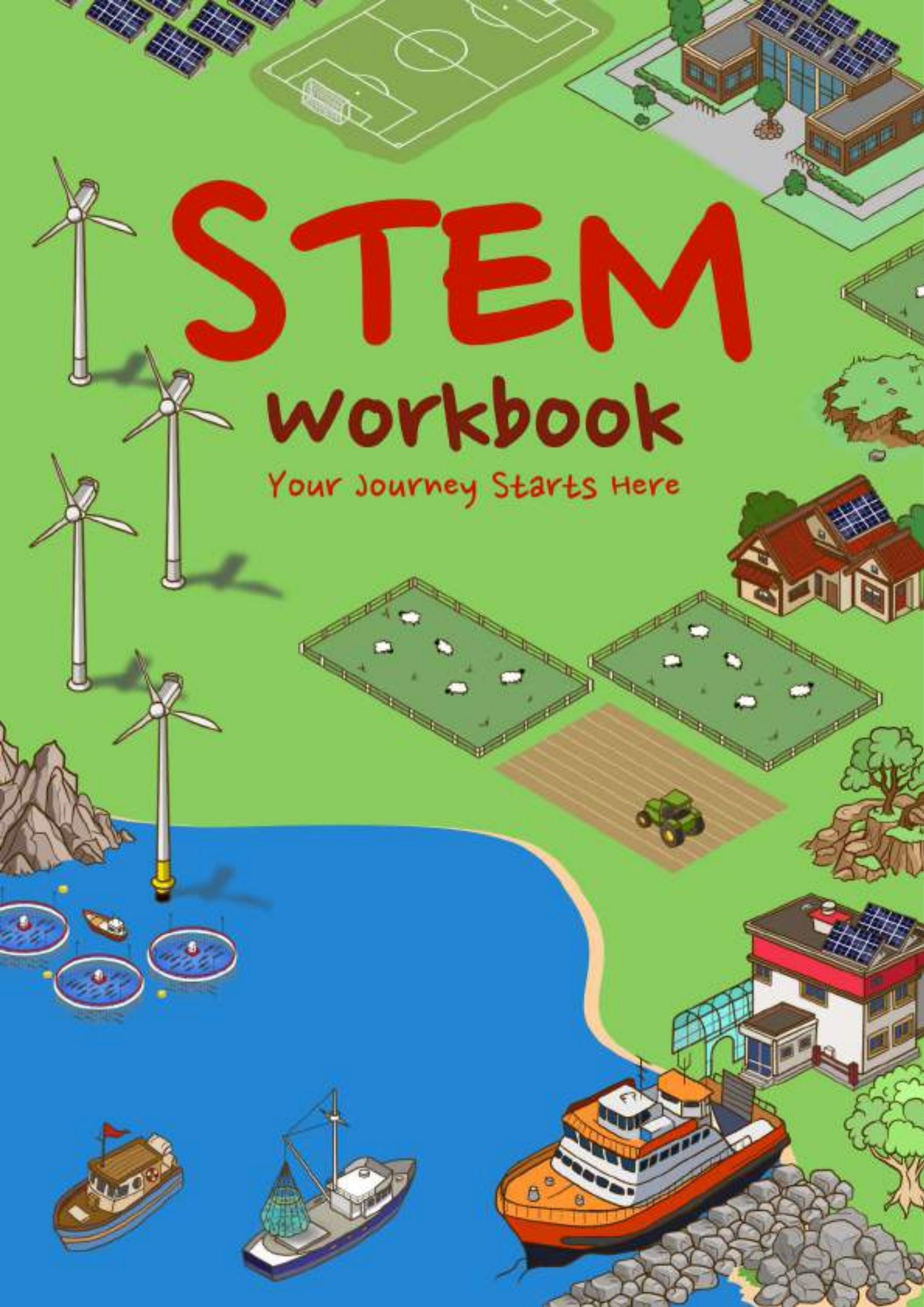

STEM
Workbook
Your Journey Starts Here

Who are we?

