

Energy & the Environment



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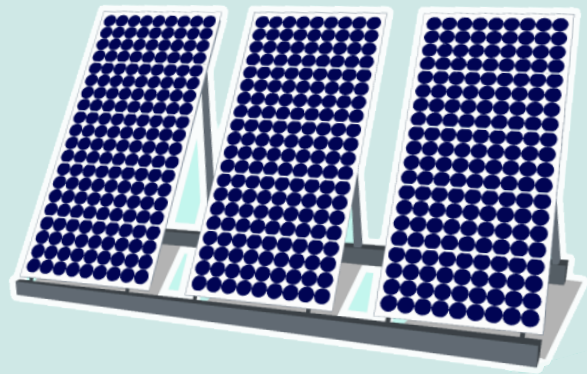
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Introduction

Hello, my name is Professor Ian Cotton. I work in the University High Voltage Laboratory where we can generate 2 million volts; if you tried to do this using batteries you'd need a line of them 45 miles long! We can make small bolts of lightning and we test equipment that is used on the electricity system.



My job involves working with other engineers to make sure we can find the best ways of getting electricity to your home and school. It's always a challenge and we spend our time solving problems. Click on the website and find out more about the area in which I work.

Hi, I'm Teresa Chilton and I work at the University of Manchester with Ian. My job involves helping primary school children (and their teachers!) to understand the work that Ian and other engineers do. I then help the children to do experiments investigating energy and to think about how we can save energy and live more sustainable lifestyles.



When I am not at University I enjoy horse riding, playing the piano and motor sports (lots of science there!).

So come on, let's use some energy to explore this website ... have fun!

What is Energy?



We use energy in everything that we do. We need energy to walk to school, we need energy to play, to run a computer or to cook our food. There are many different forms of energy;



Light Energy

Light is a form of energy. We can use solar cells to turn light energy into electrical energy. Light energy also helps plants grow.

Thermal Energy

Thermal energy is contained in anything that is hot. When you cook food you burn gas to convert the chemical energy into thermal energy. The Sun produces lots of thermal energy and keeps the Earth warm.



Electrical Energy

We use electrical energy to power lots of things such as fridges, washing machines and computers. A light bulb changes electrical energy into useful light energy and waste heat energy.

Kinetic Energy

Anything that is moving has kinetic energy. When you ride your bicycle you turn chemical energy in your body into kinetic energy.



Sound Energy

You could not hear anything unless sound energy travelled into your ears. The louder you talk, the more sound energy you produce.

Potential energy is a special name for stored energy, there are four kinds of potential energy.



Chemical Energy

Food has chemical energy. When you eat food you are putting chemical energy into your body. The body transforms this into kinetic and thermal energy. Other fuels like gas, petrol and coal contain chemical energy. These materials are burned to release thermal energy.

Gravitational Energy

Anything which is high up has gravitational energy. When the skier goes down the hill, this gravitational energy changes into kinetic energy. Gravitational energy is stored and is therefore a kind of potential energy.

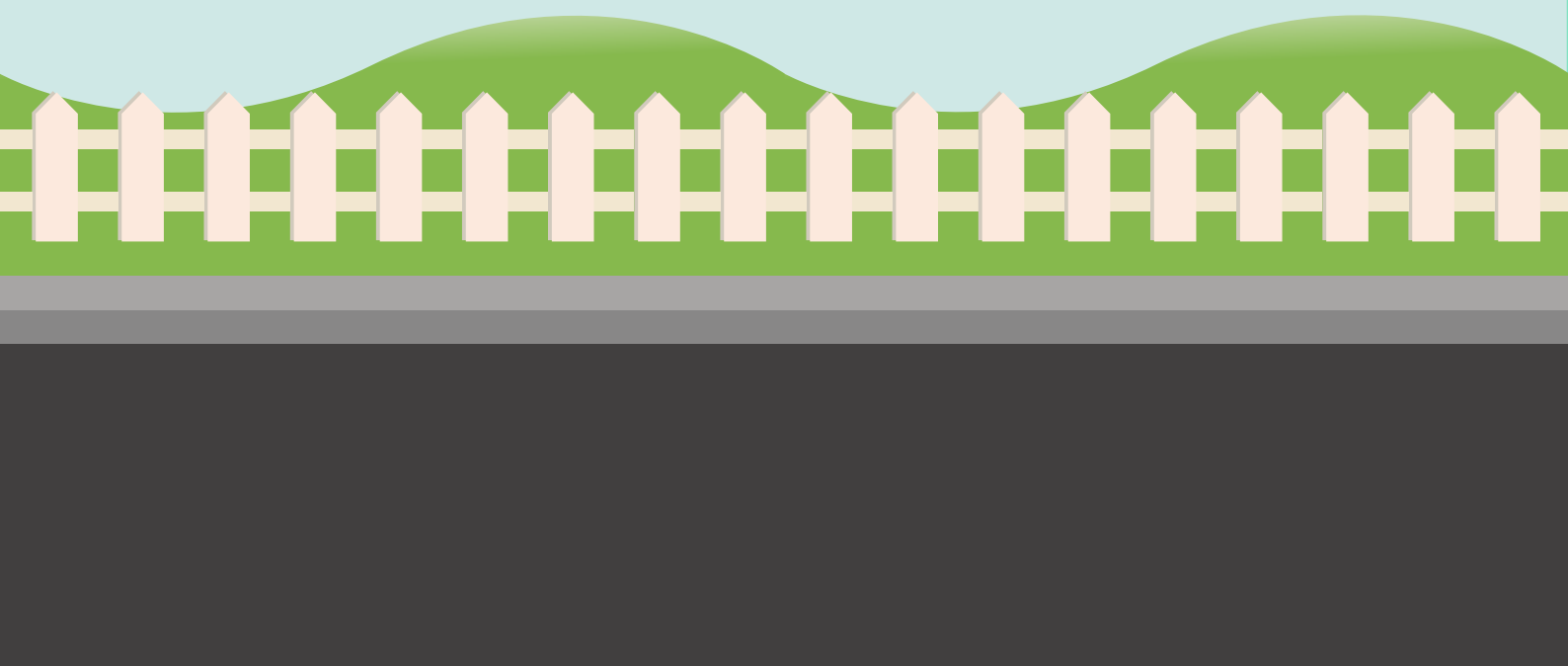


Elastic Energy

Think of pulling an elastic band and letting go. The energy stored in the elastic band turns to kinetic energy. Elastic energy is stored and so it is a kind of potential energy.

