can discuss their benefits and potential problems

SCN 3-04b

By contributing to an investigation on different ways of meeting society's energy needs, I can express an informed view on the risks and benefits of different energy sources, including those produced from plants.

SCN 4-04a

Through investigation, I can explain the formation and use of fossil fuels and contribute to discussions on the responsible use and conservation of finite resources.

SCN 4-04b

By investigating forces on toys and other objects, I can predict the effect on the shape or motion of objects.

SCN 1-07a

By investigating how friction, including air resistance, affects motion, I can suggest ways to improve efficiency in moving objects.

SCN 2-07a

By contributing to investigations of energy loss due to friction, I can suggest ways of improving the efficiency of moving systems.

SCN 3-07a

I can evaluate the changes which have taken place in an industry in Scotland's past and can debate their impact.

SOC 4-05b

I can make suggestions as to how individuals and organisations may use technologies to support sustainability and reduce the impact on our environment.

TCH 2-07a

I can identify the costs and benefits of using technologies to reduce the impact of our activities on the environment and business.

TCH 3-07a

I can follow and understand rules and procedures, developing my ability to achieve personal goals. I recognise and can adopt different roles in a range of practical activities.

HWB 1-23a

While working and learning with others, I improve my range of skills, demonstrate tactics and achieve identified goals.

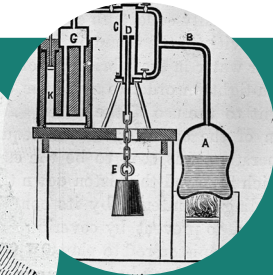
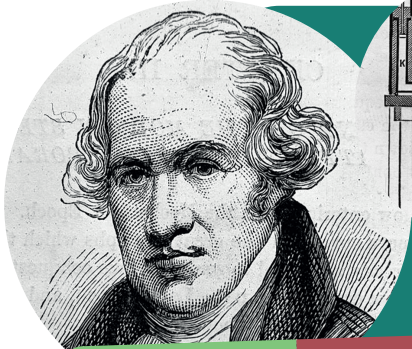
HWB 2-23a



STEM Heritage In a Local Context

STARTER: Two truths and a Lie?

Can you spot which two local facts are true and which is a lie?



In 1769, pioneering mechanical engineer James Watt developed his model for a coal-powered steam engine in a cottage in Bo'ness

TRUTH OR LIE

Credit: Falkirk Archives

1



The first EVER electricity pylon was put up at Bonnyfield near Falkirk in Scotland in 1928!

TRUTH OR LIE

Credit: Image sourced from scienceandindustrymuseum.org.uk

2



New Falkirk area (Lionthorne) wind turbine completed this year will provide power for over 70 homes

TRUTH OR LIE

3

LIE

.....Statement 3 is a lie!

The new wind turbine in Lionthorne will actually power over 700 homes.

Correct to '700' on whiteboard if possible

Teacher Note

<https://www.falkirkherald.co.uk/news/environment/new-falkirk-area-wind-turbine-to-power-more-than-700-homes-each-year-3332534>

Can you work out what links all these facts together?

That's right, these three facts help tell the story of how Falkirk has come from using one energy source to generate power (coal), to mainly using another energy source: the wind!



MAIN LESSON: Energy, Power & Electricity

Let's now recap what we know about energy, power and electricity:

Class Questions

- Q** What do we need power for at home/school and elsewhere in Falkirk (e.g. factories, businesses)?
- Q** Where do we get our power from here in Falkirk?

Most of our electricity here is supplied by generators in power stations. All generators need an energy source to create electricity.

At the moment, we still get some of our energy from gas and oil but increasingly in Falkirk, Scotland, the UK and the world, we are turning to WIND POWER

Recap renewable/ non renewable if necessary. Pupils could list different energy sources under these headings

Teacher Note

Wind power is a clean and renewable source of energy. Many people think it is the answer to the UK's energy needs and our reliance on fossil fuels such as oil, coal and gas.

In Scotland currently upwards of 90% of electricity consumption comes from renewable energy sources, mostly from wind power. Well done, Scotland!

Watch the following video and create a mind map of any key facts about wind energy

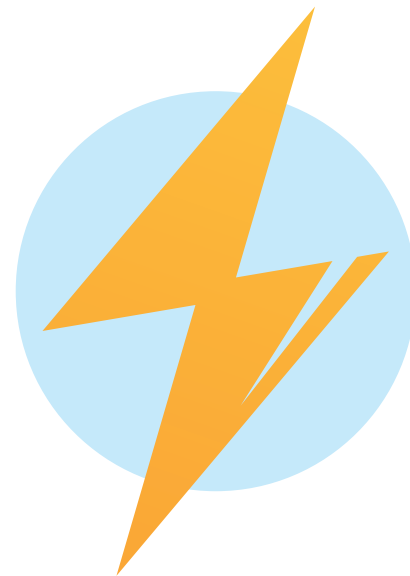
<https://www.youtube.com/watch?v=tsZITSeQFR0&safe=active> (2.16 mins)

OPTIONAL

Wind power is the fastest growing renewable energy technology in Scotland & the UK. There are two types of wind farm: offshore (turbines installed in bodies of water) and onshore (located on land)

How does wind energy generate electricity?

