EDINBURGH SCIENCE

GENERATION SCIENCE

THE GREEN MACHINE

Welcome to Generation Science

Brought to you by Edinburgh Science Learning, *Generation Science* shows and workshops spark pupils' curiosity and bring science to life.

With more than 30 years of experience delivering high quality, engaging shows and workshops, we are leaders in our field.

What we do

Each show or workshop is fully equipped and delivered by trained science communicators. We create fun, interactive environments where everyone gets out of their seats and gets involved. Our inspiring demonstrations and engaging activities are linked to the Curriculum for Excellence, explaining key concepts in a unique and memorable way.

Event Description

The Green Machine is an interactive workshop that explores energy transfer and renewable electricity generation. The class join our team of time-travelling science communicators to discover lessons from history to help work out how to make the perfect energy transfer machine.

After a lively introduction to the subject featuring interactive demonstrations and experiments, pupils will work in teams to design and test a fully-functioning, environmentally friendly, water-powered machine.

Curriculum Links

The Green Machine supports the following curriculum links:

SCN 1-04a I am aware of different types of energy around me and can show their importance to everyday life and my survival.

SCN 2-04a By considering examples where energy is conserved, I can identify the energy source, how it is transferred and ways of reducing wasted energy.

SCN 2-04b 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.

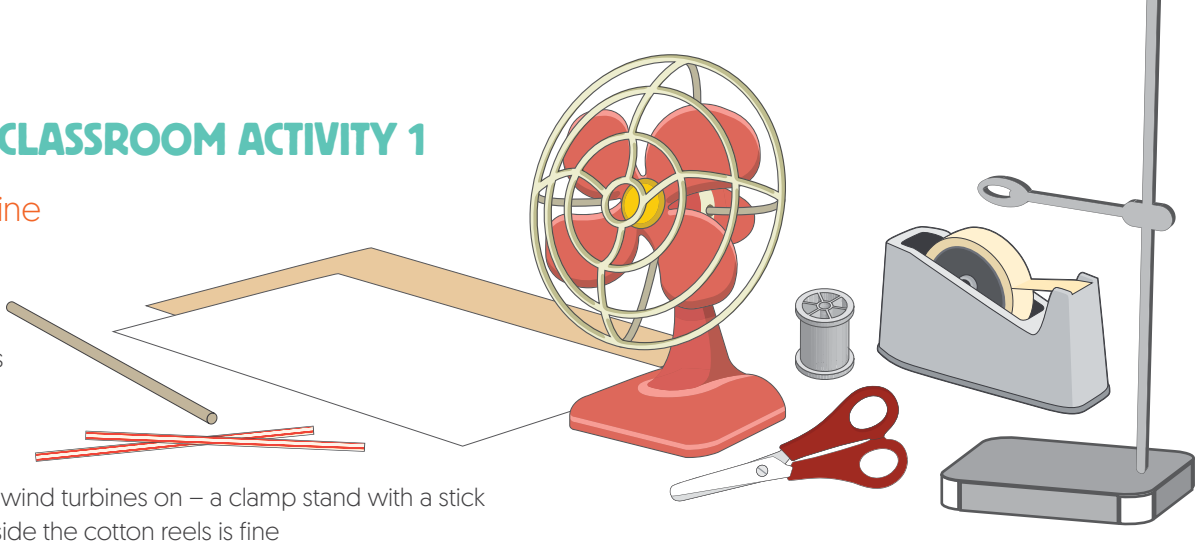
T**CH 2-06a** I can analyse how lifestyles can impact on the environment and Earth's resources and can make suggestions about how to live in a more sustainable way

Learning Outcomes

- Recall that energy cannot be created or destroyed
- Describe that energy can be converted from one form to another
- Identify different forms of energy including kinetic, stored gravitational and electrical
- Explain how a variety of renewable energy sources generate electricity (i.e. wind, solar, hydroelectric)
- Link the burning of fossil fuels and the need for renewable energy to the climate crisis
- Recall that technology is being used to explore new methods of generating and storing renewable energy
- Experiment with the design of a water wheel that shows energy transfer

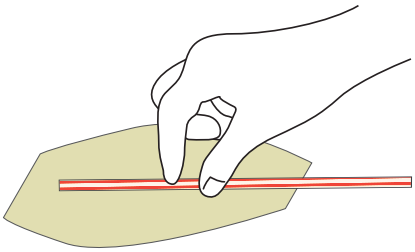
FOLLOW-UP CLASSROOM ACTIVITY 1

Build a wind turbine

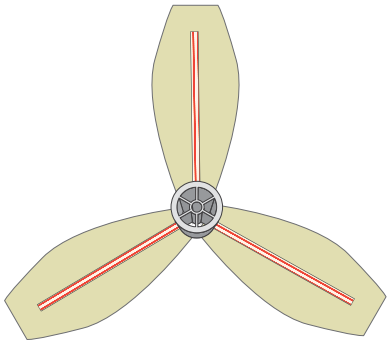


You will need:

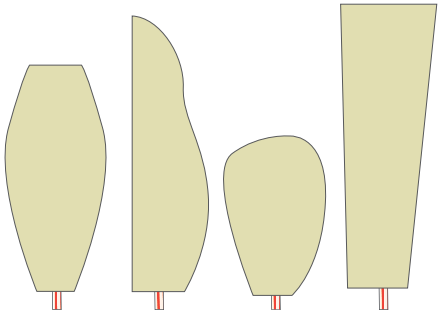
- Sticky tape
- Scissors
- Empty cotton reels
- Paper straws
- Cardboard
- Paper
- A stand to test the wind turbines on – a clamp stand with a stick which fits easily inside the cotton reels is fine
- Desk fan



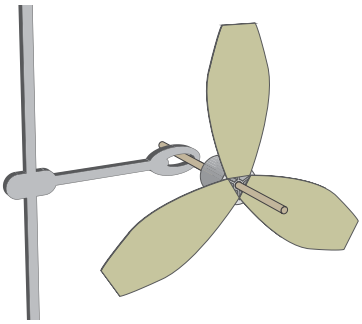
1. Using the materials provided build a set of wind turbine blades.