Nuclear Energy

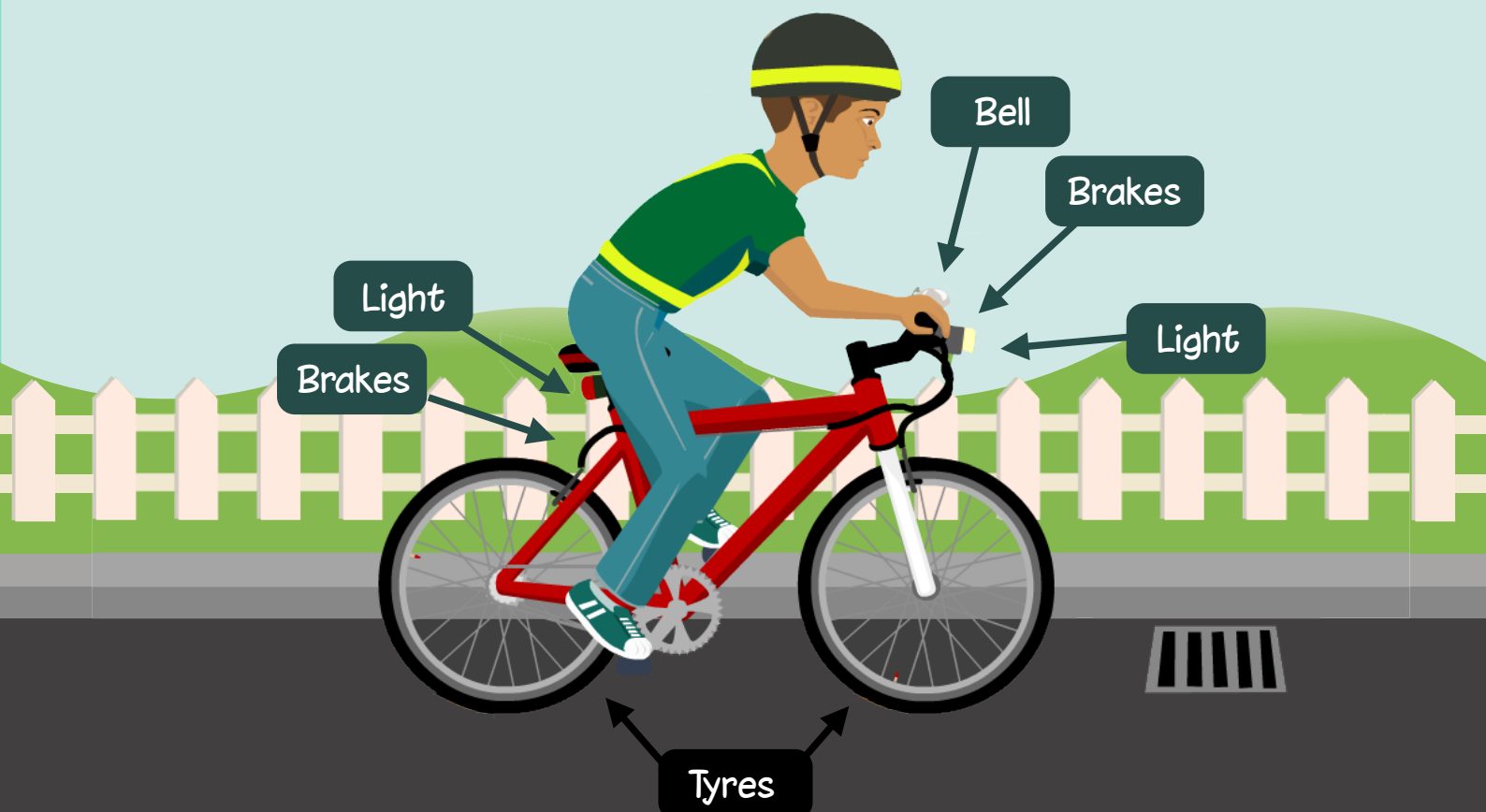
Nuclear energy is the energy contained within very small particles called atoms. It is released when atoms are joined together (fusion) or split apart (fission). The Sun's energy comes from atomic fusion, releasing different types of energy including heat and light.

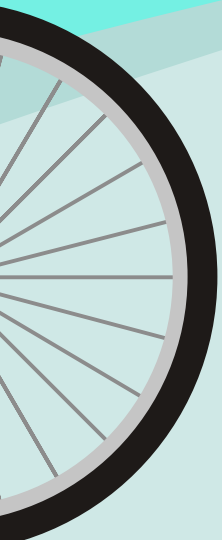


You can change energy from one form to another, but you can't make it disappear. In the morning you eat breakfast, this gives your body some chemical energy...



Think about what happens when you go for a bike ride...

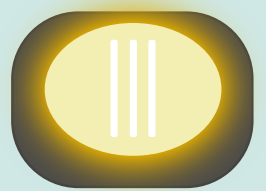




When you ride your bike, your muscles change your chemical energy into kinetic energy and this makes your bike move.

As your bike moves along, the friction of your tyres on the road transforms kinetic energy into sound energy and thermal energy.

At night you need to have lights on your bike. You could use a dynamo, a type of generator that turns kinetic energy into electrical energy. You could also use batteries to power the lights. These have chemical energy which is turned into electrical energy before you get light energy.



If you cycle up a hill you have to pedal very hard as you are giving your bike potential energy.

When you go down the hill, you don't have to pedal because the gravitational potential energy that you gained going uphill is converted to kinetic energy on your way down.



If you need to ring the bell on your bike, you use kinetic energy to make it move. This kinetic energy then turns into sound energy.

When you apply your brakes, the kinetic energy is transformed into thermal energy and your wheels will actually get warmer.

What have we learned?

Everything that we do uses energy. We need energy to work at school and energy to play at home...

There are different types of energy. They have names like: kinetic, potential, sound, light, heat, chemical and nuclear.

You can change energy from one type to another. When you eat food you give your body chemical energy. You change this into kinetic energy when you move, heat energy to keep your body warm and sound energy when you speak.



Quiz Time!

1. We've just blown up a balloon. Can you work out which type of energy it has?

- A) Potential
- B) Kinetic
- C) Light

2. Which type of energy does the balloon's potential energy turn into when we let the balloon go?

- A) Chemical
- B) Electrical
- C) Kinetic

3. In which order does energy change from one type to another when you ride a bike and then stop?

- A) Chemical - Heat - Kinetic
- B) Chemical - Kinetic - Heat
- C) Heat - Kinetic - Chemical

4. Which type of energy does a runner have?

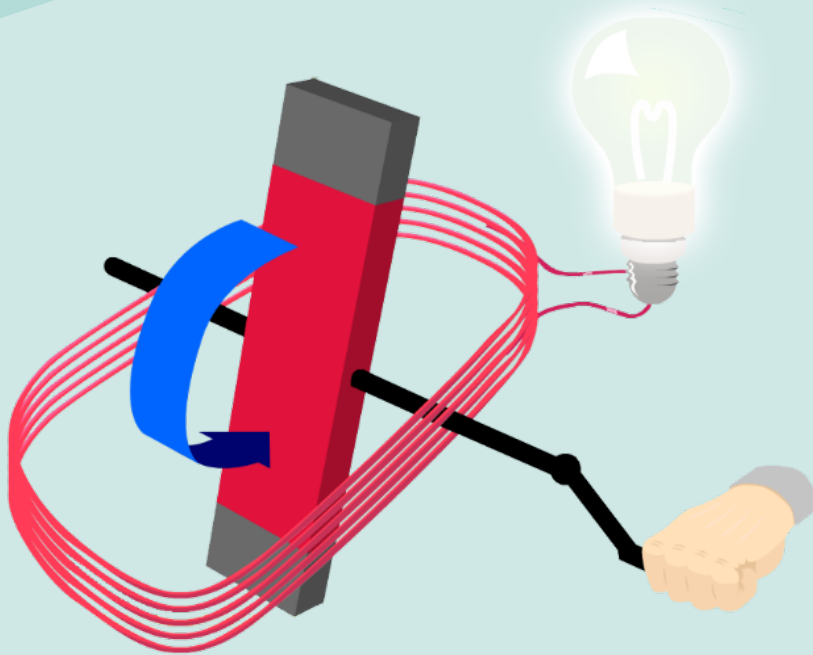
- A) Electrical
- B) Elastic
- C) Kinetic

See the answers at the end of the module.



How Do We Make Electricity?

It's easy, let's find out how!



Electricity can be made using a very simple generator like this. If we spin a magnet around within a coil of wire, electricity is made in the wire.

If we connect a light bulb to the wires that come out of the generator this electricity will light it up.

To make enough electricity for everyone, we need to use very large generators. We make these generators turn in different ways.



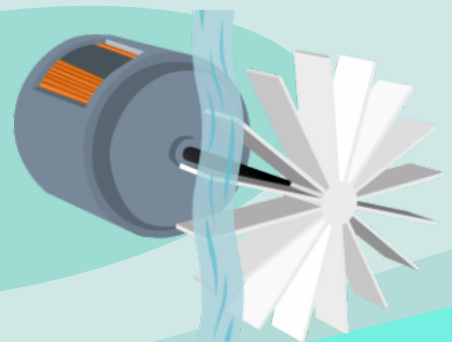
In an oil, coal or gas fired power station, we burn fuel to make water turn to steam.

This steam is then used to turn a big set of wheels called a steam turbine.

This then turns the generator.