Show - interactive animation:



Animation: How a Wind Turbine Works.
Credit: US Department of Energy,
www.energy.gov/eere/wind/animation-how-wind-turbine-works

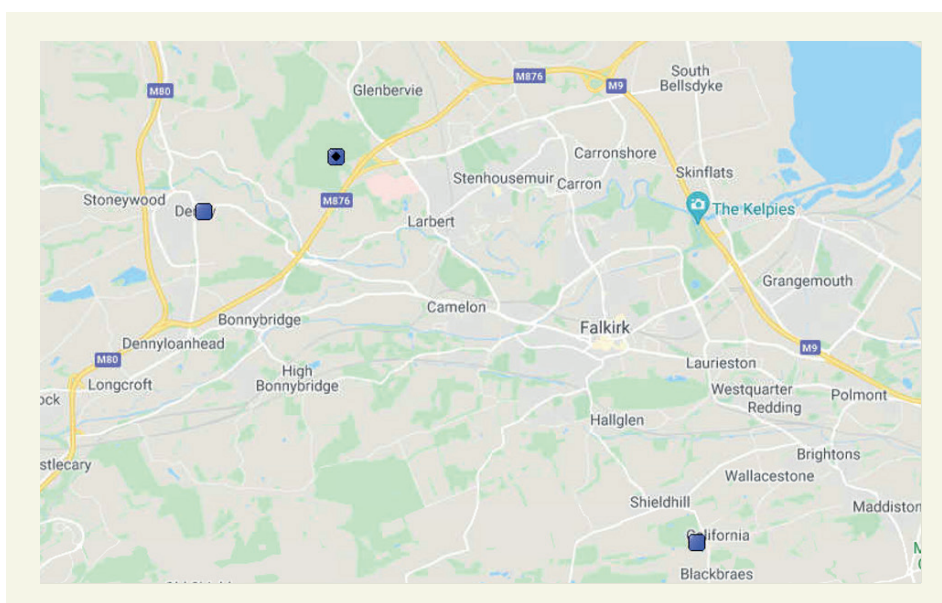
Wind Farms in Falkirk

Now let's take a closer look at wind power in Falkirk...

Show this map - link

Screenshot of Interactive Map showing Wind Farms in Falkirk.

Credit: https://www.thewindpower.net/zones_en_8_663.php



Identify three onshore wind farms in Falkirk area:
Burnhead Moss (Avonbridge),
Todhill Farm and Glenhead Farm.



Burnhead Moss wind farm at Avonbridge.
Credit: EDF Renewables



Turbines at Todhill Farm from above.
Credit: Photographer: © Andy Horne via Facebook.

Have you noticed the turbines before?
What do you know about them?
What do you think?
What do your family members think?

Teachers Notes

Using interactive features on the map, compare and contrast Falkirk's wind farms, e.g. Glenhead Farm has only 1 turbine – we aren't sure but suspect this is used privately to power the working farm that is there.

Contrast this with Burnhead Moss which has 13 turbines and powers 1000s of homes with electricity.

Note that Falkirk's most recently installed wind farm – see the Falkirk Herald article in the starter activity – does not appear yet on the Windpower.net map, but we know it was a community driven project resulting in 1 turbine powering more than 700 homes each year.

Why do you think Falkirk is a good place to harness wind power as an energy source?

[plenty of wide open space, hilly – wind is strong and reliable]

But what energy sources were used to power homes and farms in Falkirk before wind turbines?

[coal, oil (still used today but to a lesser extent, due to shift towards renewables)]

Teachers Questions

Introduce coal as energy source of the past:

Powering the Industrial Past

For more background information – see appendix by scanning the QR Code (see next page)

As we have discussed, wind power is the main energy source supplying electricity in Scotland today.

But for centuries Falkirk relied and thrived on a very different kind of energy source.

Do you know what the most important energy source in Falkirk was before wind power?



COAL!

Coal was THE fuel of the Industrial Revolution, and the Falkirk are had it in abundance – just like here today, we are able to harness the wind power because Falkirk has plenty of wind, 250 years ago coal took off as the main energy source simply because was so much of it to be found right here beneath our feet

Source: Unsplash

Iron Foundries

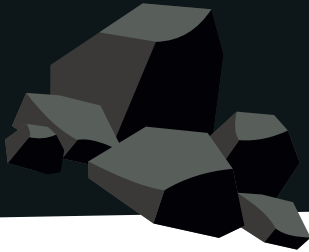
Coal was used to power the Iron Foundries - the Carron Iron Company here in Falkirk was one of the largest Iron Foundries in the world for over 200 years and made many iron products that were sold all over the world.

Coal was also essential for fuelling brick-making, sieve-making industries and many more.



Carron Iron Goods, Early 20th century.
Credit: Falkirk Archives. Maker: Unknown

People used coal to fuel fires in their homes – before electricity became available, this was their only source of light, heat and means of cooking.



Two Falkirk women by a coal-fuelled fire in their home, 1907.

Credit: Photographer: Thomas Easton via Falkirk Archives



Coal-fired power stations were eventually built to generate electricity for homes and businesses, and coal from Falkirk was transported all over the country.

Eventually the most efficient of these power stations were linked up to feed into the National Grid, to standardise the nation's electricity supply via electricity pylons (**and where was the first ever electricity pylon built.....Falkirk??**)

Coal-fired power station, Etna Road, Falkirk, 1920s.

Credit: Falkirk Herald via Falkirk Archives

Discuss

Do you know if anyone in your family worked in the coal mines?

Appendix Here



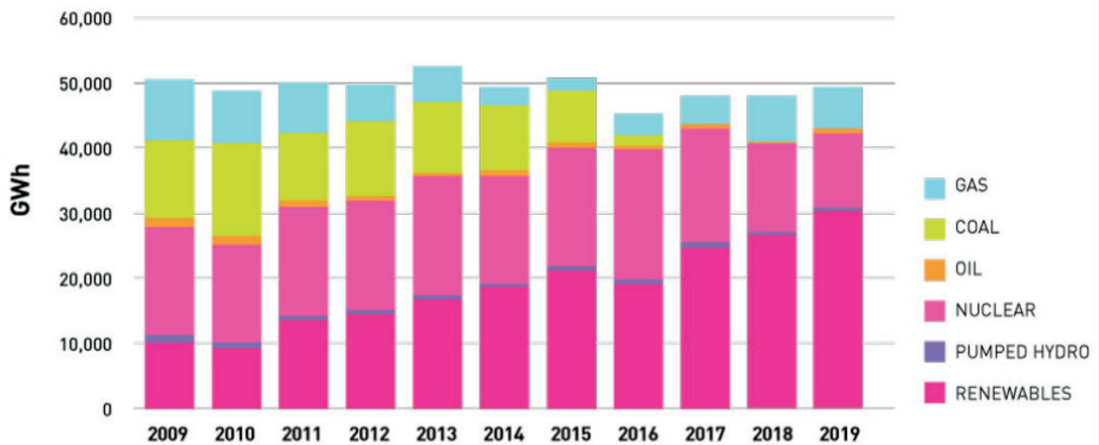


Homes, businesses and entire industries relied on coal for many years, before the switch to gas/oil in the mid-20th century.

