



EDINBURGH INTERNATIONAL
SCIENCE FESTIVAL

generation science

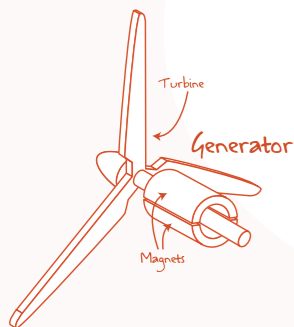


The Science behind the Show

Electricity is a form of energy. It is produced from the flow of electrons through a material. Most of the electricity we use is produced by generators in power stations.

When a magnet is passed over a wire it pushes the electrons in the wire causing them to move. This movement is an electric current and it will be continually produced if a magnet is moved over the wire repeatedly. To make this process more efficient generators have multiple magnets. The wire is also coiled round on itself many times as this increases the amount of electricity produced each time a magnet passes.

A generator requires power to make magnets move. In traditional power stations materials like coal or gas are burned to boil water and produce steam which turns a turbine to drive the generator. The turbine can also be powered by water, wind or tidal energy.

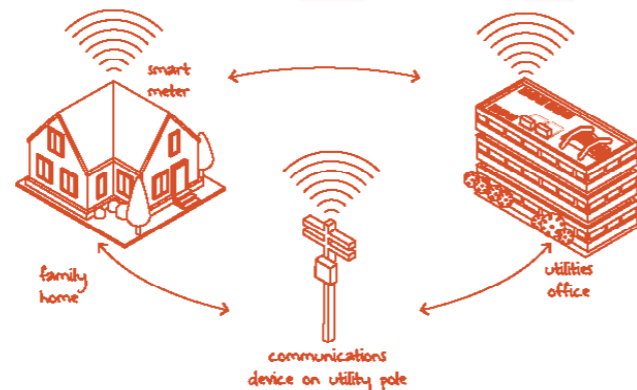


A non-renewable resource is a natural resource which either cannot be reproduced or is consumed much faster than it can be created. Once we have used all the non-renewable resources on the planet they will be gone forever.

Electricity can be generated using non-renewable or renewable resources. Non-renewable resources include things like coal, gas and nuclear energy. Renewable resources are things like wind, wave and solar energy.

The amount of electricity produced is controlled by a team of people. They continually monitor increases or decreases in the demand for energy and try to maintain a delicate balance. If things get out of balance blackouts or power surges can occur.

Smart grids aim to reduce the need for people to continually monitor the electrical grid and to reduce the chances of the grid getting out of balance. They use sensors to monitor energy demand and the flow of electricity and this information is transmitted to power companies. In the future, smart meters could be installed in people's homes and on appliances to help track, report and control power usage. This would help to conserve and efficiently distribute energy throughout the country, especially in times of peak demand.



Peak electricity demand in the UK often occurs around 6pm. This is when commercial and domestic users are both consuming electricity from the grid and there is a well recorded peak at the end of popular TV shows when everyone goes to put the kettle on! Electricity demand decreases overnight and is lowest when most people are asleep.

SMART GRID

Welcome to Generation Science!

Brought to you by the Edinburgh International Science Festival, our shows and workshops spark pupils' curiosity and bring science to life.

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

Smart Grid welcomes pupils into the world of Alex and Lee as they embark on work experience placements at two different power plants. As they discover the secrets behind electricity generation and non-renewable and renewable energy, pupils help Alex and Lee to complete their school projects and share their new-found knowledge of the smart grid. This interactive show takes pupils on a journey where they will investigate the technology involved in energy generation and the potential impacts of power usage on both the home and environment.

Curriculum Links

Smart Grid complements the following experiences and outcomes:

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.

TCH 2-02b: I can investigate the use and development of renewable and sustainable energy to gain an awareness of their growing importance in Scotland or beyond.

SOC 1-08a: I can consider ways of looking after my school or community and can encourage others to care for their environment.

Learning Outcomes

- Recall that moving a magnet past a circuit produces electricity.
- Recognise that electricity can be made by generators which are driven by turbines.
- Recognise the impact of electricity generation on the environment.
- Recall that it is important to have a balance between electricity needs and supply.
- Recall that a smart grid distributes electricity efficiently and is composed of smart ways to generate, distribute and use electricity.