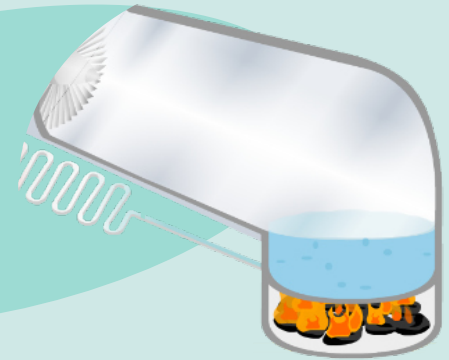
Hydro-electric

In a hydro-electric power station, lots of water is dropped through a big wheel making it turn. This is connected to the generator.



Biomass

In a biomass power station biomass fuel from trees, shrubs and animal poo is burned in a boiler to produce high-pressure steam. The steam rotates the turbines which turn the generator to produce electricity.



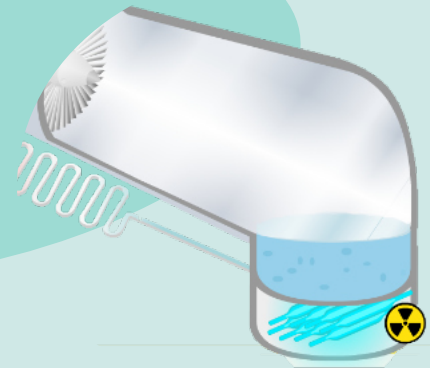
Geothermal

Geothermal energy uses the steam from hot water reservoirs deep beneath the Earth. Engineers drill down to these reservoirs. As the water rises to the surface it begins to boil. The steam is used to spin turbines which turn the generator and produce electricity.



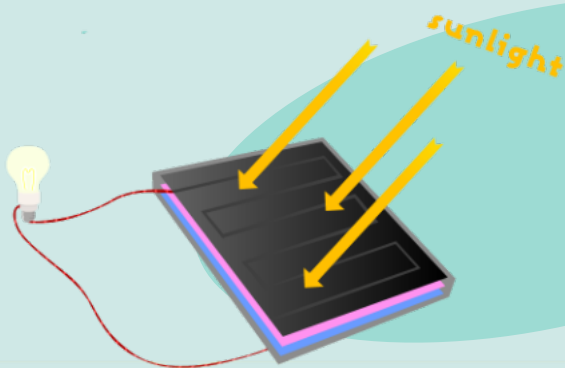
Nuclear power

Nuclear power stations use a radioactive fuel called Uranium. Uranium atoms release small particles called neutrons which hit other Uranium atoms and split them into two creating heat, radiation and more neutrons. The heat is used to make steam which runs a steam turbine generating electricity.



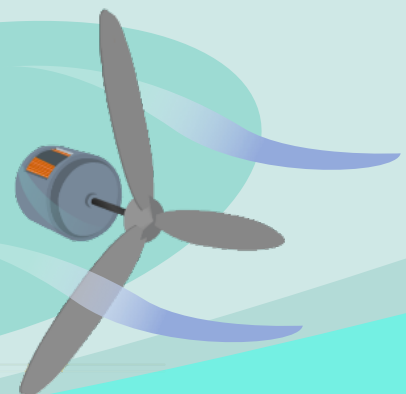
Solar

The energy of sunlight can be used to generate electricity using special solar panels called photovoltaic cells. These panels usually contain silicon and produce electricity when sunlight falls on them.



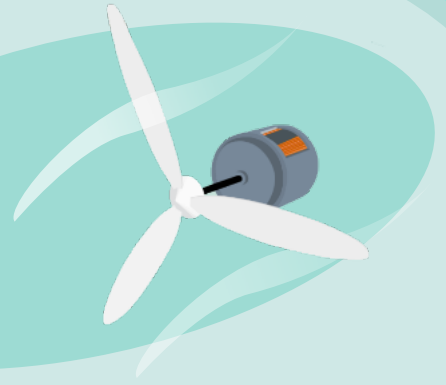
Tidal turbine

Tidal turbines are one of the many ways we can generate electricity from the sea. They are similar to wind turbines but the blades are turned by the tidal currents in the sea and must be much much stronger to survive the waves.

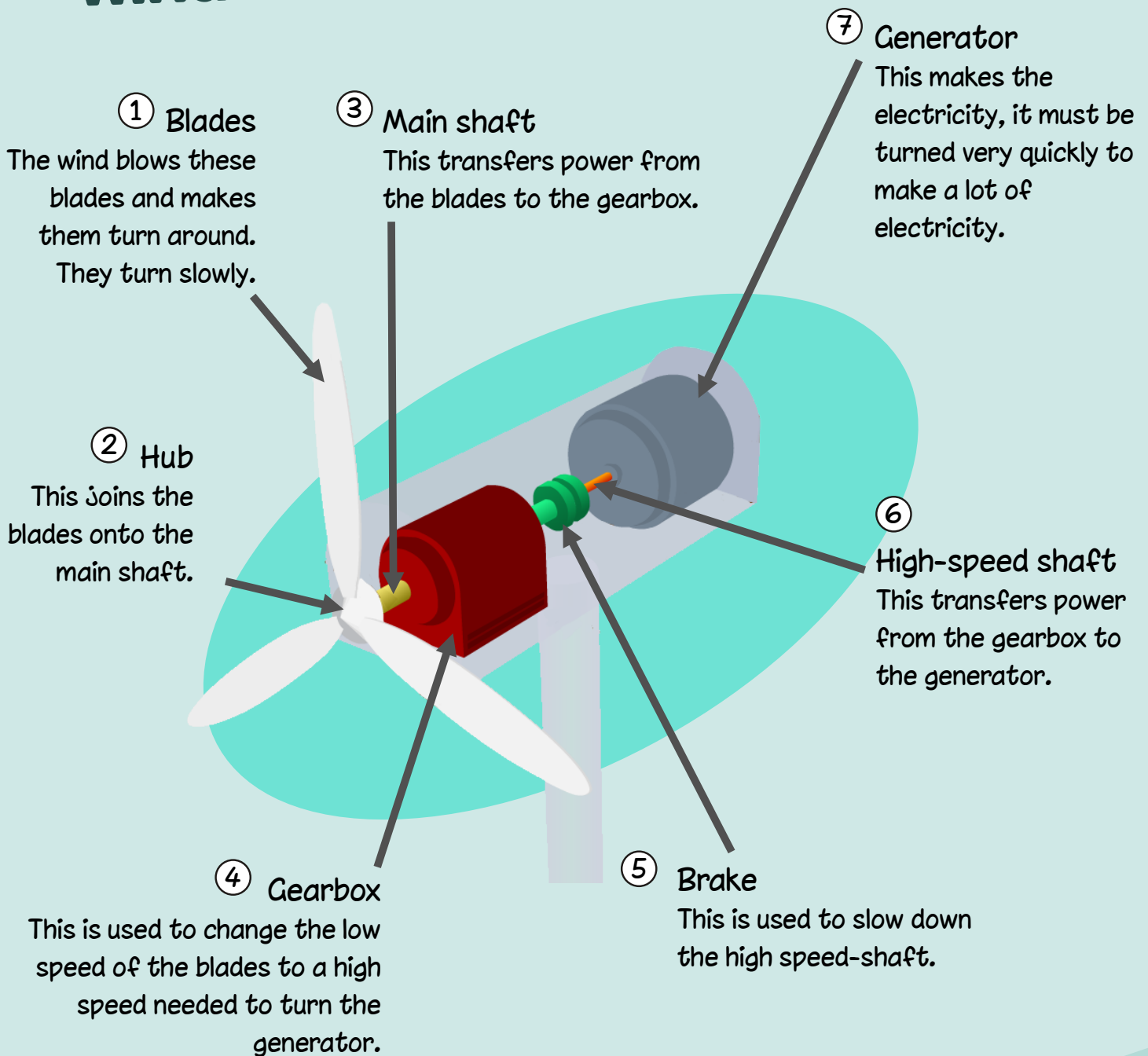


Wind turbines

Wind turbines use a very big blade attached to a generator. The blades of the wind turbine catch the wind, causing it to turn, generating electricity.



