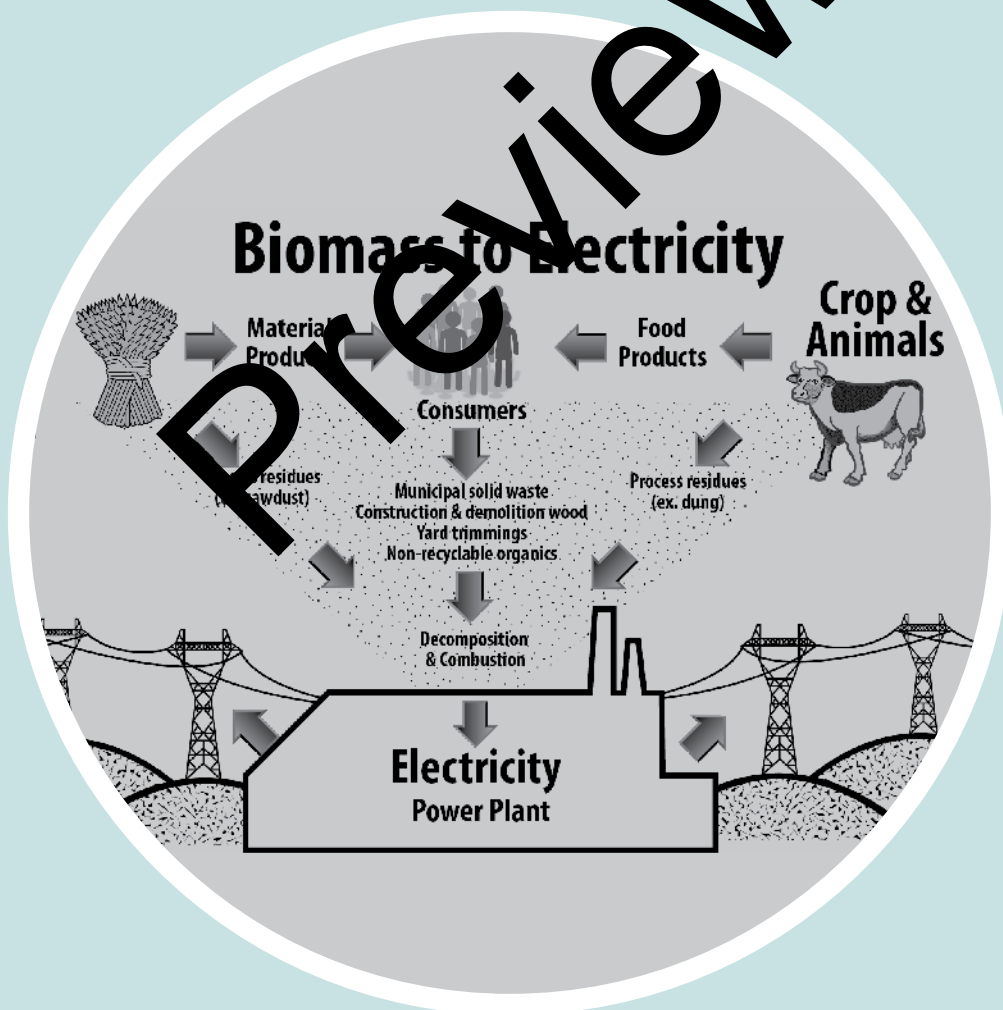


Science

Sources Of Electrical Energy



For Upper Primary

Contents

| | |
|------------------------------|------------|
| Geothermal Energy | Page 3 |
| Hydropower | Page 4 |
| Tidal Power 1 | Page 5 |
| Tidal Power 2 | Page 6 |
| What Is Biomass? | Page 7 |
| Biomass To Electricity | Page 8 |
| Biomass Experiment | Page 9 |
| Solar Power | Page 10 |
| Wind Power 1 | Page 11 |
| Wind Power 2..... | Page 12 |
| Answers..... | Page 13-14 |

Title: **Sources Of Electrical Energy** For Upper Primary
Published by **Ready-Ed Publications** © 2019
Taken from: STEM: Year 6
Author: Fiona Grant