Hi my name is Eddie, I will be popping up in this workbook to tell you fun facts!

Katie

Suzy

Hal

We are Katie, Suzy and Hal, Education Officers at ALIenergy, and we work to support learning around four important subjects - Science, Technology, Engineering and Maths. We do this with workshops in schools, taking part in summer shows and careers events.

This workbook is for you to learn about STEM and have some fun in the classroom and at home. Enjoy the activities and be creative with your workbook, there are lots of different challenges to try.

What is STEM?

Science, Technology, Engineering and Maths are not just subjects at school, college or university. They are in almost everything we experience and explore: the buildings, plants and animals around us, the food we eat, the gadgets we use, how we get around, not to mention the energy we need for life and learning in our technological world.

In our ever changing world many of the challenges we face require STEM skills to tackle them. Climate change, along with increasing populations, is putting significant pressure on demands for food, clean drinking water and energy sources. The world needs STEM specialists to help overcome these challenges in the world and solve the climate change challenge.

Why is STEM So important ?

Because our world and our existence relies on it! STEM subjects and skills are key in solving and overcoming real world challenges.

The world needs STEM specialists to help solve climate change and the huge challenges it brings worldwide.

A shortage of people with STEM skills is a huge problem for the UK economy. It's so important that young people now develop an interest in STEM and explore STEM career options.

Technology is expanding into everything we do from the latest iPhone to video doorbells. This could not happen without STEM!

Global Issues

You may have heard the terms climate change and global warming in the news. Climate change is the overall increase in the Earth's surface temperature caused by humans. This increase in temperature causes extreme weather events like floods and droughts, making it harder for humans and nature to live on this planet. Burning fossil fuels like coal, oil and gas are some of the main causes of climate change. However scientists and engineers have developed solutions to reduce our reliance on fossil fuels.

Kinetic energy is the name given to energy from movement.

Local Solutions

As you know it rains in Argyll. A lot! It is also a very hilly place, we can use these two characteristics to make clean electricity. We can store water behind dams up in the mountains and then release it down huge pipes to a power station turning that kinetic energy into electricity. This is called hydro electricity. The good thing about this is we can choose when to release the water, so at 6pm when we're using lots of electricity for cooking we can release the water. Do you recognise this hydro electric power station?

There are smaller solutions as well such as solar panels on roof tops (lots of schools in Argyll and Bute have their own solar panels now!), electric car charging points and insulating homes so they use less energy. These small things add up to help tackle climate change. There are local benefits too like cheaper energy bills, cleaner air and STEM jobs.

Have you seen these structures around Argyll? These are wind turbines that use the power of the wind to generate electricity. Meaning we don't need to burn as much polluting fossil fuels, so less carbon dioxide is produced helping to combat global warming. Argyll is a great place for them as it is very windy. There are lots of STEM careers relating to wind power. Such as technicians, engineers and ecologists.

The Argyll and Bute Energy Scene

Argyll and Bute has a lot of renewable energy potential from its natural resources. There is plenty of wind, rain, tides and even sunshine which we can use to create clean renewable electricity.

To create a wind farm or hydroelectric power plant, skilled people are needed to design and construct them. There is also a need for people to maintain and operate them after they are built. This not only creates jobs directly, such as a wind farm technician but also indirectly for example maintaining the vehicles wind turbine technicians use to get to and from the wind farm.

This doesn't mean it isn't without its challenges. It can be disruptive to local people with the increased construction traffic on the roads and some people don't like the look of wind turbines. Have you seen a wind turbine? what do you think?

The map below, shows some of the big renewable energy sites in Argyll and Bute. There are lots more, have you seen them where you live?

Ben Cruachan Pumped Hydro Electricity power station, built in 1965. It helps "store" excess electricity produced on really windy days. When we need this stored electricity they release the water through the pipes and instantly there is lots of clean electricity!

Mull has several small scale hydro-electric power stations, Garmony hydro scheme is community owned so any money it makes goes back into local projects.