Some Useful Links

www.nationalgrideducation.com/resources/

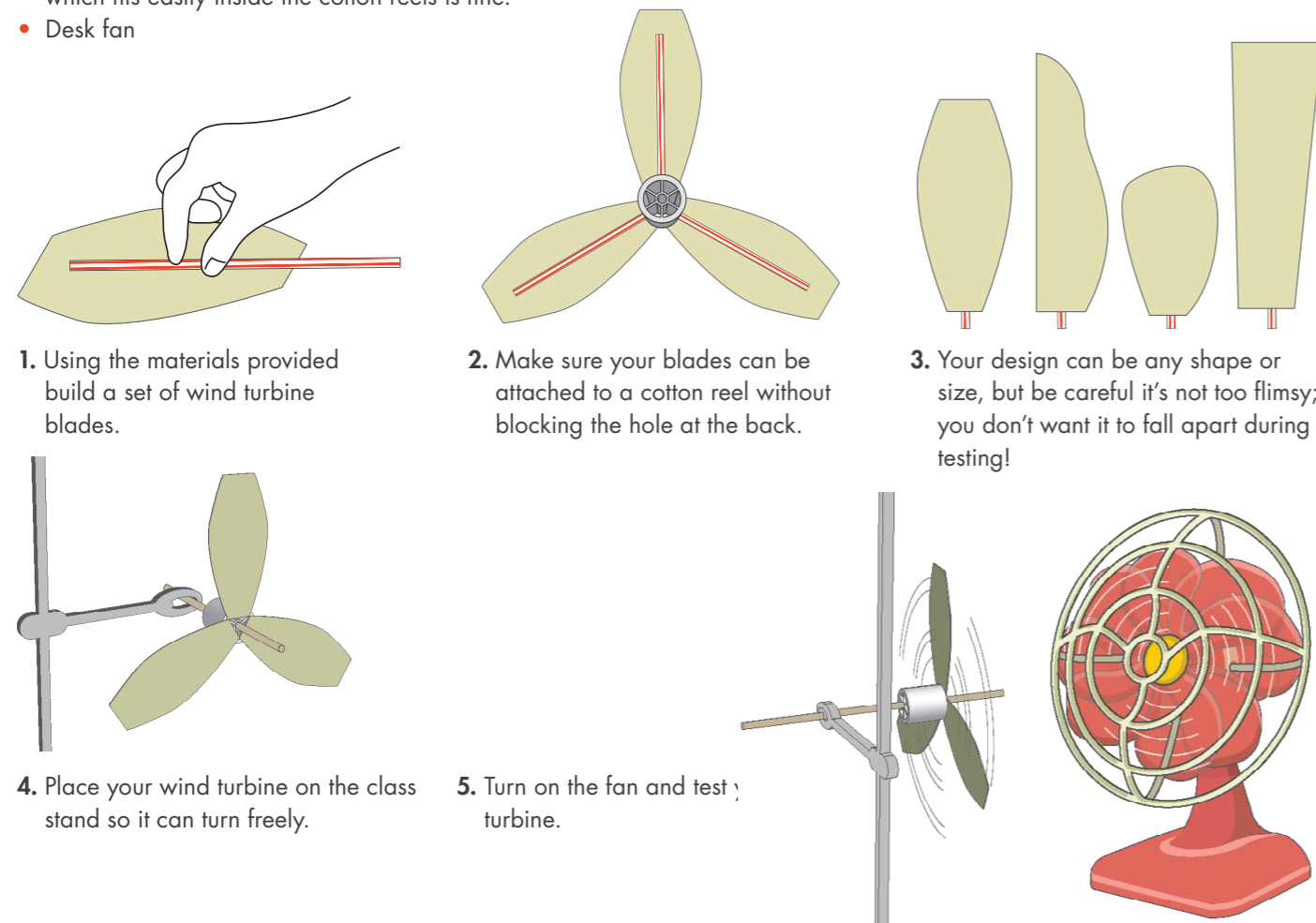
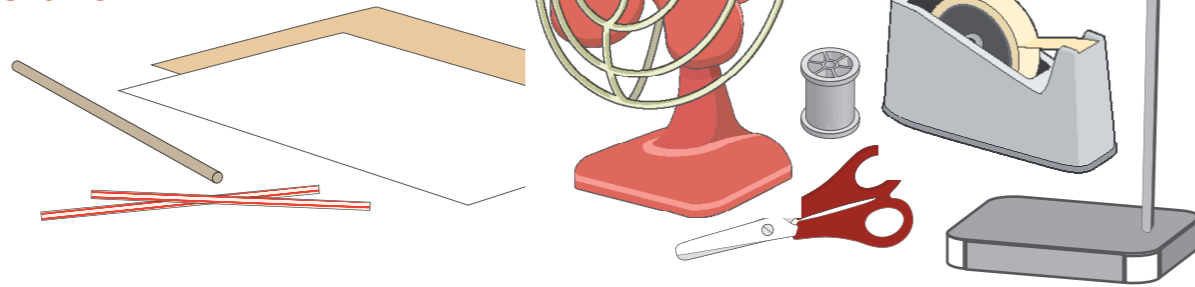
www.nationalstemcentre.org.uk/primaryscience

FOLLOW-UP CLASSROOM ACTIVITY 1

Build a wind turbine

You will need:

- Sticky tape
- Scissors
- Empty cotton reels
- 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 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.