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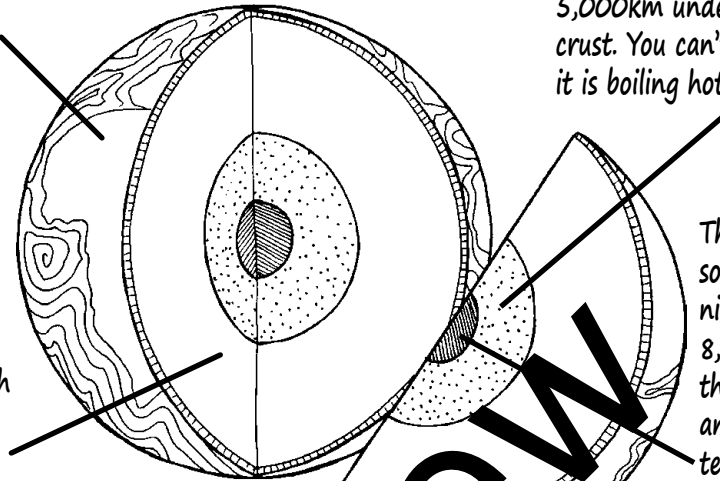
ACTIVITY

Geothermal Energy

Geothermal energy is sustainable energy. The word **geo** means **earth** in the Ancient Greek language and the word **thermal** means **heat**. Underneath the Earth's surface, there are four different sections: crust, mantle, outer core and inner core. Read to find out what each section's job is.

The crust keeps the Earth insulated from the interior heat of the Earth's core. The centre of the Earth is actually so hot that if people stood on it and not the crust, they could get injured.

You can't see the mantle, because it starts at a depth of 2,500km underneath the Earth's surface. It is semi-molten which means it is not completely solid.



The outer core is way down at 5,000km underneath the Earth's crust. You can't stand on it because it is boiling hot liquid!

The inner core is solid and made up of nickel and iron. It is 8,000km underneath the Earth's surface and reaches temperatures of up to 5,000°C, that is seriously hot!

So we now know that beneath the Earth's surface, it is hot. The question is, how do people safely harness the Earth's heat and turn it into electricity?

Rain water seeps down through the cracks of the Earth and passes through the inner core of the Earth. This is a natural part of the water cycle. Because the inner core is hot, the water heats up creating a geothermal reservoir. We can drill into the Earth to access this hot water (injection well) and return the water to the Earth's surface (production well). We use the steam from this hot water to turn turbines which generates electricity for people to use in their homes.

Using the Earth's heat to create electricity is known as **geothermal energy**.

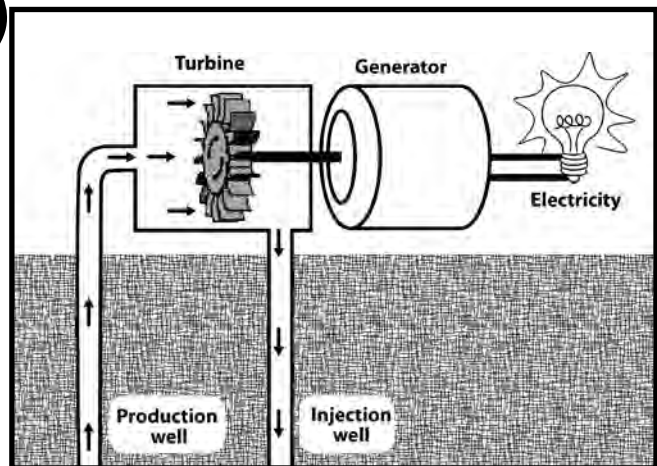


Diagram: Generating electricity using a geothermal power plant

■ BRAIN POWER TASK 1: Mini Inquiry

- » **FIND out how far down you need to drill into the Earth to access a geothermal reservoir.**
- » **FIND out how homes can be powered by geothermal energy. What variables could it depend on?**

Complete these questions in your workbooks



We have plenty of water!
96% of the Earth's surface
is covered in water.
Let's use it to
create electricity.