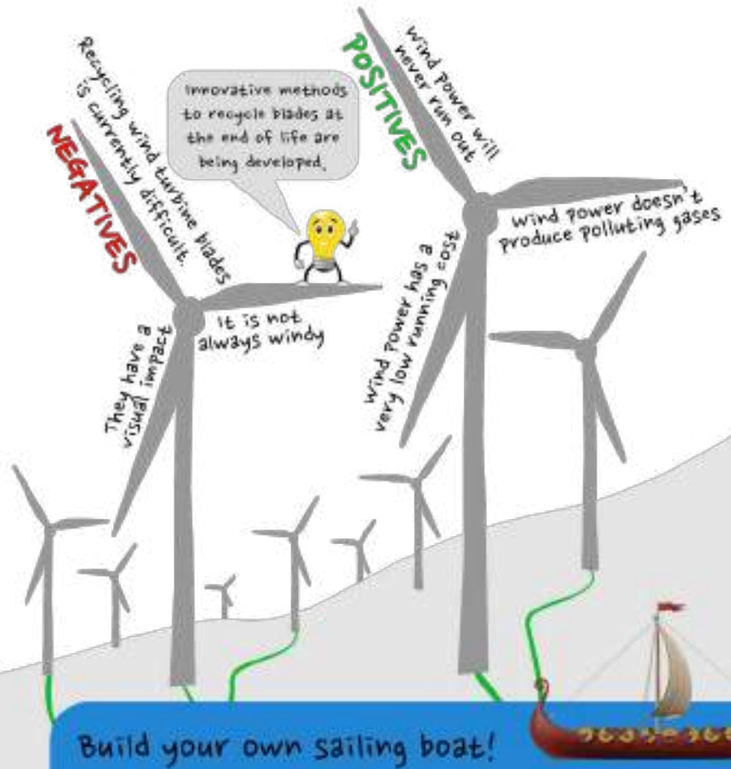
MachairWind will be the first offshore windfarm off the coast of Argyll and Bute. It will be able to power up to 2 million homes.

Loch Sloy Hydro-Electric Scheme is one of the largest hydro electric power stations in the UK. The dam holds back 36 million cubic metres of water.

Machrihanish Business park recently installed a solar farm to help power the businesses in the local area.

Beinn an Tuirc Has 45 turbines, enough to power 150 million xboxes at the same time!!!

Wind Power



What is wind power?

We can use the power of the wind to make electricity. Wind turbines turn kinetic energy into electrical energy. The wind pushes on giant blades which then spin around a central point, turning the movement into electricity.

Wind power myth-busting

"Wind turbines don't work when the wind is not blowing."

Although a wind turbine can't turn without wind, they do work in light breezes. Engineers place them in windy places such as on top of hills or out at sea.

"Wind turbines break when they spin too fast"

Although it is true wind turbines have failed due to storms and high winds, this very rarely happens. Wind turbine technicians ensure the components are well maintained, increasing the life span of the wind turbines.

"Wind turbines harm wildlife."

All man-made objects have some impact on the environment. Any impacts are minimised with careful planning and by carrying out ecological surveys to help inform habitat management plans before construction begins.

Build your own sailing boat!

Humans have been using the wind for tens of thousands of years for moving people and cargo around the world.

You will need: A container such as a margarine tub, a pencil, blue tack, a piece of A4, tape and a stapler.

1). To create the sail, first cut the A4 paper into a square. Fold the square diagonally to create a triangle and fold again. Tape the edges to hold the small triangle together.

2). Attach the sail to the mast (pencil) by pushing the pencil between the layers of paper and staple the paper together to hold it in place.

3). Mould a big blob of blue tack around the base of the mast.

4).Stick the mast to the bottom of the container, you may also need to use tape to add strength.

5). With the help of a responsible adult, find a body of water to test and race your boats.

BONUS EXERCISE: Full size sailing boats can sail upwind, how do they do this? Can you modify your boat to do this?

Hydro Electricity and Energy Storage

Some hydro electric power stations in Argyll and Bute are over 70 years old and still producing clean energy.