Why have we now moved away from fossil fuels towards cleaner energy sources?

Dunipace Pylons, 1984. Credit: Falkirk District Council: Planning & Environment via Falkirk Archives

ELECTRICITY GENERATION IN SCOTLAND BY FUEL (GWh)



Did you know, Scotland hasn't used coal to produce electricity at all since 2016

<https://www.scottishrenewables.com/our-industry/statistics>

OPTIONAL

Coal Vs Wind Sorting Activity (See Additional Resources)

STEM Story Challenge

...low enough.

Pupils at Kelpie High School in Falkirk have been learning all about wind power!

Many pupils think it would be a good idea to have a wind turbine installed on school premises. In harnessing the wind to generate all of the electricity the school needs, a wind turbine would potentially save them hundreds of pounds in energy bills every year while also reducing their carbon footprint.

Unfortunately their head teacher, Mr Mackie, isn't convinced it's a good idea.

He's not sure that a mini wind turbine would be able to generate enough energy to power an entire school and is worried about how much it would cost to design, build and install.

Therefore it's up to you to design and create a prototype wind turbine from low-cost classroom resources to demonstrate how easy it is to generate energy from the wind.

The team that designs the turbine that lifts the most weight will win!

Are you up to the challenge?

For most of the...



STEM Activity Instructions

Activity Summary: Pupils will be working in groups of three to design, create and test a wind powered machine made from low cost materials.

Source: Practical Action



Teacher Note

See page 23 for pupil-friendly instructions to be photocopied and given out to each group

Complete Kit list

15 activity packs (10x for pupils working in groups of 3 plus 5 spare and for teacher to practice).

Inside each activity pack you will find:

1x roll of sticky tape

1x pencil

1x paper cup

60cm of string (needs to be cut up in advance by teacher)

Scrap card (approx. 1xA4 per group)

Additional materials not provided in box:

Weights (e.g. coins, Maths manipulatives ,..as long as it's the same in each group)

Scissors (1 pair per group)

Hairdryer (1 per class)

BEFORE LESSON

Set out the correct number of activity packs (1 per group) and gather materials that were not provided in box (see below)

Cut up 60cm of string per group / activity pack

AT THE START OF THE LESSON

Hand out the Different Types of Wind Turbines Poster (pdf) to groups for pupils to refer to throughout the activity.

If you are using the planning or reflection worksheet, prepare these now.



Let's take a look at some different kinds of wind turbine...

What is the same about these turbines? What is different?

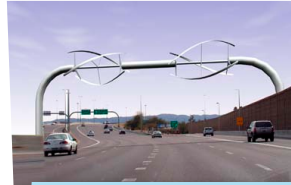
Different Types of Wind Turbines



Wind turbine used to pump ground water in Kenya



Wind turbine from a small scale wind power scheme in Peru



In development is an idea for wind turbines that can be placed over roads to capture wind generated from passing cars



Roof top turbine which sends the electricity it produces straight into the house to be used



Vertical axis wind turbine which takes wind from any direction and can be used in areas where there are buildings and trees



Wind farm turbines that have blades which turn at six times the speed of the wind



Traditional windmill used to grind flour

Can you explain these differences – why did the designers make these different decisions?

practicalaction.org/STEM



Poster Access Here



The main difference in design is that turbines producing electricity need to spin fast so have fewer (typically three), thinner blades. Those that harness wind power to drive machinery, such as water pumps and windmills, **need a higher torque** and to be more stable. They generally have a higher number of larger blades.

Poster: Different Types of Wind Turbine. Credit: ©Practical Action

Teacher Note

In groups, pupils need to think about what design decisions they will make regarding the number of blades and their shape/size, and also how the shaft will be attached to the desk.

You could also take this opportunity to discuss variables: what will be kept the same (control variable) and what will be changed during the testing (test variable). The pupils should understand that in order for the test to be fair, the wind turbine design and hair dryer power should be kept the same whereas the weights used to test will gradually increase and therefore vary.

Optional:

Discuss how the design could be made in as sustainable a way as possible, e.g:

- By reusing scrap material rather than new
- By reducing waste to a minimum (card, sellotape, string)
- Do you need to use a hairdryer? Is there anything less energy intensive that could be used as a wind source?

Optional:

At this point pupils could spend time filling in the STEM Story Challenge Planning Worksheet



**GOOD
LUCK**

Let's do it!

Instructions:

Your task is to work together to use these materials to design and create a wind powered turbine. The winning team will be the one producing a machine that lifts the most weight off the ground using a hairdryer!

You have just 20 minutes to complete your wind turbine

When time is up you will be asked to demonstrate your machine and tell the rest of the class why you made your design choices and how you did it!

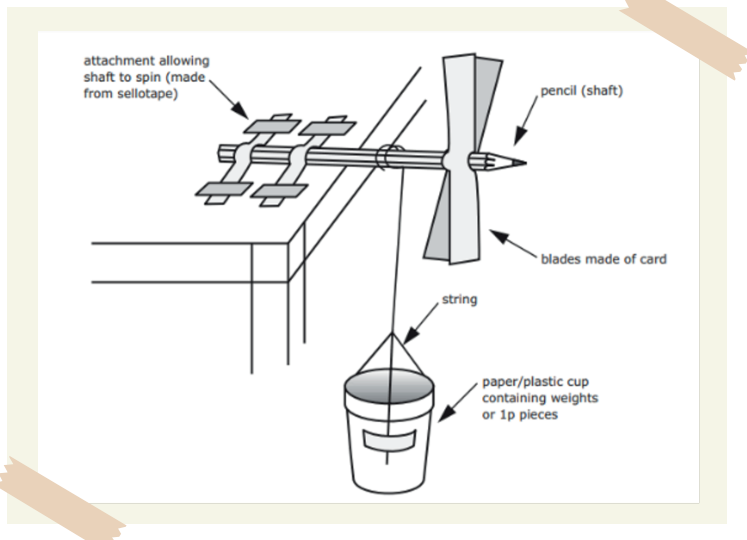


Diagram of Possible Wind Turbine Design. Credit: © Practical Action

Optional

You could show them this example of a wind turbine design using the materials provided – it's up to you if you wish to show this to your pupils before or after they try to come up with their own design.