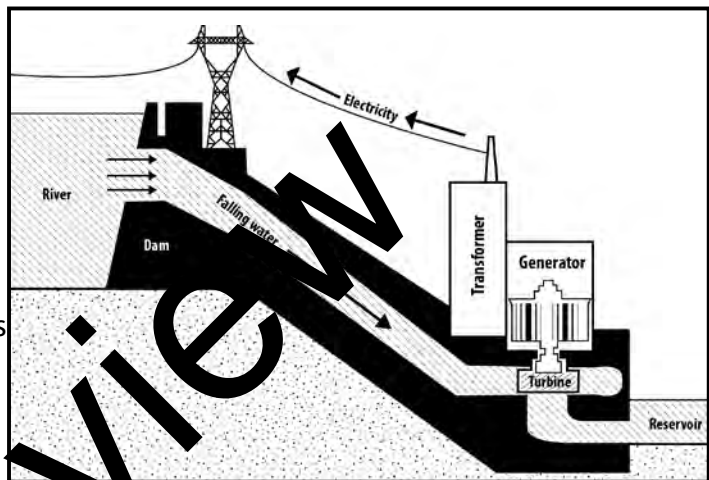


Hydropower is a clean, renewable and reliable energy source that uses water to create electricity. The process only uses existing water created by nature. **This process is not new.** The first water wheels were created over 2000 years ago. Since then humans have kept making the process more efficient.

One way of creating hydropower is by attaching a dam to a river. This raises the water level of the river and creates falling water. The water usually falls into a reservoir. The kinetic energy (moving energy) created from the rush

and pressure of falling water turns a generator which is converted into electricity.

The image shows that the potential energy stored in a body of water when held at a raised height, converts into kinetic energy when it falls and this kinetic energy turns a turbine and creates electricity. The water is directed through a pipe-like device, then the pressure turns the blades in a turbine to spin a generator to produce electricity.



■ **Task: Write your thoughts on the back of this sheet or in your workbook.**

A. Questioning and predicting

1. Explain how falling water can be created. Can you think of more than one way?
2. Where could hydropower plants be located? Think of two places.
3. How much electricity is currently being made by hydroelectric power around the world? Use your research skills to find out. Is it more or less than the electricity created by burning coal?

B. Planning and conducting

Virtual Fieldtrip: If you have a set of VR goggles, then download Google Expeditions for free and guide your way through 'Angel Falls'. If not, google 'waterfalls' so that you can make observations using your senses and by researching on the internet.

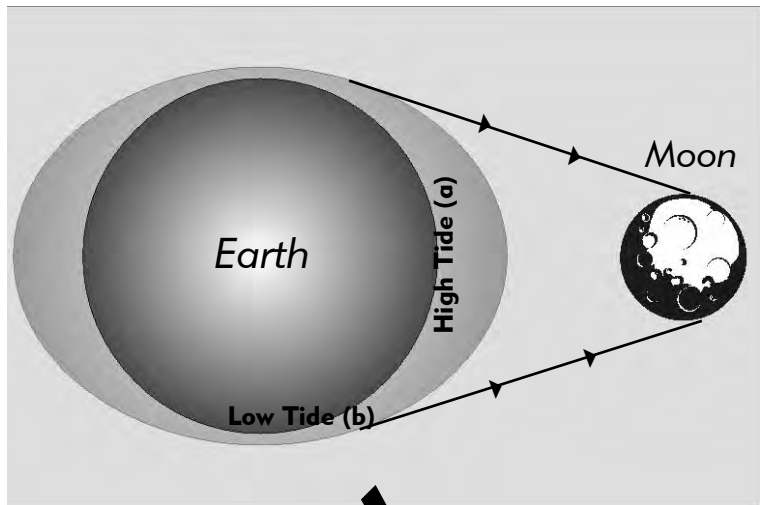
1. What would the pressure feel like under a waterfall?
2. Research the three levels of pressure used to create hydroelectric power.