Ecologist

A turbine is the term we use for a machine that turns movement into electricity.

'Hydro' is a word we use for things relating to water. Hydroelectricity is the term we use for electricity made from the movement of water.

Positives

Doesn't emit polluting gases

We can choose when to make electricity

Negatives

A valley has to be flooded

It has high upfront costs

2% of UK power is from hydro

Electricity distribution worker

To get water to move we use gravity to move it from a high place to a low place. This converts the gravitational potential energy to kinetic energy. When flowing water passes the turbine at the bottom of the hill it converts it from kinetic energy to electrical energy.

Pumped Hydro Storage is a way we can store energy when we have too much wind power. This involves using huge pumps to move water from a loch up a mountain to a high reservoir, this gives it gravitational potential energy. When there isn't enough wind or there is high demand, the water can be released from the reservoir high in the mountains passing through a turbine to generate electricity.

Tunnelling specialist

There are loads of different jobs in hydro electricity, can you think of any?

We are very lucky in Argyll because we have the mountains and the water to create pumped hydro power plants as there aren't many places this is possible. Another technology is battery storage. These are similar to the batteries in your gadgets but much, much larger. These can help us store excess renewable electricity so we can use it later.

Reservoirs are so big we use cubic metres instead of litres. 1 cubic metre is equal to 1000 litres!

Make your own water wheel!

You will need four paper cups, 2 paper plates, 2 rulers, a bucket or bowl, blue tack, tape, a skewer,a jug

1). Poke a hole in the centre of both plates with the skewer (Picture 1)

2). Tape the cups to the plate (Picture 2)

3). Put the next plate on top and tape this to the cups

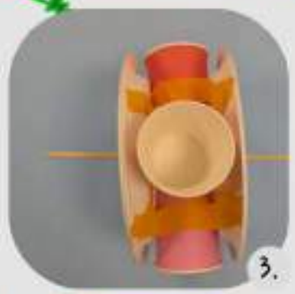
4). Insert the skewer through the holes in the plates. (Picture 3)

5). Use half the blue tack to stick the rulers onto the bucket (Picture 4)

6). Divide the remaining blue tack into 4 pieces, stick 2 pieces 1cm apart in the middle of rulers (Picture 5)

7).Balance the skewer on the rulers between the tack (Picture 5)

8). Fill a jug with water and pour it into a cup on one side of the wheel and watch it spin (Picture 6)



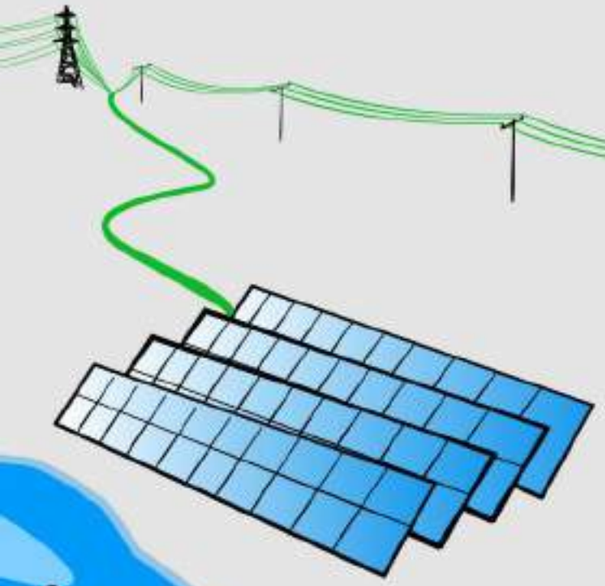
Solar Power

Solar panels turn light energy from the sun into electricity. The technical word for these are photovoltaic panels. When light energy hits a layer of silicon in the panel it creates an electrical charge, creating a flow of electricity.

Solar panels work the best on sunny days but they can still produce electric when it's cloudy. They cannot however produce electricity at night. One solution to this is using batteries or pumped hydro to save the electric for later.

You may find them on little electronic devices. Can you think of one? Or they might be a lot bigger, covering a roof top or as a solar farm.