Teacher Note

After 20 mins, most pupils should have completed or nearly completed their turbine.

The next step is for pupils to test their turbine using an agreed set of weights (e.g. pennies, maths cubes).

One by one, each group should prepare to present to the class:

- How their turbine works (live demonstration)
- How much weight it can lift
- Why they made their design decisions.
- If they had the chance to do it again, what improvements would they make and why?

As all the groups are presenting, keep a note of how much each turbine can lift so you have crown one group the WINNER at the end!

**Optional:
STEM Story Challenge: Reflection
Worksheet**



STEM Story Challenge: Wind Power

Pupils at Kelpie High School in Falkirk have been learning all about wind power!

Many pupils think it would be a good idea to have a wind turbine installed on school premises. In harnessing the wind to generate all of the electricity the school needs, a wind turbine would potentially save them hundreds of pounds in energy bills every year while also reducing their carbon footprint.

Unfortunately their head teacher, Mr Mackie, isn't convinced it's a good idea.

He's not sure that a mini wind turbine would be able to generate enough energy to power an entire school and is worried about how much it would cost to design, build and install.

Therefore it's up to you to design and create a prototype wind turbine from low-cost classroom resources to demonstrate how easy it is to generate energy from the wind.

The team that designs the turbine that lifts the most weight will win!

Are you up to the challenge?

Kit list

A4 Card
1x roll of sticky tape
1x pencil
1x paper cup
1x pair of scissors
60cm of string
Weights
Hairdryer (1 per class)



Instructions:

- Your task is to work together to use these resources to design and create a wind powered turbine. The winning team will be the one producing a machine that lifts the most weight!
- You have just 20 minutes to complete your wind turbine
- When time is up you will be asked to demonstrate your machine and tell the rest of the class why you made your design choices and how you did it!

**GOOD
LUCK**

TIP:

Use these designs from the **Different Wind Turbines** poster to inspire you!

STEM Challenge Planning: Wind Power Challenge

What is the challenge?

.....

Brainstorm ideas:



Wind turbine ideas

List of materials:

.....

.....

When you test your turbine, how could you measure if it is successful or not?

.....

.....

.....

.....

OPTIONAL: Variables: to ensure your test is fair, what things could you keep the same (control), and what could you change (test)?

TIP: think about the shape, size and thickness of the blades, and how the shaft is attached to the desk

.....

.....

.....

.....

.....

Describe how you will make your wind turbine OR draw and label a diagram of your proposed wind turbine

Safety check

Risk	High/Medium/Low	What could happen	Prevention

What other problems are you anticipating and how could you avoid or resolve them?

.....

.....

STEM Challenge Reflection: Wind Power Challenge

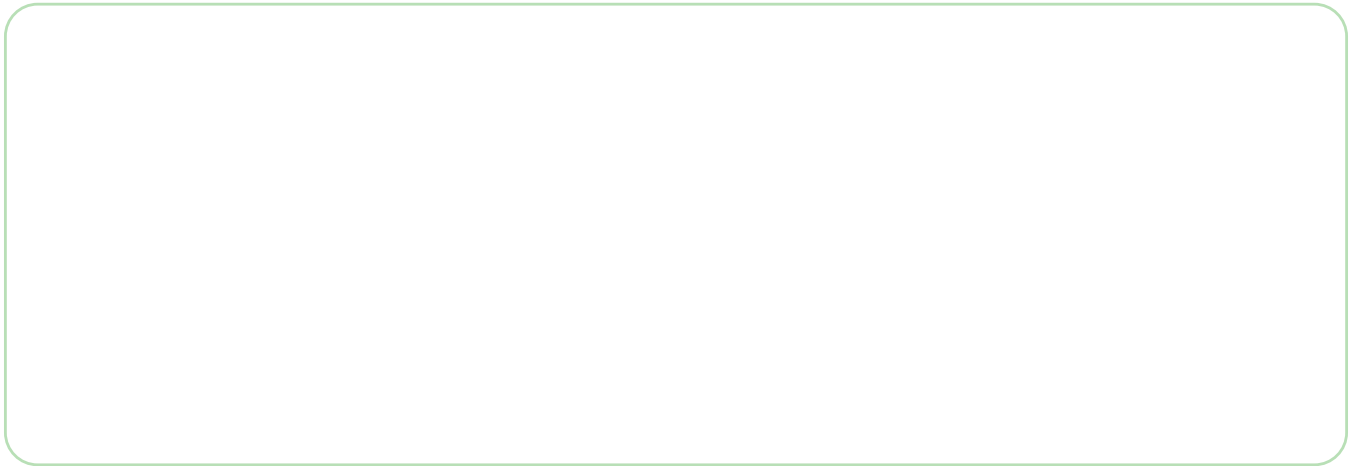
What is the challenge?

.....

List of materials used:

.....

Draw and label a diagram of your wind turbine:



Results: did your wind turbine turn out like you expected? Explain why/why not.

.....

.....

.....

Results: what happened when you tested your wind turbine?

.....

.....

If you could have another go, what might you do differently?

.....

Pupils could explore the variables that will be involved in making design decisions.

- Shape of the blades – research the link to nature: shape of bird's wings, seeds falling from trees
- Number of blades – pupils could experiment with 2 or 4 blades and report back on findings.
- Size of blades -
- Thickness of blades
- How the shaft is attached to the desk

Pupils could explore how the design could be made as sustainable as possible, e.g.