C. Processing and analysing data and information

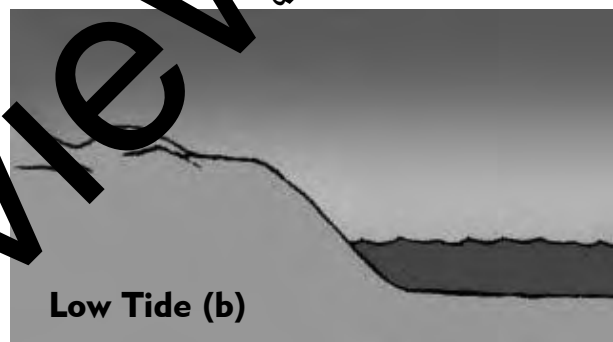
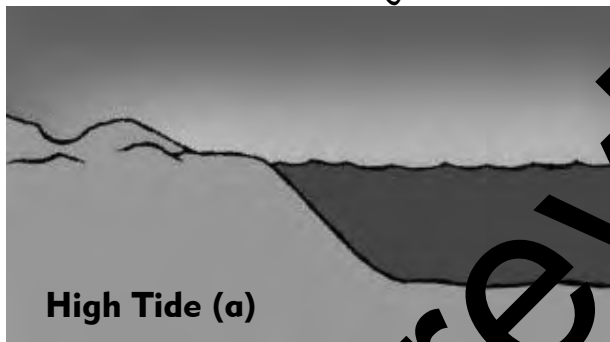
1. Tell your elbow partner about your findings.
2. Discuss any issues you can think of which could affect the reliability of hydroelectricity.
3. Compare the information you found on the internet about the required pressure needed for creating hydroelectricity and reliability. Do you think more of the world's energy demands should be supported by hydropower? Give reasons for your answer.

■ Read the information then complete the activity sheet on the next page.

Tidal power is a form of energy made from tidal energy in the ocean! The Earth experiences two main tides each day, caused by the moon. The moon's gravitational pull generates tidal force. This tidal force causes the ocean water to bulge outwards on the side of the Earth closest to the moon and on the opposite side of Earth, the side farthest from the moon. These bulges of water are known as **high tides**. **Low tides** are experienced at the same time by the other two quadrants

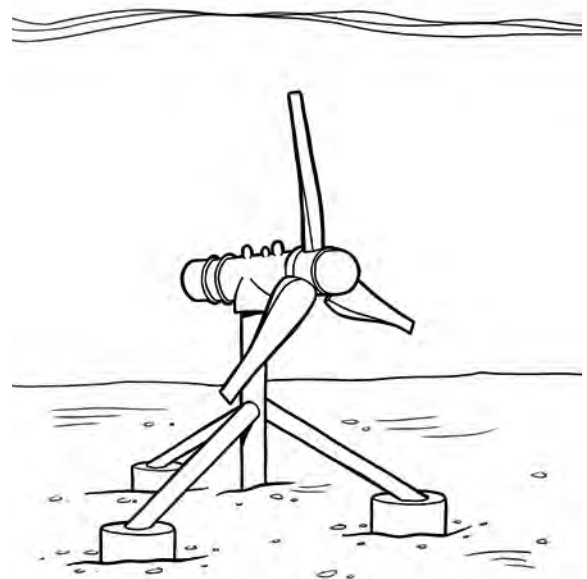


There are two high tides and two low tides every 24 hours.



Tidal generators (turbines) work like wind turbines in a lot of ways, they even look similar. It is the ocean currents which turn the turbine, not the wind. The spinning turbine is connected to a generator that produces electricity which travels through wires to where people can use this electricity.

The turbine is lowered into the ocean where no-one can see it. The world's largest tidal generator weighs 143 tons, the turbine blades are 18 meters and stand 22.5 meters high. The turbine is capable of generating enough electricity to power more than a 1000 homes. It is important that the turbine is located near to the houses that it is going to provide power for.



■ Discuss!

If we do not invest in energy sources like tidal power, what might happen to our planet?

There are three ways of creating tidal power:

tidal barrages

tidal turbines

tidal fences

- Use the internet to find out how each device functions and find one positive and one negative fact about each type. The information on P5 will also help you.

Tidal Barrages

| | |
|---------|----------------|
| Sketch: | How they work: |
| | Positive: |
| | Negative: |

Tidal Turbines

| | |
|---------|----------------|
| Sketch: | How they work: |
| | Positive: |
| | Negative: |

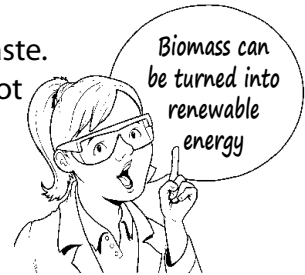
Tidal Fences:

| | |
|---------|----------------|
| Sketch: | How they work: |
| | Positive: |
| | Negative: |

Biomass means using our rubbish to produce electricity!