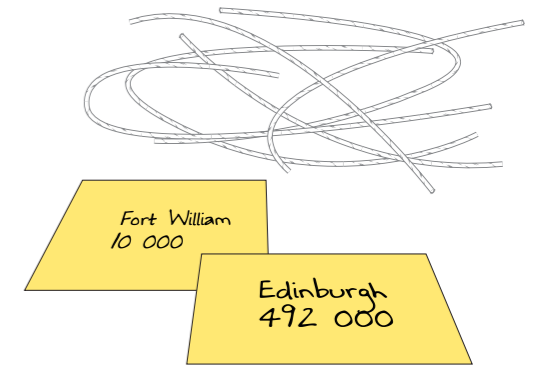
The simplest design of a turbine blade is called an angled sail. The moving air hitting the blade at an angle pushes the blade around the turbine's axis. Today most turbines employ more sophisticated blade designs in the shape of an aeroplane wing (this shape is called an aerofoil). These blades are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

FOLLOW-UP CLASSROOM ACTIVITY 2

Grid Investigations

You will need:

- 10 city population cards (create these in advance by selecting 10 Scottish communities and writing down their name and population on a piece of card)
- Approximately 20 pieces of string cut to 0.5m length



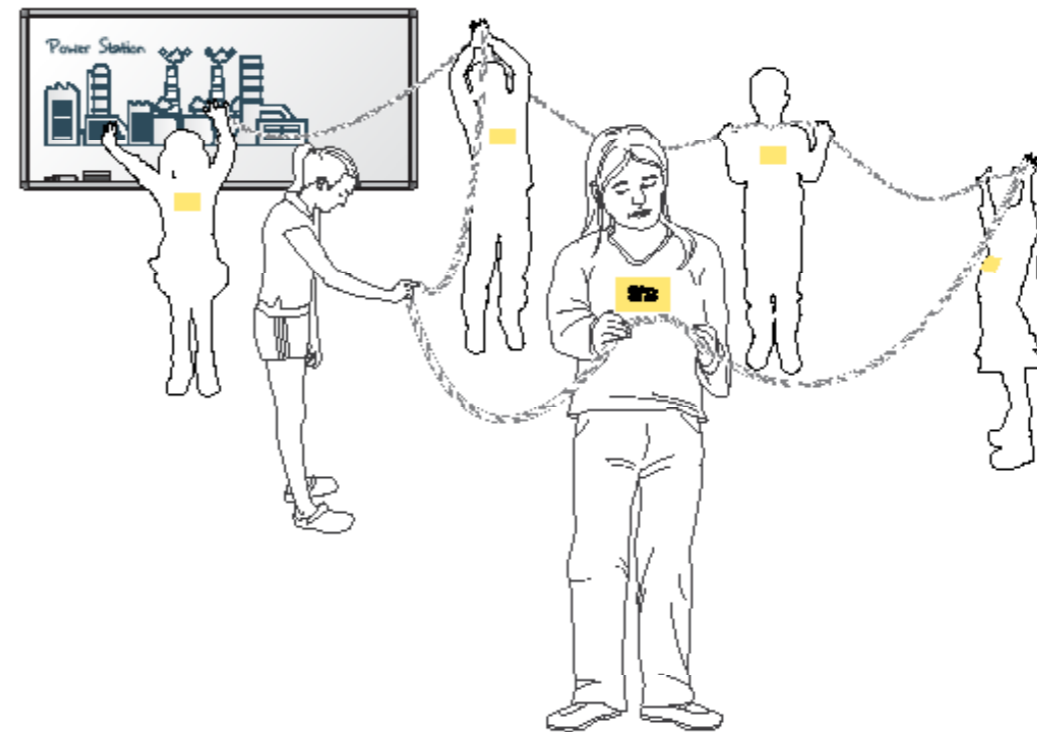
1. Select 10 pupils to be communities, hand them each a population card and get them to spread out around the room.

2. Select an area of the room to be the power station (e.g. the whiteboard). The remaining pupils are electricity pylons and the pieces of string are the power lines.

3. The challenge is to connect as many communities as possible. To make a connection pupils acting as pylons hold the ends of two pieces of string together, making sure they touch.

4. Hand out a few power lines to start and try to connect as many people as possible. When the class can't connect any more communities, hand out more power lines.

5. When everywhere is connected, model what happens when a power line goes down by cutting one of the strings, ask: Who is affected by this? How do we fix the problem? If repair is suggested, hand out a new power line to model the system being restored.



Ideas to investigate: Think about times of the day or night that communities might use more electricity than others. Discuss how we might deal with this?

Create a list of all the electrical equipment used in your house and think about how you could use electricity more efficiently. What appliances could be controlled by a smart grid without affecting you too much?

Explanation

In the UK almost all communities, big or small, are connected by the National Grid. Even if there's a blackout it will usually only last a few hours. A power outage might occur because the power lines supplying a community have been damaged and need repaired or because there has been a temporary

reduction in the power available to a community due to excess demand across the grid. The team at the National Grid try to ensure that electricity is always flowing and there is enough for everyone.