- Reusing scrap material rather than new
- Reducing waste to a minimum (card, sellotape, string)
- Do they need to use a hairdryer?

You could introduce a prize for the most sustainable design as well as the one which lifts the most weight.

- Ask the students to think about how they want to make it a 'fair' test.
This could include
- Limiting the amount of materials (card, sellotape, string) that can be used for each group
- Ensuring all the hairdryers are of the same power rating
- Ensuring the hairdryer is a fixed distance away from the blades
- Allowing or not allowing students to touch the machine when it is operating

STEM Heritage Quiz

Q1. Which energy source is the fastest growing technology in Scotland today?

- a) Hydro b) Gas c) Coal d) Wind

Q2. What are the two types of wind farm found in Scotland?

Q3. Why is Falkirk a good place to harness wind power?

Q4. Which energy source powered the industrial revolution?

- a) Oil b) Wind c) Coal

Q5. What kind of engine did James Watt develop in Bo'ness in 1769?

- a) Steam-powered coal engine
b) Coal-powered steam engine

Q6. Name two industries in Falkirk that relied on coal to provide power the heavy machinery:

Q7. Give one pro / one con of coal as an energy source

Q8. Give one pro / one con of wind power as an energy source

Answers

Q1: d)

Q2: (onshore / offshore)

Q3: Windy/rural area

Q4: c)

Q5: b)

Q6: (brick-making, iron foundries, sieve-making, file-making)

Q7: see sorting activity for range of answers

Q8: see sorting activity for range of answers

STEM Career Pathways: Wind Power

Meet one of our key partners in gathering resources for this STEM box:

Lorna Bennet from **ORE Catapult**.

Lorna is a Mechanical Engineer in the Operational Performance directorate at the Offshore Renewable Energy Catapult.

Use these links to learn more about the jobs that interest you!

DYW Live: <https://e-sgoil.com/dyw/>

ORE Catapult are running monthly 1 hour online presentations about the different areas of renewables and projects they are working on. Teachers need to register here: shorturl.at/acjBZ

Interesting opportunities for future careers and environmental discussions in [the](https://www.youtube.com/watch?v=VsK-3Gg4-iE)<https://www.youtube.com/watch?v=VsK-3Gg4-iE>

My Energy Future careers videos:
<https://www.myenergyfuture.co.uk/>

The IET have a great series of videos for female role models in Engineering linked to their Young Woman Engineer of the Year Awards:
https://youtube.com/playlist?list=PLtIC0J_-ClBtNSza92B8NEXqhppoaGIXU

This mapping tool provides information on industry roles, job duties, qualifications, training, experience, and skills required
<https://www.renewableuk.com/Page/CareerMapping>

Faces of Renewable Energy
<https://www.facesofwindenergy.com/>



Lorna Bennet, Mechanical Engineer at ORE Catapult.

Credit: Photographer: © ORE Catapult

Find out more about Lorna's work here:

<https://www.youtube.com/watch?app=desktop&v=tbIT0wz5Rhc>

Follow this link to access more video content from Lorna and her colleagues at ORE Catapult.



Another wind farm in Falkirk?

(please note: this is a fictional scenario!)

Should another Wind Farm be built in Falkirk ?

EDF Renewables have chosen Falkirk as a suitable site to build a wind farm, similar in size to Whitelee Farm (the biggest in Scotland!)

This proposed wind farm would include 210 turbines which are 121 metres tall. According to EDF, these turbines will generate 560MW of electricity which can be used to power 360,000 homes.

Using this photo and map and what you already know about Falkirk's landscape and climate, **can you suggest reasons why this site was chosen as a suitable site to build a wind farm?**



Credit: Falkirk District Council: Planning & Environment via Falkirk Archives



Credit: Google Maps

Does everyone see this development as a good thing?

Different groups have different viewpoints about the development. Some groups support the proposal, whereas others oppose it. This can cause conflict.

Read through the conflict dilemma cards in front of you, complete the table below .
Be sure to use evidence to support your statements.

Who? For/Against?	Reasons for their opinion

Another wind farm in Falkirk?

Hallglen & Shieldhill Residents

You are the residents of Hallglen & Sheildhill. Even though you understand why Scotland needs renewable energy, you don't understand why it needs to be in your back gardens!



Scotland Against Spin

You are Scotland Against Spin, an organisation trying to change the Scottish Government's wind energy policy as it believes that wind farms have a negative impact on society and the natural environment.



EDF Renewables

You are EDF Renewables, the company which wants to build these wind turbines in Falkirk. You are unpopular with groups that are against wind farms, so you need to work hard to persuade them that your plan will benefit the local area.



Falkirk Council



You work in the planning department at Falkirk Council. As local government workers, you need to think about what will benefit your people, your economy and the environment—not only on a local scale, but also a national scale. Your aim is to showcase Falkirk as a council ward that is leading the way in terms of environmental issues.



Falkirk Council

Coal vs. Wind:

Which energy source comes out top, socially, economically and environmentally?
Can you sort the statements into the correct place in the boxes?

	Coal 	Wind 
Social (how it impacted people, community, everyday life)		
Economical (how it impacted jobs business, money & resources)		
Environmental (how it impacts the natural environment, including how things look and sound)		