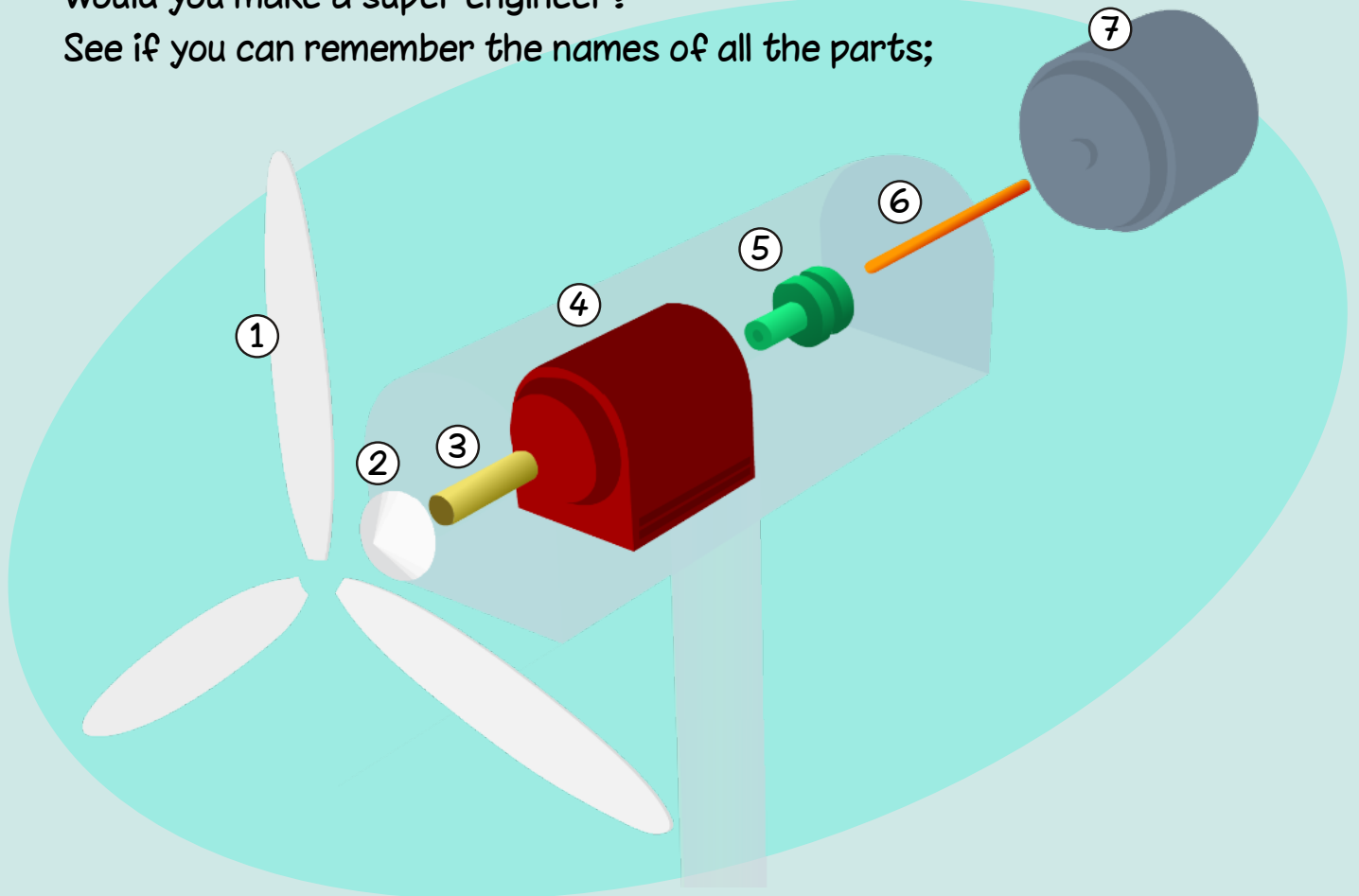
Find out how a wind turbine works!



Can you build a wind turbine?

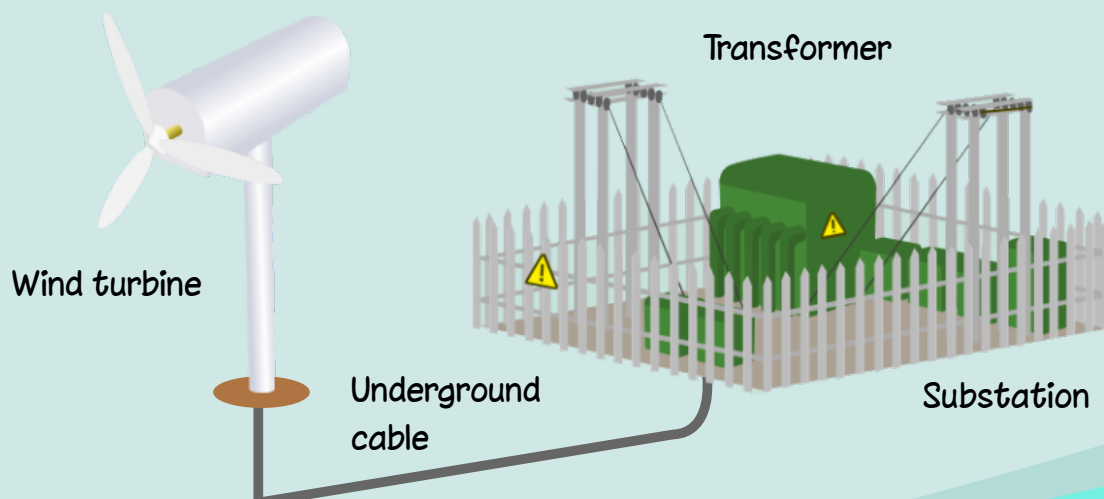
Would you make a super engineer?

See if you can remember the names of all the parts;

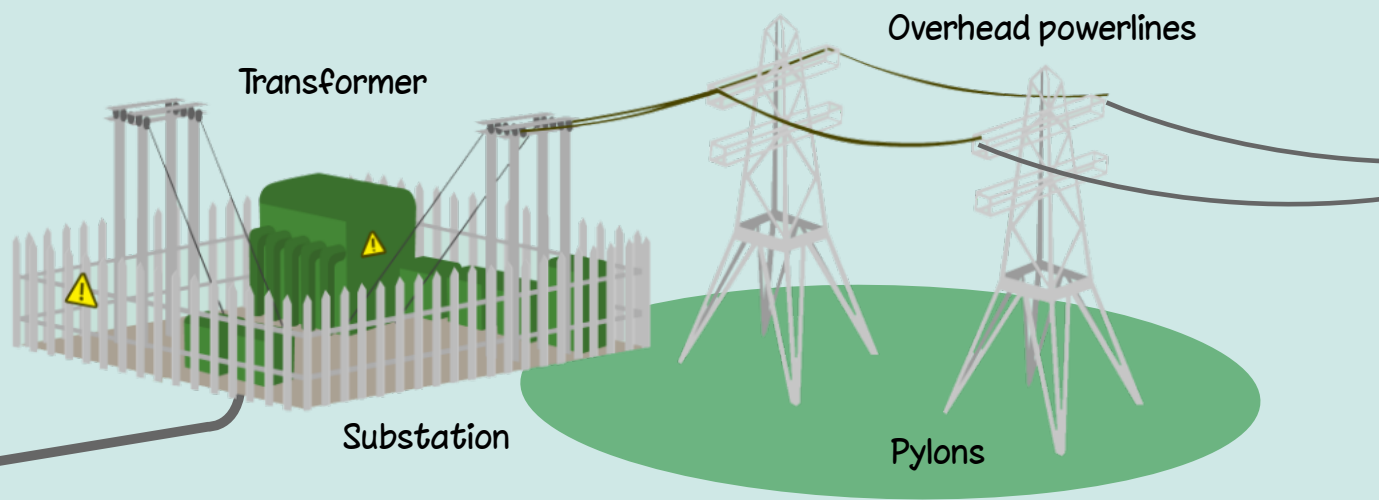


Generators

The electricity from the generator travels along underground power lines to a substation. Inside the substation, a transformer changes the electricity to a higher voltage. This makes it easier and more efficient to move along long distances of overhead power lines and underground cables.