Solar farms are becoming a familiar sight in some parts of the UK especially in the south of England where it is really sunny. The land below them can still be used for farming or left as a habitat for wildlife.



Did you know solar panels are used to power the International Space Station!

Can you find solar panels near you? Clue they can be big and they can be very small.

True or false? Solar panels can't generate electricity on cloudy days. Answer on page 10.

Build a Solar Oven

We can use the sun's energy for many different purposes. You may have seen solar thermal panels on roof tops which turn the sunlight into heat for hot water. Below we can create a solar oven to cook food.

A Solar Thermal Panel

Even though Scotland is not a warm place, we can concentrate direct sunlight to create heat.

The Odeillo solar furnace in Spain concentrates light to create 2500°c temperatures. Scientists use this for heat experiments

To build a solar oven you will need. A cardboard box (a pizza box works well) aluminium foil, glue stick, black card, cling film, ruler or stick, marshmallows, chocolate, digestives and (very importantly) a sunny day.

1. Cut into the top of the box on three sides about 3cm cm from the edge.

2. Bend this flap up and glue foil to the underside of it.

3. Glue foil to the rest of the sides inside the box.

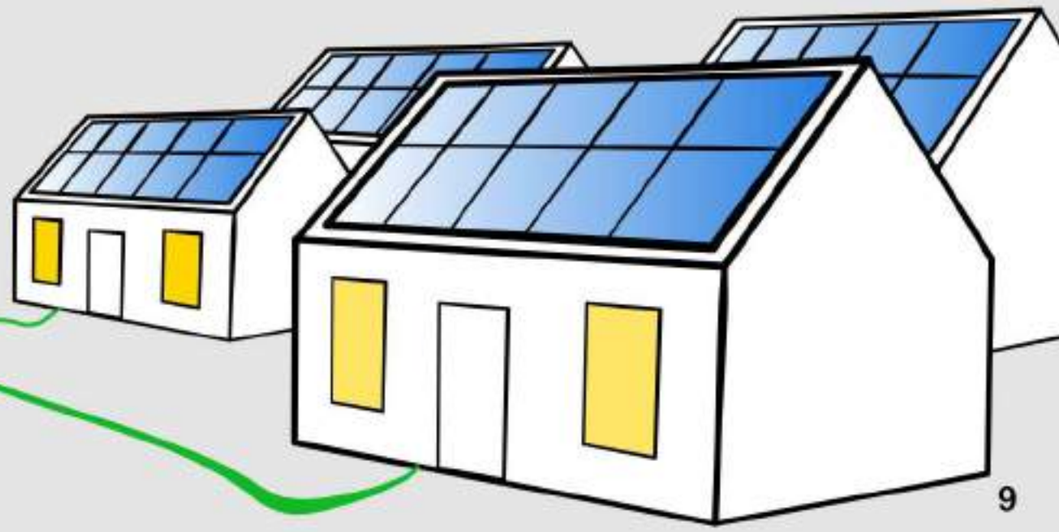
4. Cover the hole with clingfilm by gluing around the edge of the hole. Make sure the clingfilm is taut.

5. Place a black piece of card in the centre of the box.

6. Stack your digestive, marshmallow and chocolate on top of each other and place in the centre of the box.

6. Prop the lid up with a skewer or stick.

7. Find a place with direct sunlight and wait for the marshmallow and chocolate to melt. Enjoy your snack!



The Future of Energy

In the first half of 2025 renewable power produced more electricity than polluting coal for the first time globally. In 2024 the UK closed it's last coal fired power station. The way we use energy is changing, we will need more electricity in the future and this should not be from polluting fossil fuels.

We will need more electricity for electric cars, heating our homes and to power hungry technology such as artificial intelligence.

Can you invent a machine for producing electricity? Use the previous pages as inspiration. Wind and hydro source their energy from movement (kinetic energy). Could other sources of movement be used? Burning fossil fuels creates heat which is called thermal energy. Is there a clean source of heat we can use?

What will your electricity machine look like?