Wind farms could add £2.3 billion to the economy by 2050.	Collieries were “dirty, ugly blots on the landscape, with steam, smoke and dust flying about.”	Extensive mining in the area has left scars on the landscape visible today
Energy from coal and other non-renewable fossil fuels is now linked to global warming and pollution on a global level.	Many people, including in Falkirk, oppose wind farms due to impact on landscape, wild life etc.	Recent technological developments mean that there is less noise now than there once was with wind turbines.
Many Wind energy companies sponsor local events and local schools, claiming to provide many benefits for the community	Coal literally fuelled the industrial revolution all over the world creating jobs and expanding villages, towns, cities and communities, transforming the rate of industrial production creating new, highly profitable industries. The economy would never be the same again.	Community-driven wind farm projects are on the rise, where members of a community come together to utilize wind energy to support and reduce energy costs to the local community.
Wind turbines which create electricity mean that large pylons would need to be built across the landscape to transport electricity.	Wind turbine blades cannot be recycled	Wind farms could add £2.3 billion to the economy by 2050.
Coal was abundantly available all across the Falkirk area (and much of Scotland).	Some people think wind farms are pretty.	It can encourage tourism in the area. A lot of people are interested in wind farms.
Coal was for many years the cheapest and most efficient energy source available.	In the 19th Century collieries (coal mines) then popped up all over Falkirk and provided thousands of local people (men, women and children) with reliable incomes.	Many collieries established various social, educational and leisure activities and groups for miners and their families to take part in.
The coal mines were a central aspect of everyday social and communal life in Falkirk’s towns and villages.	After a wind farm is built, full time, permanent jobs to maintain the turbines and keep them safe become available to local residents.	There is a lot of wind in Falkirk which makes it an ideal place to build wind turbines. It would be a pity not to take advantage of our natural resources.
While a wind farm is built, lots of full time jobs are created temporarily in the area to build the turbines	The parts of the turbines, made of steel, are often manufactured abroad.	Turbines cannot be used if the winds are too low or too high, so they can be unreliable.
Today, the Falkirk area’s strong links to coal and the Industrial Revolution means Falkirk is a site of historical interest, which in turn creates jobs in heritage sector and generate tourism	Wind energy is cheap to produce—it costs roughly 3 to 4 pence to create every unit of electricity—similar to coal prices but less than nuclear.	Wind is clean, low-carbon and renewable energy source which leaves no pollution.
Building wind farms can create thousands of jobs a year in Scotland.		

Answers

Coal



Wind



Social

(how it impacted people, community, everyday life)

The coal mines were a central aspect of everyday social and communal life in Falkirk's towns and villages.

Many collieries established various social, educational and leisure activities and groups for miners and their families to take part in.

Many Wind energy companies sponsor local events and local schools, claiming to provide many benefits for the community.

Community-driven wind farm projects are on the rise, where members of a community come together to utilize wind energy to support and reduce energy costs to the local community.

Economical

(how it impacted jobs business, money & resources)

Coal was for many years the cheapest and most efficient energy source available.

Coal literally fuelled the industrial revolution all over the world creating jobs and expanding villages, towns, cities and communities, transforming the rate of industrial production creating new, highly profitable industries. The economy would never be the same again.

In the 19th Century collieries (coal mines) then popped up all over Falkirk and provided thousands of local people (men, women and children) with reliable incomes.

Today, the Falkirk area's strong links to coal and the Industrial Revolution means Falkirk is a site of historical interest, which in turn creates jobs in heritage sector and generate tourism.

Wind energy is cheap to produce—it costs roughly 3 to 4 pence to create every unit of electricity—similar to coal prices but less than nuclear.

Building wind farms can create thousands of jobs a year in Scotland.

While a wind farm is built, lots of full time jobs are created temporarily in the area to build the turbines

After a wind farm is built, full time, permanent jobs to maintain the turbines and keep them safe become available to local residents.

The parts of the turbines, made of steel, are often manufactured abroad.

It can encourage tourism in the area. A lot of people are interested in wind farms.

Wind farms could add £2.3 billion to the economy by 2050.

Environmental

(how it impacts the natural environment, including how things look and sound)

Coal was abundantly available all across the Falkirk area.

Collieries were "dirty, ugly blots on the landscape, with steam, smoke and dust flying about."

Extensive mining in the area has left scars on the landscape visible today

Energy from coal and other non-renewable fossil fuels is now linked to global warming and pollution on a global level.

There is a lot of wind in Falkirk which makes it an ideal place to build wind turbines. It would be a pity not to take advantage of our natural resources.

Turbines cannot be used if the winds are too low or too high, so they can be unreliable.

Recent technological developments mean that there is less noise now than there once was with wind turbines.

Some people think wind farms are pretty.

Wind turbines which create electricity mean that large pylons would need to be built across the landscape to transport electricity.

Many people, including in Falkirk, oppose wind farms due to impact on landscape, wild life etc.

Wind turbine blades cannot be recycled

Wind is clean, low-carbon and renewable energy source which leaves no pollution

Explore Further:

Helpful links and resources from our partners ORE Catapult

Two PowerPoint presentations: Fun facts about Wind Power and Turbine Blades (ORE Catapult)

Four lessons for First and Second Level pupils (ORE Catapult)

See: Wind Turbine – 4 lessons (5x MS Word docs)

Download Content Here



YouTube videos (ORE Catapult)

Levenmouth Demonstration Turbine in Fife

https://www.youtube.com/watch?v=xNTgQxqdZ_E

Robotics in offshore wind

<https://www.youtube.com/watch?v=977PK2afP04>

Sustainable decommissioning of offshore wind (circular economy)

<https://www.youtube.com/watch?v=VsK-3Gg4-iE>
great opportunities for future careers and environmental discussions.

Our test facilities in the north east of England

<https://www.youtube.com/watch?v=w8CWOkfq8FM>

Explaining the forces and loads on a turbine

https://www.youtube.com/watch?v=7C0_rmHqnT0

Recommended activities + resources to purchase:

EcoStyle turbines

<https://www.ecostyle.co.uk/shop/p/wind-turbine-kit>

Science4you Wind Power kit

<https://www.booghe.co.uk/products/vivid-science4you-wind-power-kit>

Knotts to Watts

<https://www.scdi.org.uk/yesc/knotts-to-watts-celebration-of-stem-2020-21/>

https://www.scdi.org.uk/yesc_downloadable_resources/

Where does the wind come from?

https://www.youtube.com/watch?v=niZ_cvu9Fts

Experimental example to demonstrate and possibly recreate

<https://www.youtube.com/watch?v=zBU23ZM6EO8>

Right click the links to open them up in a new tab!