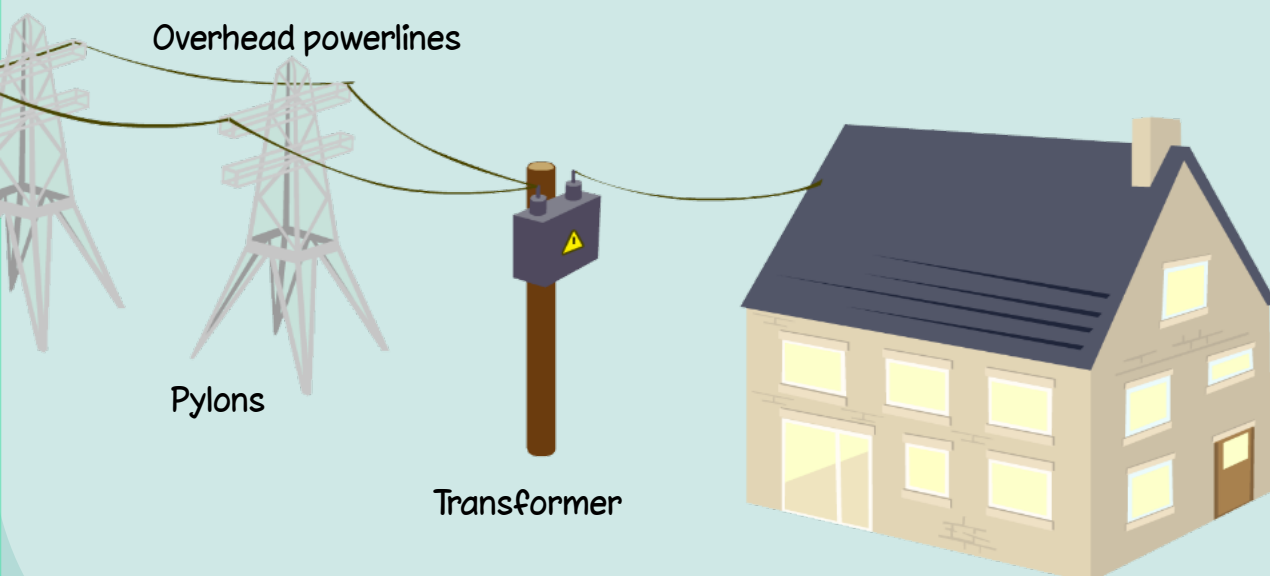


Overhead lines allow electricity to be transported at high voltage over long distances. They are very dangerous and you should not go near them.



Another transformer turns the high voltage electricity into a lower voltage, making it safe to be used in the house. They are also very dangerous and you should not go near them.

In a city, the electricity is sent to your house from the substation along an underground cable that you can't see. Next time you are in the countryside, see if you can spot the overhead power lines and the transformers on the electricity poles.



Quiz Time!

1) Which of these is used to make electricity?

- A) Generator
- B) Transformer
- C) Turbine

2) Which of these is used to turn the generator?

- A) Generator
- B) Transformer
- C) Turbine

3) Which of these provide energy to turn the turbine?

- A) Sun, wind, water
- B) Coal, wind, biomass
- C) Geothermal, Sun, nuclear

4) What is the fuel used in nuclear power stations called?

- A) Coal
- B) Uranium
- C) Titanium

5) What is the correct name for a solar cell?

- A) Photovoltaic
- B) Photochromic
- C) Photoreceptor

6) What is the gearbox used for in a wind turbine?

- A) To increase the speed of rotation
- B) To generate electricity
- C) To catch the wind

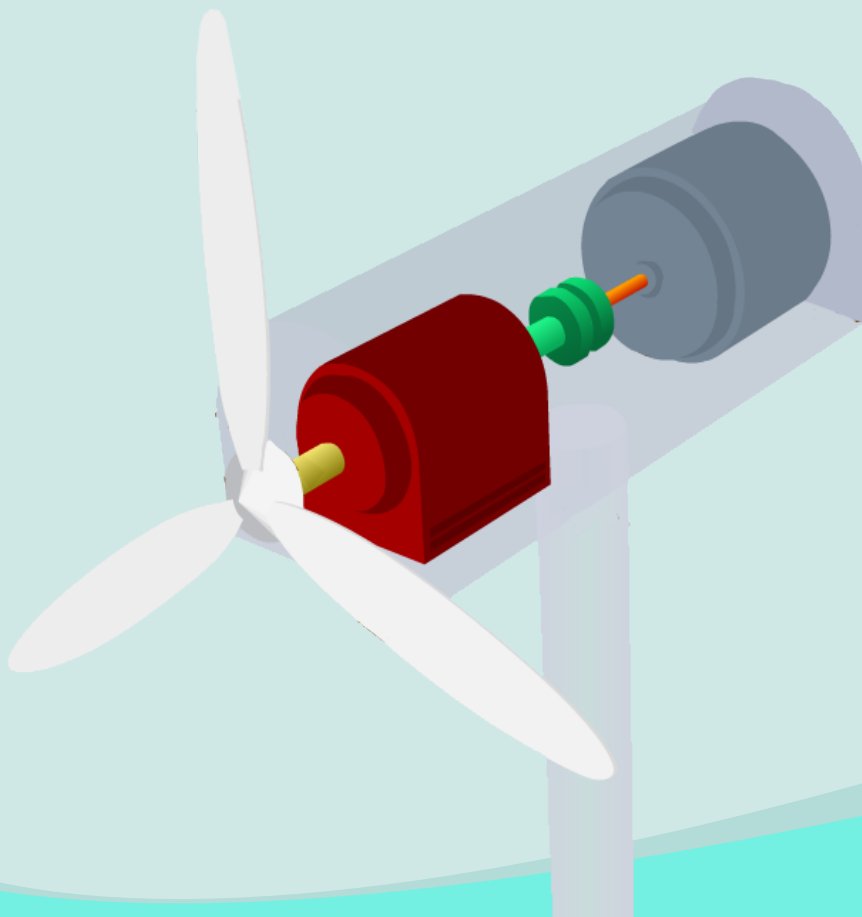
7) What is used to increase the voltage of the electricity?

- A) Generator
- B) Turbine
- C) Transformer

8. What is used to decrease the voltage of the electricity?

- A) Generator
- B) Transformer
- C) Turbine

See the answers at the end of the module.



Renewable and Non-Renewable Energy

Electricity can be made from renewable or non-renewable energy sources. Let's find out more...

Non-renewable sources

Most of our electricity comes from power stations that use fossil fuels like coal, oil and gas to generate the electricity. They are called non-renewable sources because you can't make any more and they will eventually run out.

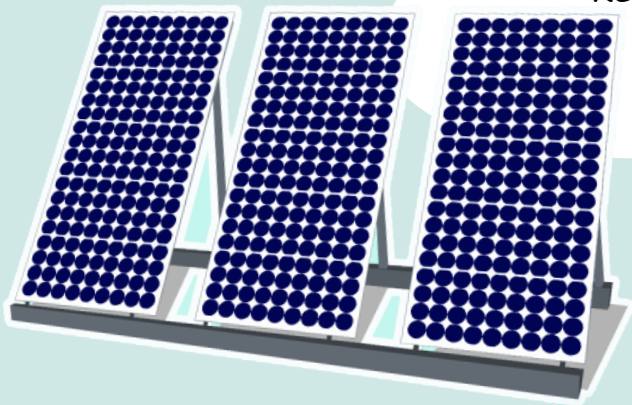
Unfortunately, burning fossil fuels produces greenhouse gases like carbon dioxide and methane which may cause global warming.



Renewable sources

Renewable energy sources like the Sun, wind, waves and the heat of the Earth are also used to make electricity. Renewable sources can be used again and again and should not run out.

Renewable sources are either carbon neutral or do not produce greenhouse gases so are much less harmful to the environment.



Non-Renewable Energy



Oil and gas

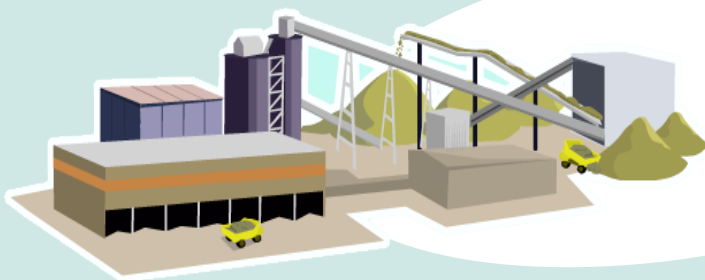
Oil and gas are fossil fuels were formed in the Carboniferous period millions of years ago when tiny sea creatures called diatoms died and sank to the bottom of the oceans.