What natural energy source will your electricity machine use? Think: heat, light, movement

What are the advantages and disadvantages of your electricity machine?

DRAW YOUR MACHINE HERE

Here's an example

A wind up light

Did you know that the band coldplay use static bicycles and kinetic flooring to generate electricity to power their concerts?

Answer to page 8: False. Solar panels can produce power on cloudy days, just not as much.

Careers Word Search

Can you find the careers in the word search below? All of these are STEM jobs that you could do in the future.

MECHANICAL ENGINEER
ZOOLOGIST
DOCTOR
PARAMEDIC
FORENSIC SCIENTIST
CIVIL ENGINEER
PHYSICIST
ECOLOGIST
METEOROLOGIST
CAD TECHNICIAN
ARCHITECT
BIOCHEMIST
SOFTWARE DEVELOPER

E	Q	O	Y	S	H	R	F	D	T	F	Z	A	A	U	W	S	C	D	S
S	M	E	C	H	A	N	I	C	A	L	E	N	G	I	N	E	E	R	O
F	E	H	T	I	J	Z	K	F	U	L	X	P	V	G	C	J	Y	L	F
C	O	D	F	Z	O	O	L	O	G	I	S	T	D	E	S	B	V	Z	T
B	R	B	W	L	Y	X	A	F	K	Q	J	S	D	Q	U	I	T	F	W
D	L	D	O	C	T	O	R	U	S	B	P	X	J	R	G	O	D	L	A
Q	V	C	I	A	H	C	A	P	A	R	A	M	E	D	I	C	F	R	R
N	F	X	M	B	D	A	P	J	P	K	F	I	A	G	A	H	B	O	E
D	O	B	E	A	E	D	M	C	R	E	H	H	R	L	Z	E	Q	B	D
M	R	N	T	H	K	T	S	V	T	X	Y	D	C	F	U	M	B	H	E
E	P	H	E	O	L	E	F	M	F	N	I	N	H	S	V	I	X	O	V
C	Q	G	O	T	B	C	L	O	Q	T	J	W	I	A	D	S	K	X	E
O	B	Y	R	F	H	H	J	S	V	F	I	F	T	L	T	T	H	A	L
L	G	F	O	R	E	N	S	I	C	S	C	I	E	N	T	I	S	T	O
O	H	S	L	W	D	I	J	S	R	G	H	D	C	G	P	E	F	D	P
G	T	G	O	P	F	C	D	J	H	P	U	K	T	A	U	K	G	S	E
I	F	Z	G	S	C	I	V	I	L	E	N	G	I	N	E	E	R	I	R
S	K	D	I	D	K	A	N	G	C	M	S	V	E	H	L	P	B	L	O
T	W	X	S	Z	V	N	X	H	L	K	M	D	J	B	L	M	C	K	B
S	T	J	T	K	A	G	W	G	P	H	Y	S	I	C	I	S	T	A	R

After you have completed the word search have a think about the jobs you have found. If you don't know what the job is, can you research it in a dictionary or ask an adult?

If you have an idea of what you would like to do when you grow up, what subjects at school would be important for that job? And why would you need them? For example, if you want to be a Doctor, it would be important to know about biology, chemistry and maths.

WHAT JOB WOULD YOU LIKE TO DO?_____

WHAT SUBJECTS ARE IMPORTANT FOR THAT JOB ?

_____

WHY WILL YOU NEED THESE SUBJECTS?

_____

_____

Ecology

What is Ecology?

Ecology is the study of living things and their interactions with the environment.

What is Biodiversity?

Biodiversity is the variety of plants and animals in a habitat.

What is a Habitat?

A habitat is a place in the environment where plants and animals live.

Why is Ecology so Important?

Due to the impacts from humans (part of which is climate change), we are loosing biodiversity and habitats. It is important we take care of these habitats and create new ones to ensure the survival of these species.

Renewable energy and the natural environment

Renewable energy can help us tackle climate change but it can also have a negative impact on habitats and biodiversity if it is not planned carefully.