CATAPULT
Offshore Renewable Energy

Facts about renewables in Scotland:

The world's first wind turbine built to make electricity was invented by a Scotsman, James Blyth, in 1887, who was a professor at what is now the University of Strathclyde:

https://scienceonstreets.phys.strath.ac.uk/new/James_Blyth.html

The world's first commercial wave energy converter was designed and built in Edinburgh in 2004

<https://www.emec.org.uk/about-us/wave-clients/pelamis-wave-power/>

We have the world's first tidal array (farm) in Shetland, designed and build by a team in Edinburgh 2016

<https://www.novainnovation.com/>

The world's first commercial scale tidal array in the Pentland Firth with Atlantis Energy and the MeyGen Project 2016

<https://simecatlantis.com/projects/meygen/>

We also have the world's first floating offshore wind farm at Hywind Scotland 2017

<https://www.equinor.com/en/what-we-do/floating-wind.html>

Scotland hasn't used coal to produce electricity at all since 2016

<https://www.scottishrenewables.com/our-industry/statistics>

In 2019 Scotland supported 22,660 full time jobs in the renewables sectors (some other interesting numbers here

<https://www.scottishconstructionnow.com/article/new-figures-reveal-extent-of-scotland-s-renewable-energy-jobs-and-investment>)

Offshore wind in Scotland is set to increase by a factor of 10 times by 2030, and there will be thousands of jobs created to install and maintain all the new wind turbines and the equipment that comes with them (vessels, robotics, etc.).

This video shows some of the technology developments ORE Catapult is working with companies to develop

https://www.youtube.com/watch?v=xNTgQxqdZ_E

Community Driven Wind Power Projects

A School run community energy project at Glenmuckloch:

<https://www.buccleuch.com/energy/glenmuckloch-community-energy-park/>

The Isle of Eigg

<http://isleofeigg.org/eigg-electric/>

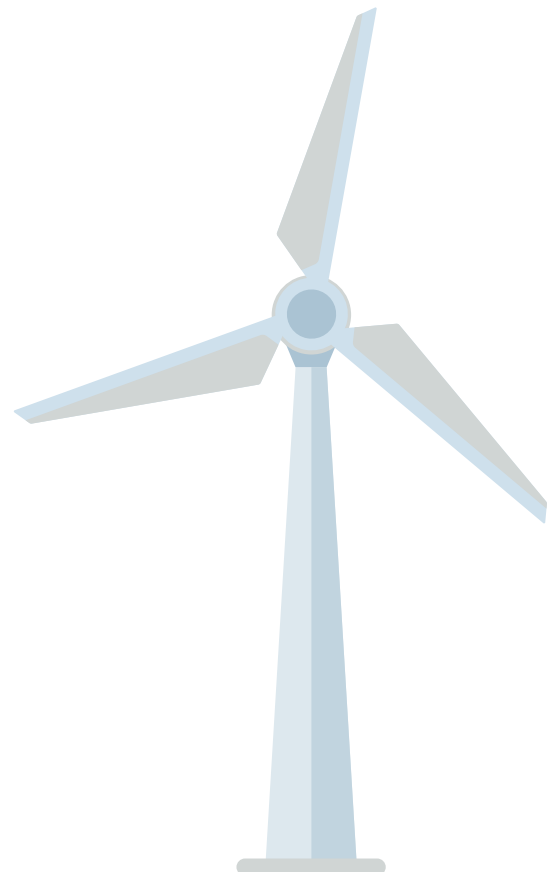
<https://www.youtube.com/watch?v=6gK1BZO14Gg>

<https://www.communityenergyscotland.org.uk/projects-innovations/western-isles-micro-turbines/>

<http://www.scottishenergynews.com/big-news-for-scotland-western-isles-community-owned-wind-turbines-will-reach-19-5-megawatts/>

"Community and locally owned renewable energy in Scotland at June 2020"

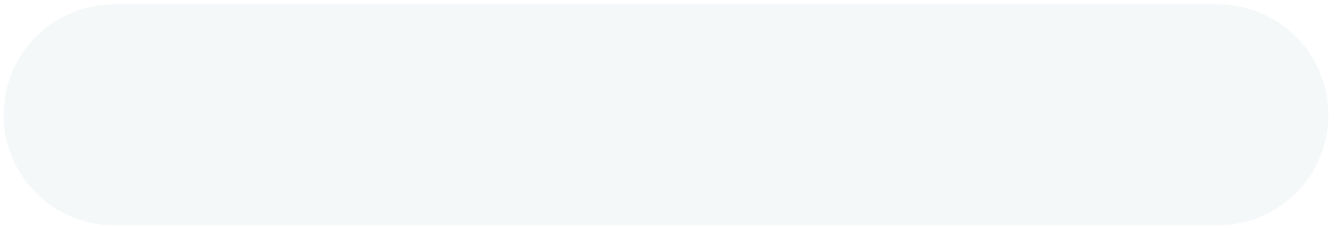
<https://energysavingtrust.org.uk/wp-content/uploads/2021/03/Community-and-locally-owned-renewable-energy-in-Scotland-2020-report.pdf>