Biomass is organic material that comes from plants, animals, food and waste. After we have finished using something, we usually throw it away, but a lot of things we throw away can be used as a renewable source of energy.

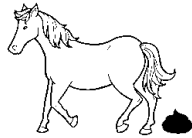
Biomass contains stored energy from the Sun. Plants absorb the Sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or converted to liquid biofuels or biogas that can be burned as fuels.



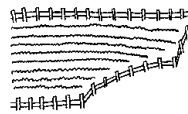
Examples of biomass and their uses for energy:



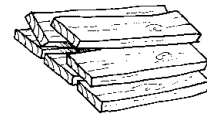
» Food waste (rubbish): burned to generate electricity in a power plant.



» Animal manure and human sewage: converted to biogas which can be burned as a fuel to create electricity.



» Agricultural crops (not needed or ruined): burned as a fuel or converted to liquid biofuels (to power cars).



» Wood waste from wood processing plants: burned to heat homes and converted to electricity.

■ Read the following article about a waste conversion plant in WA and complete the questions.

Green light for waste conversion plant in Western Australia

Waste conversion plants are on the rise across WA. The Environmental Protection Authority (EPA) has approved new facilities to accommodate more waste to energy recycling plants.

It is estimated that from one plant alone, 400,000 tonnes of household rubbish can be used to power up to 50,000 homes a year.

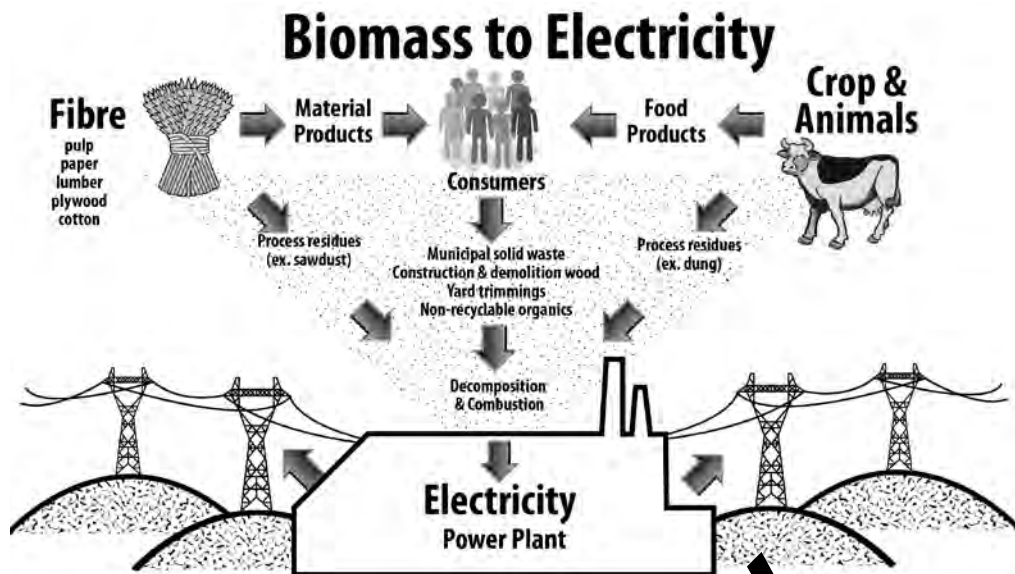
WA currently has two plants and a third is currently being approved. Commercial waste from companies is also going to be converted to generate energy to feed back into industries.

This is great news for all of those seeking to support environmental sustainability.