As more and more layers of sediment covered the sea creatures, they were crushed by the massive pressures and the carbon in their bodies eventually turned to oil and gas. We burn this oil and gas in power stations today.

Coal

Coal is a fossil fuel which was formed in the Carboniferous period millions of years ago, (before the dinosaurs!), when the Earth was covered with oceans, swamps, trees and plants!

When the trees and plants died they formed a layer of peat, which over time became buried by layers of clay, sand and rock. Over millions of years, the pressure of these layers turned the peat into coal. This is what we put on our fires and fuel our power stations with today.



Nuclear

Nuclear fuel is made from radioactive Uranium Ore which occurs naturally in the ground, particularly in Australia, Canada and America.

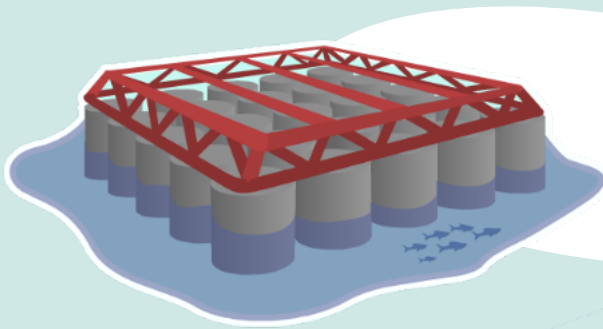
It is also known as yellowcake for its distinctive bright yellow

colour. The yellow Uranium Ore is purified to provide the shiny Uranium metal used in nuclear power plants.

Renewable Energy

Wind

Wind is made when the Sun heats the Earth and the area above land gets hotter than the area above water. The hot air above land rises upwards leaving an area of low pressure. Cooler air moves into this area of low pressure making wind which we use to turn wind turbines and make electricity. Wind used to be used to turn windmills to grind wheat into flour.



Waves

Waves are created by the wind blowing across the sea and by the gravitational force of the moon. Wave power uses the energy of the waves to turn turbines that make electricity.

Tidal

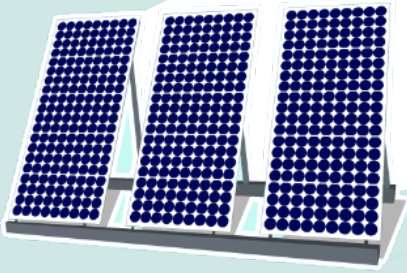
Tidal energy comes from the movement of water in the sea by the tides. These tides happen twice a day. The flow of water that is created by the tides is used to turn generators that make electricity.



Geothermal

Geothermal power uses the heat that comes from deep rocks under the surface of the Earth. The temperature of the Earth increases towards its centre. The hot water or steam that comes from deep within our planet can be used to make electricity.



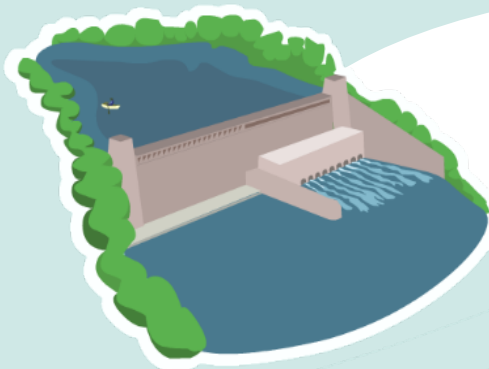


Solar

The Sun releases an amazing amount of energy due to the nuclear fusion of hydrogen taking place within its core. Solar panels, called photovoltaic cells are used to convert the Sun's energy into electricity. The Sun can also be used to heat water passing through special solar collectors.

Biomass

Biomass uses the energy from plants and waste materials to make electricity. For example, wood or animal droppings can be burnt to make steam that turns turbines to make electricity.

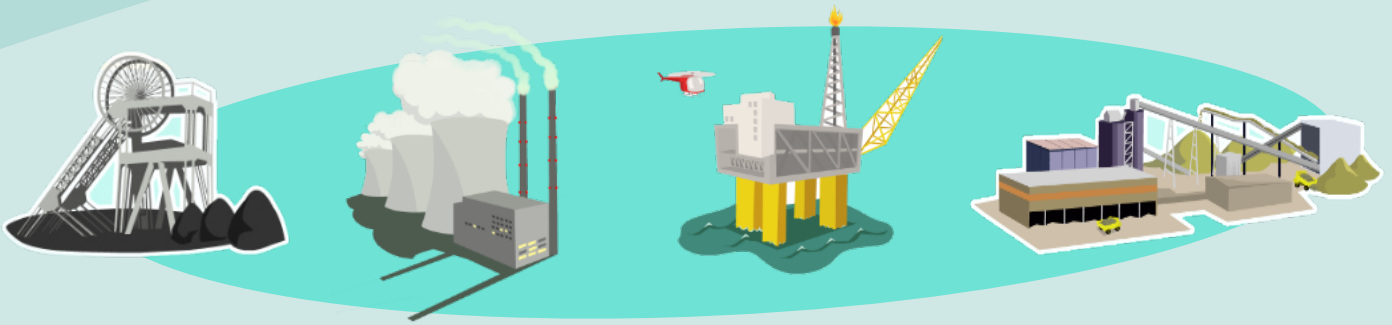


Hydro-electric

Hydro-electricity is generated from running water. Dams are built across a lake or river in a valley to trap water. The water flows through tunnels and turns the turbines which make electricity.

Can you remember the names of these types of renewable and non-renewable energy?

Non-renewable sources



Renewable sources



Quiz Time!

1) What is a non-renewable energy source?

- A) One which will run out.
- B) One which won't run out.
- C) One which can be renewed.

2) What is a renewable energy source?

- A) One which will run out.
- B) One which won't run out.
- C) One which can be renewed.

3) Which of these are renewable energy sources?

- A) Wind, Sun, tidal
- B) Wind, nuclear, tidal
- C) Wave, wind, coal

4) Which of these are non-renewable energy sources?

- A) Wind, Sun, tidal
- B) Nuclear, coal, oil
- C) Coal, gas, biomass

5) What makes wind?

- A) Wind turbines
- B) Movement of trees
- C) Differences in temperature

6) Wood and animal droppings are examples of?

- A) Biomass
- B) Biometrics
- C) Biomechanics

7) Which period was coal formed?

- A) Cretaceous
- B) Triassic
- C) Carboniferous

8) As we go deeper below the Earth's surface, the temperature:

- A) Stays the same
- B) Increases
- C) Decreases

See the answers at the end of the module.

Advantages and disadvantages...

Non-Renewable and **Renewable** energy, let's investigate each different source...

Non-Renewable energy

Coal

Advantages

- Coal can be found in lots of places in the world and there is still plenty in the UK.
- Coal can be easily transported to the power stations.
- Coal is a relatively cheap energy source.

Disadvantages

- To dig up coal, we have to create mines which can be dangerous and not very nice to look at.
- Transporting coal by lorry and train from the mine to the power station causes pollution.
- Burning coal produces polluting gases like sulphur dioxide which make acid rain.
- Of all the energy sources, oil and gas - lots of people will want it.
- Coal is a non-renewable source and will run out in about 100 years.
- Coal miners can be affected by black lung disease or pneumoconiosis and also emphysema if they breathe in too much of the coal dust.



Oil and Natural Gas

Advantages

- Oil and natural gas are found in lots of places in the world.
- We can transport oil and gas in pipes and by using tankers or ships.



← Disadvantages

- Environmental damage can be caused when building the rig and by accidental oil spillages.
- Oil and gas are not renewable, so once the supplies are used, they will run out.
- Burning these fuels releases greenhouse gases into the air. This may add to global warming.
- The price of oil and gas will increase because supplies are running out and lots of people will want it
- Working on an oil or gas rig can be dangerous due to the risk of explosions and bad weather.