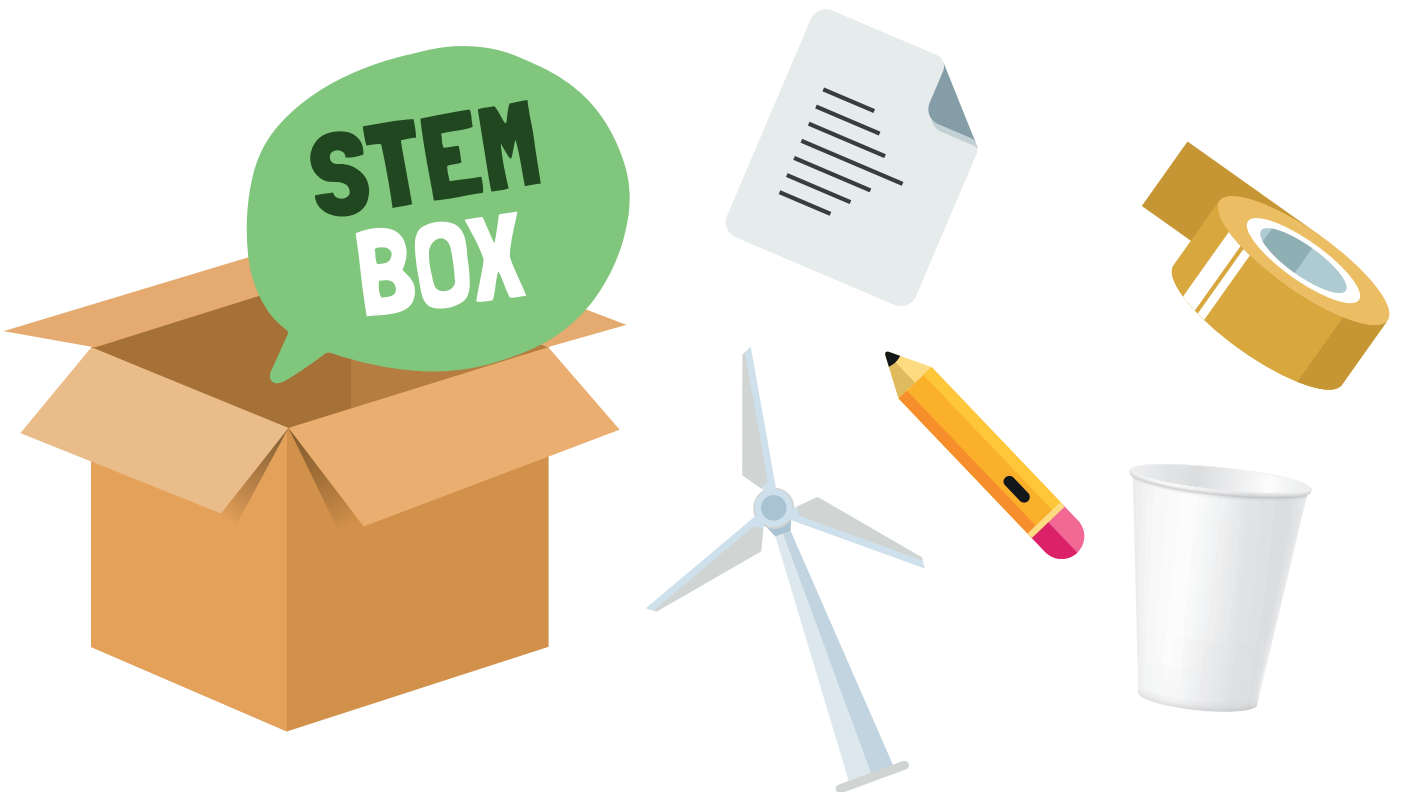
Certificate of Completion



This certificate is awarded to



for the completion of the **Wind Power in Falkirk**
STEM Box Experiment



Taking care of your STEM Box

Thank you for choosing to use this STEM Box resource in your classroom. In preparation for the lesson we wanted to include a few helpful pointers to ensure the activities go as planned:

- To enable a smooth introduction to this topic of Wind Power for everyone, we have included teacher's notes alongside the lesson script, as well as an appendix which features additional background information on coal as an energy source in Falkirk. There is also a whiteboard-friendly version of the information to be accessed on your digital board or laptop.
- Within the activity section, we have provided the majority of resources needed for pupils to carry out the challenge, however we reasoned that we would be better off asking teachers to source a few key classroom materials to save on unnecessary costs (and the environment!). The resources you will need to gather yourself are clearly listed in the STEM Story challenge section.
- We have designed this resource as shared between groups of 2-3 pupils in a 30-pupil class, it can also be easily adapted to suit groups or individuals. There are also a few activity packs left over for practitioners to practise with if desired.
- If you need additional copies of any of the worksheets, please feel free to photo copy from the teacher's guide.
- COVID 19: The STEM box is designed in such a way as to encourage learning in a way that works socially distanced or within small groups/pairs where pupils can use their own tools independently and share where appropriate. Wiping down of any shared item is encouraged.

Please keep your STEM Box in a cool, dry location

The box is made from 75% recycled material, 100% recyclable & degradable

The worksheet wallets included are 100% recyclable

The packaging can be used more than once. We encourage reuse where appropriate by keeping your printed teachers guide handy, and placing all unused materials or worksheets back in the box for another class.

We recommend that you model to pupils how to safely use scissors and supervise closely where necessary.

Please keep string out of reach of small children. Prepare small sections before distributing to pupils to avoid injury.

Risk Assessment



Wind Power in Falkirk

Content creation and curation supported by Lorna Bennet at ORE Catapult.

STEM Activity originally created by Practical Action.

Compiled and Edited by Natalie Allison and Harriet Ward

Graphic Design: Bluestone 98

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Thank you to Lorna Bennet from ORE Catapult for developing and sharing her vast knowledge of wind power and the renewables sector in Falkirk, Scotland and beyond!

Thank you to Practical Action for allowing us to repurpose their activity, 'Wind Power Challenge', accessed here:

<https://www.sustainablelearning.com/resource/wind-power-challenge>.

"The Wind Power Challenge was created by Practical Action. Practical Action is an international development organisation that puts ingenious ideas to work so people in poverty can change their world. It works with communities to develop ingenious, lasting and locally owned solutions for agriculture, water and waste management, climate resilience and clean energy. And it shares what works with others, so answers that start small can grow big. You can find more resources like this one at:

www.practicalaction.org/school"

Thank you to the Falkirk RAiSE team and Barbara Hanning for supporting the development and distribution of the boxes.

This STEM box has been funded by National Lottery Heritage Fund as part of Great Place Falkirk: Landscape, Industry, and Work project and the Scottish Government as part of Falkirk Science Festival.

Warning: The STEM Box is a Science Experiment Kit
Not suitable for children under 8 years
For use under adult supervision
Some parts may cause skin or eye irritation

Some parts may be Flammable
May Contain Small Parts
Recyclable
Handle with Care
Store in a cool, dry place
For Educational Purposes Only