1. List 8 key words from the article.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

2. Discuss with your elbow partner and then write down your understanding of WA's waste to energy plant.



- **BRAIN POWER 1:** In small groups, investigate types of waste which can be converted to electricity or energy in a waste conversion plant. Remember the main types of rubbish you are looking for are: food waste, animal manure, human sewage, agricultural crops, wood and wood processing plants' wood waste.

| What | Where | What Happens |
|---------|-------------|------------------------------|
| bananas | power plant | burned to create electricity |
| | | |
| | | |
| | | |
| | | |
| | | |

- **BRAIN POWER 2:** Poo! It stinks! But poo may be the key to powering our world! How are different countries using their sewerage for biomass? Do some research and complete the table.

| Who - Country | Where | What Happens |
|---------------|-------|--------------|
| | | |
| | | |
| | | |
| | | |

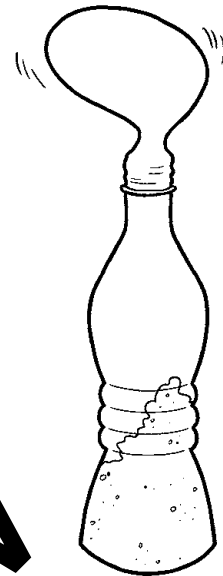
- **EXPERIMENT:** Complete the waste to energy experiment to test the concept of biomass yourself.

Equipment:

- 1 clear plastic bottle
- 1 teaspoon of sugar
- 2 teaspoons of yeast
- warm water
- 1 balloon
- 1 plate to catch any waste

Steps:

1. Fill the bottle with about 4 cm of warm water.
2. Add 2 teaspoons of yeast and gently swirl the bottle around for 5 seconds.
3. Add 1 teaspoon of sugar and swirl again for 5 seconds.
4. Blow up the balloon a few times to stretch it out then put it over the opening of the bottle.
5. Leave the bottle to sit in a warm place for about 20 minutes.



- **TASK:** Complete the biomass inquiry sheet.

A. Conduct the experiment - what is it testing?

B. Report your results. Were you successful? Explain your findings.



Today, people can install solar panels, which convert the energy from the Sun into electricity. This electricity can contribute to the energy needs of a home. Businesses can install solar panels over a large area to power their business needs. If only 1% of the Earth's land was covered in solar panels, it would generate enough power for everyone! If all the rooftops in Australia had solar panels, there would be enough energy to supply the whole country's power requirements!

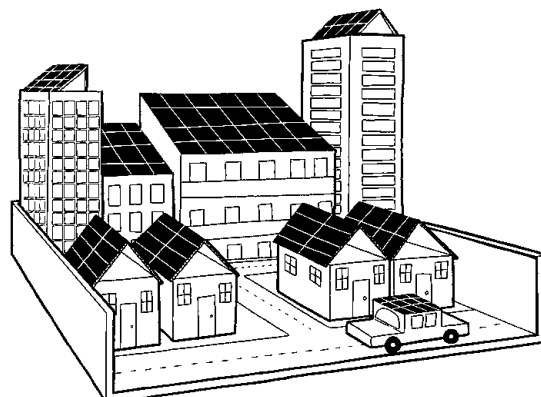


1. WORK IN PAIRS: Complete the questions about solar power.

| Question | Answer |
|---|--------|
| Is wind a type of solar power? If you agree explain why. | |
| How is electricity made from sunshine? | |
| What is a solar panel made from that enables it to convert sunshine into power? | |

2. CREATE A DIORAMA: Build a model of a Solar Powered City. Make a plan below.

| What I will need | Sketch Of My Diorama |
|------------------|----------------------|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |



HOW IS THE WIND CREATED?

Wind is moving air. It is created because the Sun heats land faster than it heats water. Think of a beach where there is always a lot of wind. The Sun heats the sand faster than it heats the water, creating wind.

This uneven heating of the land and the water creates conflicting air pressure (low pressure over the land and high pressure over the water) which in turn creates wind. The greater the difference in air pressure, the greater the wind.