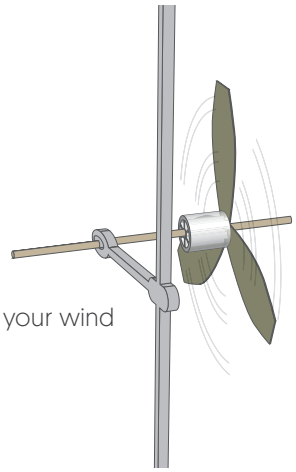
2. Make sure your blades can be attached to a cotton reel without blocking the hole at the back.



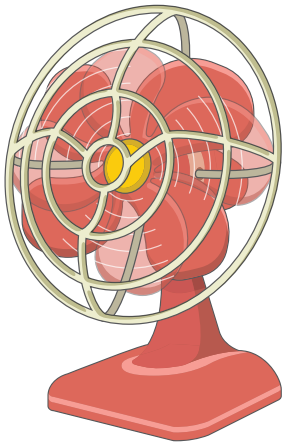
3. Your design can be any shape or size, but be careful it's not too flimsy; you don't want it to fall apart during testing!



4. Place your wind turbine on the class stand so it can turn freely.



5. Turn on the fan and test your wind turbine.



Which designs worked best and why? Why did some designs work less well? How are these different to the real world?

Explanation

Wind turbines are used to convert kinetic energy from the wind into electricity. The wind can move turbine blades because moving air has a force. If an object is placed in the way of moving air, the air will exert a force on the object. If the object is free to move in a direction which is less than 90˚ to the moving air it will accelerate in that direction.

The simplest design of a turbine blade is called an angled sail. The moving air hitting the blade at an angle pushes the blade around the turbine's axis. Today most turbines employ more sophisticated blade designs in the shape of an aeroplane wing (this shape is called an aerofoil). These blades are pulled around due to the effects of lift which is generated as air flows over the blades.

FOLLOW-UP CLASSROOM ACTIVITY 2

Marble Run Mayhem

For each group of 4-5 pupils, you will need:

- Four toilet roll tubes
- Cardboard
- Scissors
- Tape
- Glue
- Dominoes
- A small ball (eg: a marble or ping pong ball)

1. **Set the challenge:** working in teams, can the class create a marble run which has enough kinetic energy to knock down standing, closely stacked dominoes? Think about how to maximise that stored energy to convert it to kinetic energy!
2. Allow the groups to build structures using things found in the classroom. Think about how to reduce friction in the marble run to make it faster or smoother.
3. **Have a competition:** which group can knock down the most dominoes or travel the furthest distance?
4. **Discuss as a class:** what was it about the winning design which worked?

Explanation

Marble runs are a good way to demonstrate energy conversion. Tall, long marble runs maximise potential (stored) energy, which is then converted to kinetic (movement) energy once the ball is moving. Their design will inevitably mean some energy is lost to friction, as well as sound and (very small amounts of) heat. What can be done to reduce this?

Energy can't be created or lost, but just converted from one form into another. A lot of design and engineering of machinery is concerned with ensuring that energy converts into the most efficient forms, rather than wasting fuel on unnecessary heat, movement or sound.

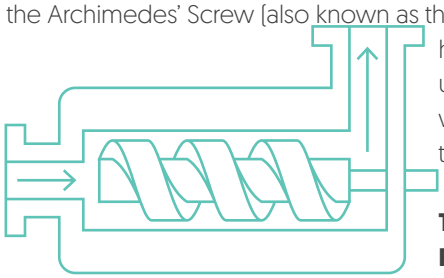
THE SCIENCE BEHIND THE SHOW

Humans need fuel to survive, but we currently use a lot of fossil fuels which release carbon dioxide. These emissions are contributing to the climate crisis. Around 80% of global energy currently comes from fossil fuels (source: United Nations), which is something scientists are trying to reduce.

Energy can't be created or destroyed. It can only be converted into other forms, which is crucial for humanity. Examples of energy types include: kinetic (movement), stored, gravitational, chemical and electrical. Sound, heat and light are also types of energy, which may also be produced during energy transfer.

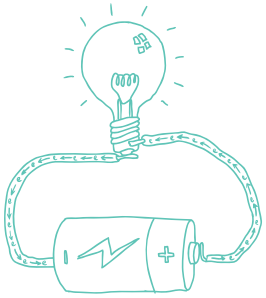
Movement is key to generating power. We use the energy stored in fossil fuels, or alternative energy sources, to move machinery which can then convert into the electrical energy we need.

History can give us clues for our future. Renewable energy has been used for a long time, including examples such as the Archimedes' Screw (also known as the water screw), a hydraulic machine used to raise water, which can be used to turn a turbine.



The Industrial Revolution (1760 – 1840) was a time of great technological development. It also saw an increase in the use of fossil fuels, primarily coal. It's estimated by multiple agencies that atmospheric carbon dioxide levels are over 50% higher now than they were before the Industrial Revolution.

Storage is a major issue with renewable energy. Scientists and engineers are working on this issue, but it means that we currently need to use a range of different sources, and try to save energy wherever we can.



Some Useful Links

UNICEF guide to Sustainable Energy: https://www.unicef.org/lac/media/40516/file/A-young-persons-guide-to-sustainable-energy.pdf

Our Future Energy (classroom resources, maintained by Glasgow Science Centre): https://ourfuture.energy/

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