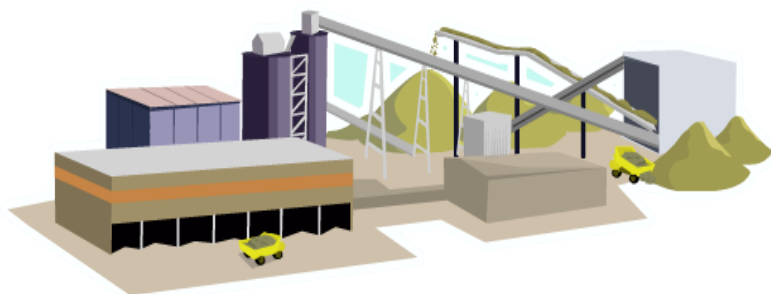
Nuclear

Advantages

- Nuclear fuel does not make harmful greenhouse gases.
- You only need a very small amount of nuclear fuel to make a lot of energy.

Disadvantages

- The waste that is produced when using nuclear fuel is radioactive and very harmful. It needs to be disposed of carefully.
- Nuclear power stations are at risk from terrorist attack and sabotage.
- World Uranium supplies may run out in about 50 years.



Wind

Advantages

- Wind is free and will not run out so the only cost is in building the wind turbine.
- Wind power generation does not create greenhouse gases.
- There are very few safety risks with wind turbines.

Disadvantages

- We can only use wind turbines in areas where there is a lot of wind. Sometimes there may be days where there is little wind.
- We need a lot of turbines to make a lot of electricity.
- Some people don't like the way wind turbines look, they think they spoil the countryside.



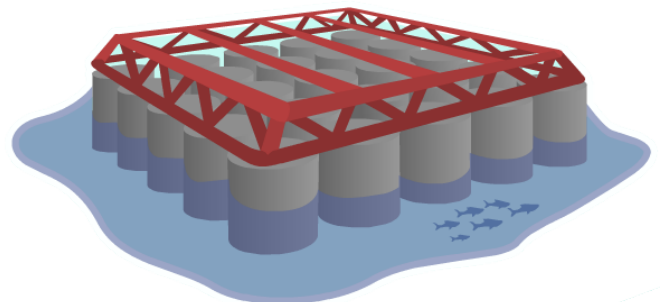
Wave

Advantages

- Waves are free and will not run out so the cost is in building the power station.
- Wave power does not produce greenhouse gases.
- There are very few safety risks with wave power generation.

Disadvantages

- Waves can be too big or too small so you may not always be able to generate electricity.
- You need to find a way of transporting the electricity from the sea onto the land.
- Not many people have tried to generate electricity this way yet so the equipment is expensive.



Tidal

Advantages

- Tides are free and will not run out so the cost is in building and operating the power station.
- No greenhouse gases are produced when we make the electricity.
- We know exactly when the tides happen so we know when electricity will be made.



Disadvantages

- You may need to build a large wall called a dam to make the water flow through the generators. This may not be good for plants and animals that live nearby.
- The tides only happen twice a day, so can only produce electricity for that time.

Geothermal

Advantages

- Geothermal energy does not produce greenhouse gases.
- The energy source is free and will not run out.

Disadvantages

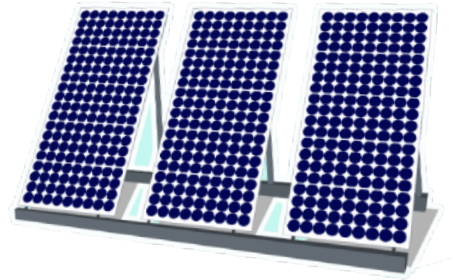
- There are not many places where we can build geothermal power stations.
- Harmful gases and minerals may occasionally come up from the ground below. These can be difficult to control.



Solar

Advantages

- The energy from the Sun is free.
- The Sun does not produce greenhouse gases.
- The Sun will always be there during our lifetime.



Disadvantages

- It is relatively expensive to build solar power stations.
- When it is cloudy or at night, there is not enough light, so no electricity can be made.
- Some people don't like the look of solar panels.

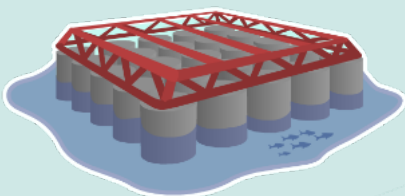
Biomass

Advantages

- The fuel is cheap and we can use things that we might otherwise throw away.
- We can find waste everywhere and should not run out.

Disadvantages

- When the fuel is burned greenhouse gases are made which pollute the environment.
- Sometimes people grow biomass crops where we could grow food.
- We may not have enough space to grow enough biomass fuel.



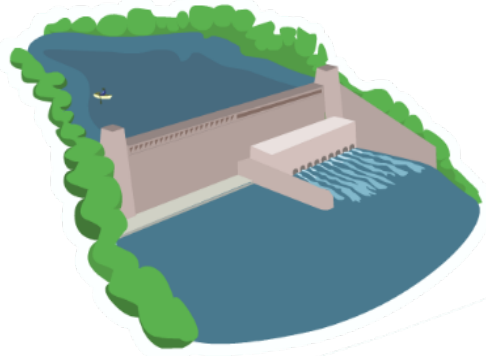
Hydro-electric

Advantages

- When the electricity is generated, no greenhouse gases are made.
- The water used is free.
- It is a renewable energy source.

Disadvantages

- The dam is expensive to build.
- By building a dam, the nearby area has to be flooded and this could affect nearby wildlife and plants.
- If it does not rain much we may not have enough water to turn the turbines.



Quiz Time!

1. Which energy sources produce the least carbon dioxide?

- A) Non-renewable
- B) Renewable
- C) Non-sustainable

2. Which energy source can lead to acid rain?

- A) Coal
- B) Tidal
- C) Solar



3. Which of these energy sources are free?

- A) Sun, wind, waves
- B) Sun, biomass, coal
- C) Sun, oil, gas

4. Pneumoconiosis is a disease associated with...

- A) Too much sun
- B) Cold winds
- C) Coal dust

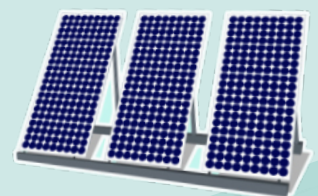
5. What is a disadvantage of hydroelectric electricity generation?

- A) Water is expensive
- B) Greenhouse gases are given off
- C) Nearby land is flooded

6. Which of these are the safest ways to generate electricity?

- A) Nuclear, solar, wind
- B) Wind, solar, tidal
- C) Coal, gas, solar

See the answers at the end of the module.



Energy and Global Warming

What is global warming?

The temperature of the Earth's atmosphere has risen by about 0.5°C in the last hundred years. It is predicted to rise another 4°C by the end of the century. Does it matter? Yes! Let's find out why..



Temperature increases lead to...



Drought

Drought causes warmer, drier summers which mean less water resulting in droughts in some areas. Shortage of water affects people, animals and crops.

Increased rainfall causes warmer temperatures in winter leading to more rain, storms and flooding. Damage to homes, offices, power and water supplies and food crops may result.

Increased rainfall



Rising sea levels

Rising sea levels causes water to expand as it gets warmer. This can result in a rise in sea levels. There is a risk of land and buildings flooding and erosion in coastal areas.

Melting ice caps

Ice caps and glaciers melt causing a rise in sea levels and loss of habitat. Polar bears are losing their natural icy home and finding less seals to feed on.



Harmful bacteria

Warmer temperatures can be unpleasant and lead to an increase in harmful bacteria. More illness occurs and also an increased risk of heart and breathing problems.