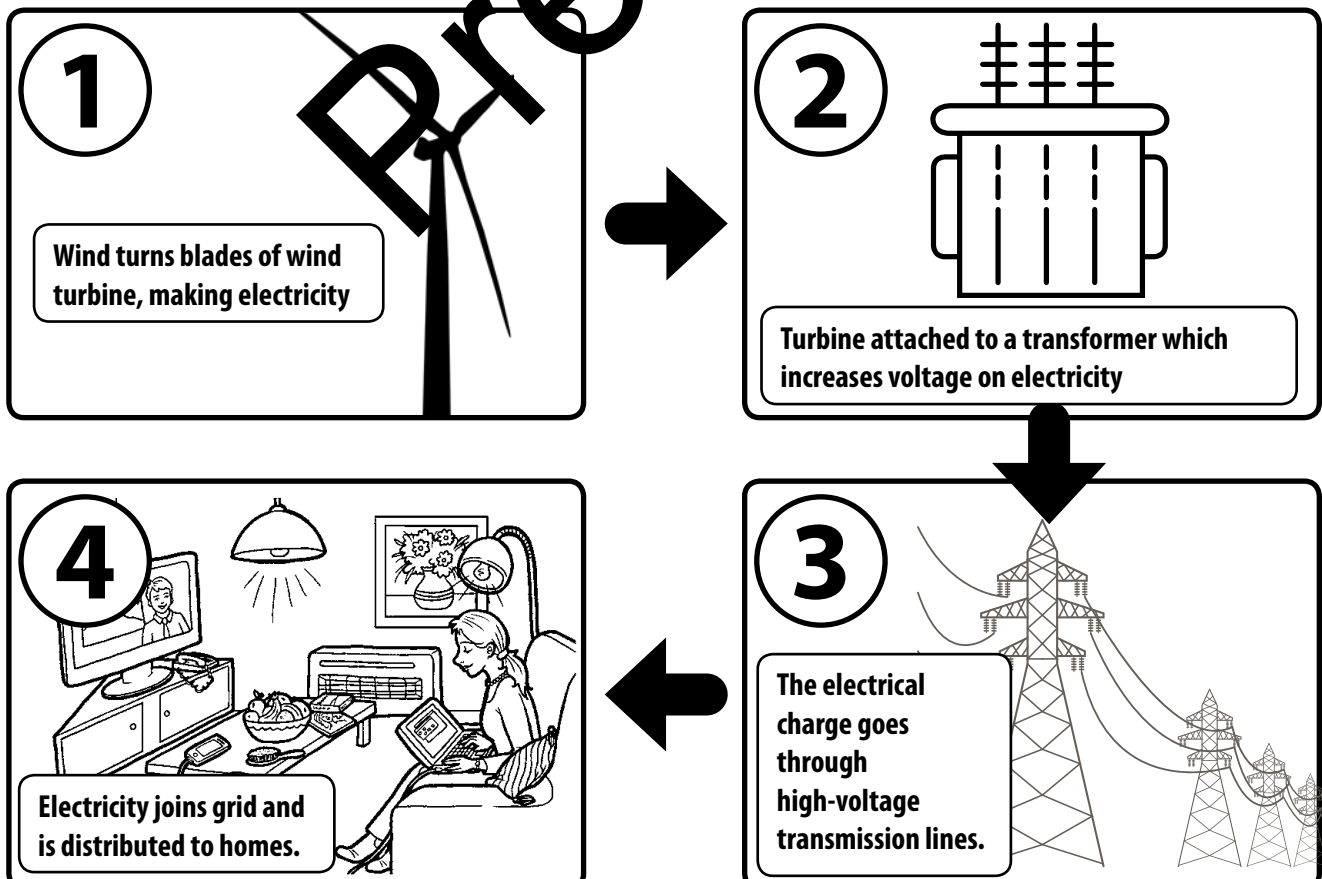
Low pressure (warm) air rises, and as it does higher pressure (cool) air takes its place. This movement creates wind.

**Wind Power**

Wind is a source of energy that is renewable and does not pollute the Earth. Wind power is a cleaner alternative to burning fossil fuels. Other advantages of wind power is that it uses no water and uses little land.

Wind power means using the wind to turn wind turbines. Wind turbines are like pinwheels; they collect the wind's kinetic energy (motion). The giant blades are connected to a drive shaft that turns an electric generator to produce electricity. There are two types of wind turbines: vertical and horizontal.

Study the diagram to see how wind turbines work.



Use page 11 to complete this activity page.

■ TASK 1

Read the information about how wind is created. Explain this information using a labelled diagram. Study other diagrams about wind to help you.

■ TASK 2

Complete the close about wind turbines.

| | | | | |
|-------------|-------------|---------|---------|--------------|
| DISTRIBUTED | WIND | GROUND | TURNS | FOSSIL FUELS |
| ATTACHED | BLADES | LAND | GREENER | WATER |
| ELECTRICITY | TRANSFORMER | VOLTAGE | CLEANER | INCREASED |

Wind turbines are powered by the _____. As the wind _____ the _____ of the wind turbine, it creates _____.