Ecologists are needed to understand these impacts so we can choose the places for renewables which have the least impact on important habitats. Renewable energy can actually can help biodiversity in some circumstances. For example, offshore wind farms can act as artificial reefs where marine organisms can grow.

What can be done to minimise impacts?

You might have a bird box in your garden at home, this is a type of artificial nesting site to help birds find a place to raise their young. One offshore wind developer has built a structure specifically for nesting kittiwakes, a threatened seabird species.

The Royal Society for the Protection of Birds (RSPB) has opposed certain wind farms because of the impacts on sea birds. However they also understand the importance of the technology as a way to tackle climate change.

Argyll's Rainforests

Did you know that rainforests not only exist in far away tropical countries. There are rainforests right here in Argyll! These are called temperate rainforests. You might be able to identify a rainforest if you can spot certain types of trees such as oak, hazel, ash and birch. These trees are often covered in mosses and lichens.

Nature Bingo

A Log	A Mammal	Moss	Mud	An Insect
A rock	A Conifer Tree	A Bird	A source of water	An Amphibian
A branch	A Fern	A Flower	A Broad-Leaf Tree	A Tree Stump
Tracks	A Worm	Lichen	A Snail	A Fungi
A Spiders Web	A Pine Cone	A Feather	Litter	Roots

Look around for examples of the things you can see in the bingo card above. You can play with other people, first person to find five in a row wins, or play on your own and see if you can find all of them. Good Luck!

Did you know?

Beavers became extinct in the UK in the 16th century. In 2009, Knapdale near Lochgilphead was the first place in the UK they were reintroduced. Today there are over 2000 beavers in Scotland. Beavers are considered ecosystem engineers. This is because they create pools behind the dams they build. This creates a habitat for other water loving plants and animals.

In Argyll and Bute there is forecast to be hundreds of job opportunities in STEM related roles. This is down to industries expanding as well as people retiring at the end of their careers. In this book we have focused on STEM jobs relating to renewable energy but there are so many different STEM jobs in all sorts of areas.

Robotics Engineer

Ferry Captain

Marine Ecologist

Water testing Analyst

The Skills Gap

Forestry, fishing, renewable energy, aquaculture, marine science, defence and ecology are some of the key STEM industries in Argyll and Bute.

Zoologist

Having STEM skills opens up these career opportunities. Meaning rewarding, stable and well paid job opportunities close to where you live.

Wind Turbine Technician

Follow the QR code to our website and navigate to our STEM Education programme pages. We hope that our online resources inspire you to think about STEM and give you a greater understanding about what amazing careers are right on your doorstep. There is no one right way to get to the career you love. Sometimes it's about trial and error and finding the right path for you.

Explore Your Options

FURTHER EDUCATION

Any education after secondary school that is not a degree programme at university. There are local colleges with a range of different STEM courses.

MODERN APPRENTICESHIPS

Anyone over the age of 16 who has left school can do a modern apprenticeship and start earning straight away. You learn skills on the job while working towards qualifications. It is a partnership between an employer, Skills Development Scotland and a local person.

HIGHER EDUCATION

Education after secondary school that most commonly takes place within a university and is studying to a degree level. Scotland has some of the most respected STEM departments at universities.

GRADUATE APPRENTICESHIPS

These are for college or university students to put their learning straight into practice in paid positions with an employer. Designed by industry, the apprentices are certain that the skills they gain in both the workplace and in their studies are entirely relevant and sought after.

FOUNDATION APPRENTICESHIPS

These are for school students to gain work experience and an industry recognised qualification. They happen alongside their school week developing their skills in the workplace.

Don't worry if you don't know what you want to do when you grow up. If you do, Great! Think about what subjects are important for the job you want.

What ALIenergy are up to in 2026

- MAK STEM Fest
- Hermitage STEM Fest
- Summer agricultural shows
- Secondary school careers events
- Secondary school workshops

You may see us at these events. Come and say hi! Email education@alienergy.org.uk to get in touch.

This workbook belongs to:

_____

ALIENERGY

drax foundation

ScottishPower Renewables

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