The _____ of this electricity is then _____ inside a _____. Transformers are _____ to wind turbines.

Transformers can be underneath the _____ so we cannot see them.

The electricity in the transformer is then _____ to homes. This is a _____ and _____ way of using energy. It does not burn _____ and does not use any _____ and uses little _____.

Page 3

Brain Power Task 1:

150-200 metres to 10,000 metres

Tunnels dug underground vertically or horizontally can generate geothermal energy for the home. Variables include the earth's temperature in the area of the home, areas of the world closer to the equator can benefit well from geothermal energy.

Page 4

Questioning and predicting

1. Waterfalls and dams
2. Victoria Falls, Niagra Falls, Iguazu Falls
3. Approximately 17% of International Energy Agency electricity output records

Planning and conducting

1. A lot of pressure at a steady rate
2. High pressure, medium pressure and low pressure. The higher the pressure the less water flow is needed the lower the pressure the higher the water that is needed.
Processing and analysing data and information
3. Reliability of hydropower can be affected by the constant supply of water at a steady rate, costs

Page 5

Possible points raised in discussion: If we do not invest in alternative energy sources like tidal power, our planet will become more polluted, because burning coal to create electricity releases harmful chemicals into the air. These chemicals can create climate change. Climate change affects animals; they can be threatened because of loss of habitat. If we lose a species, it affects us all because the ecosystem is no longer in balance. Burning fossil fuels like coal and natural gases affects our planet because they are non-renewable, which means that we risk running out of these resources if we do not use them carefully.

Page 6

Tidal barrages

How they work: Tidal barrages are similar to hydro-electric dams. A dam blocks and controls the speed of water through a turbine. The turbine is spun by the incoming and outgoing water.

Positive: Tidal currents are predictable.

Negative: They are expensive to build.

Tidal turbines

How they work: Tidal turbines sit in the water and are moved by the incoming and outgoing tide under the water creating electricity.

Positive: Efficiency is high as it is a purely mechanical device reliant on the tides.

Negative: There is potential impact on fish, marine mammals and birds.

Tidal fences

How they work: Tidal fences sit under the water and the incoming and outgoing tide moves the tidal fence turbines to create electricity.

Positive: There is less environmental damage than a tidal barrage.

Negative: They can disturb marine life and the ecology of the area.

Page 7

1. waste; conversion; plants; power; commercial; industries; environmental; sustainability
2. WA has two waste to energy conversion plants. There is a third plant which will be built. The plants convert household waste to energy in the form of electricity to power households. Businesses are also able to convert their waste to energy. These plants will improve the environment.

Answers

Page 8

Brain Power 1

Possible answers

| What | Where | What Happens |
|------------------|---------------------------------|--|
| Wood waste | Commercial business power plant | Produces electricity |
| Paper | Waste to energy plant | Makes steam for generating electricity |
| Leather products | Combined heat and power plant | Biogas to electricity |

Brain Power 2

Possible answers

| Who | Where | What Happens |
|---------|----------|---|
| America | Colorado | Anaerobic digestion used to convert sewage to biogas to power generators which produce electricity. |
| Europe | Germany | Biogas converted to electricity |

Page 9

What is it testing?

It is testing why waste is a problem (waste decomposes which can cause pollution).

Were you successful? Explain your findings.

The yeast when mixed with sugar will ferment giving off gas which will expand the balloon (the balloon will blow up from the gas given off by the yeast and sugar fermenting in the bottle). This shows that organic waste can be turned into renewable energy sources. The process of combustion

can convert organic waste to energy or electricity.

Page 10

Wind is a form of solar power. Winds are caused by the uneven heating of the atmosphere by the Sun. Wind flow can be used to create energy.

3. Solar-powered photovoltaic (PV) panels convert the Sun's rays to electricity.
4. Solar panels are made from solar photovoltaic (PV) panels made up of multiple PV cells. Cells are semiconductor devices which convert energy from the Sun's rays directly into electricity.

Page 11

2. wind; turns; blades; electricity; voltage; increased; transformer; attached; ground; distributed; cleaner; greener; fossil fuels; land; water