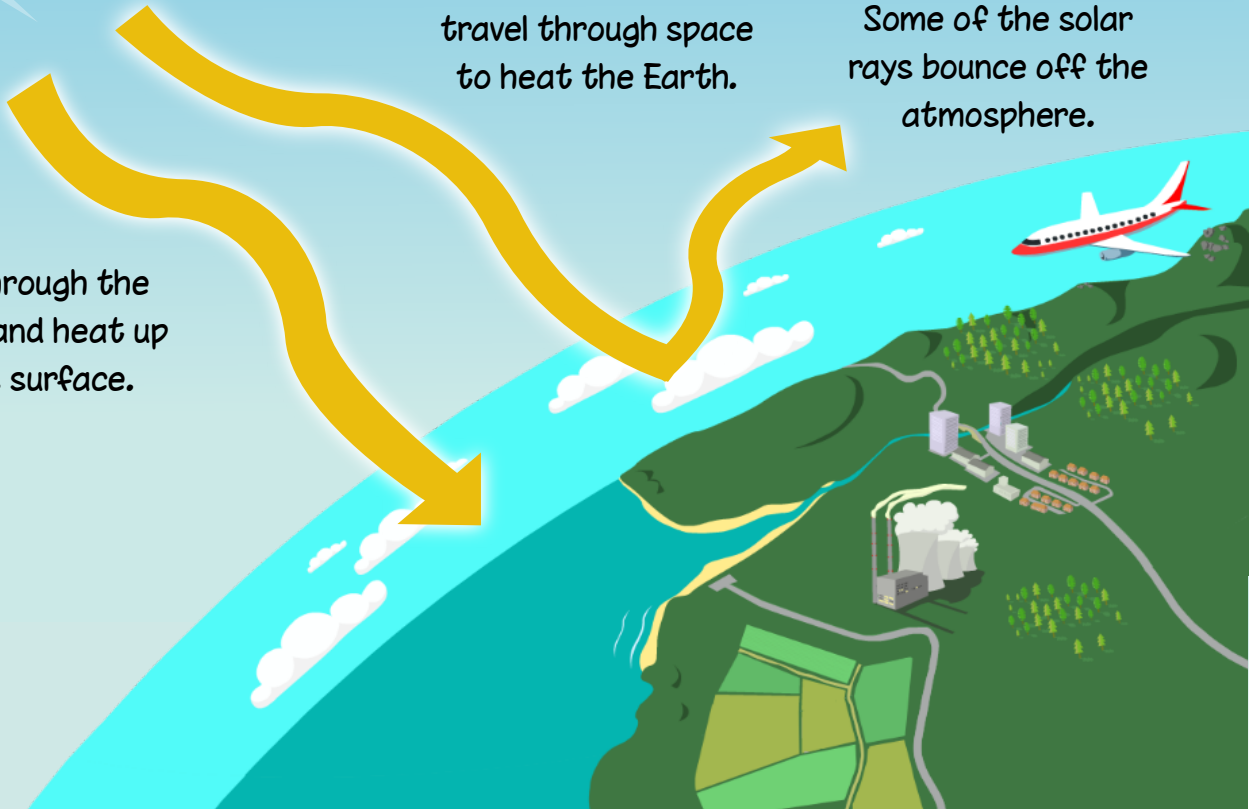
What controls the Earth's temperature?



The Sun gives off solar rays which travel through space to heat the Earth.

Some of the solar rays bounce off the atmosphere.

Some get through the atmosphere and heat up the Earth's surface.



Some of the infra-red heat rays escape from the Earth's atmosphere.

Others are absorbed or reflected back by greenhouse gases and keep the Earth's atmosphere warm.

Greenhouse gases are therefore very important, without them the Earth would be about 32°C lower.

Brrr!

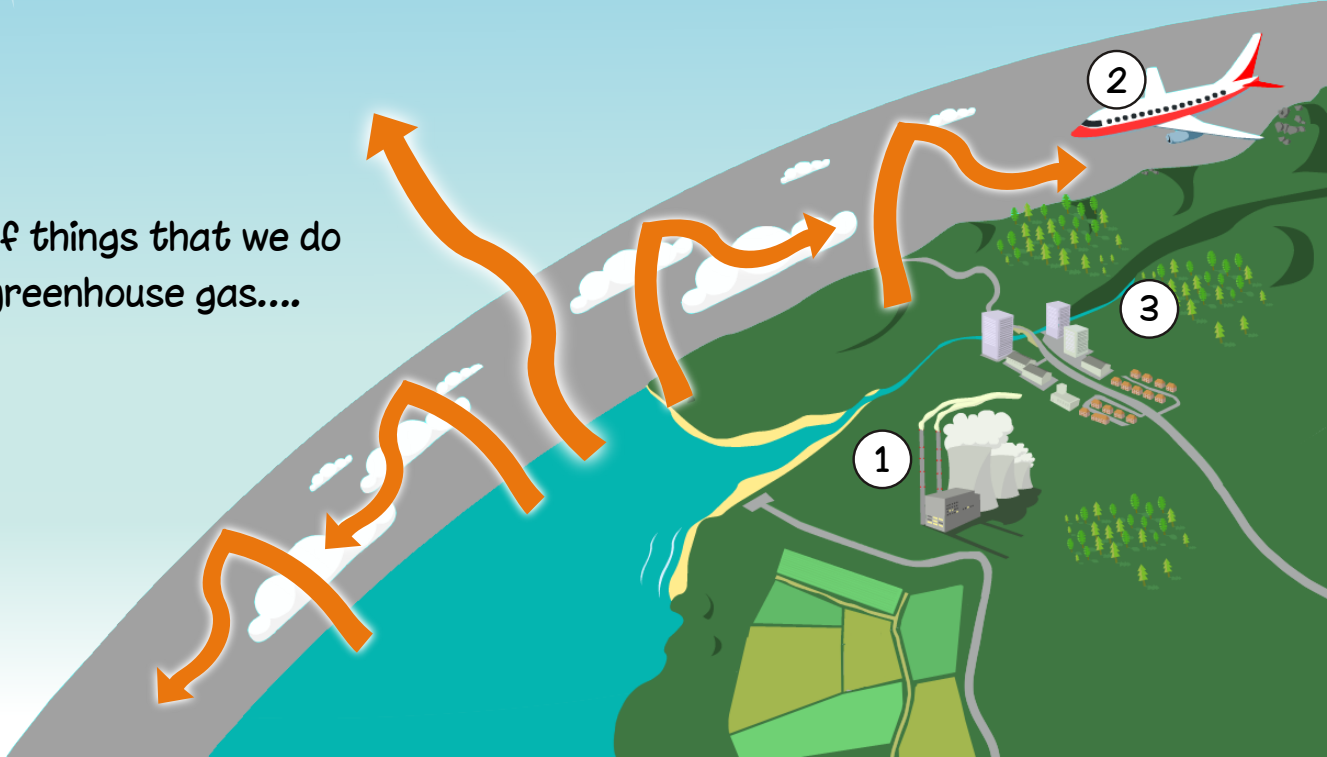




Why is the temperature rising?

If the amount of greenhouse gas in the atmosphere increases, more of the heat will be reflected back to Earth and the Earth's temperature will rise.

Lots of things that we do make greenhouse gas....



- ① When fossil fuels, like coal, oil and gas, are burnt to heat our homes and make electricity, carbon dioxide and other greenhouse gases are released into the atmosphere.

②

Cars, buses and aeroplanes burn the fossil fuels petrol, diesel and jet fuel and give out carbon dioxide on every journey they make.



③

Cutting down trees and forests and burning the wood means more carbon dioxide. Live trees use photosynthesis to remove carbon dioxide from the atmosphere and combine it with water to make sugar for growth. Less trees means more carbon dioxide.



What can we do?

- Use less electricity
- Walk or cycle instead of using the car
- Plant more trees

Did you know?

Scientists at the University of Manchester have found that the temperature is lower in cities when there are lots of trees. That's because trees use the heat energy to pull water through the trunk to their leaves.



Quiz Time!

1. How much has the Earth's temperature increased in the last 100 years?

- A) 0.5°C
- B) 5°C
- C) 50°C

2. Where does the Earth get its heat energy from?

- A) Coal
- B) Sun
- C) Oil

3. Which gases help to control the Earth's temperature?

- A) Noble gases
- B) Condensed gases
- C) Greenhouse gases

4. Why is the Earth's temperature rising?

- A) Less greenhouse gas
- B) More greenhouse gas
- C) Same greenhouse gas

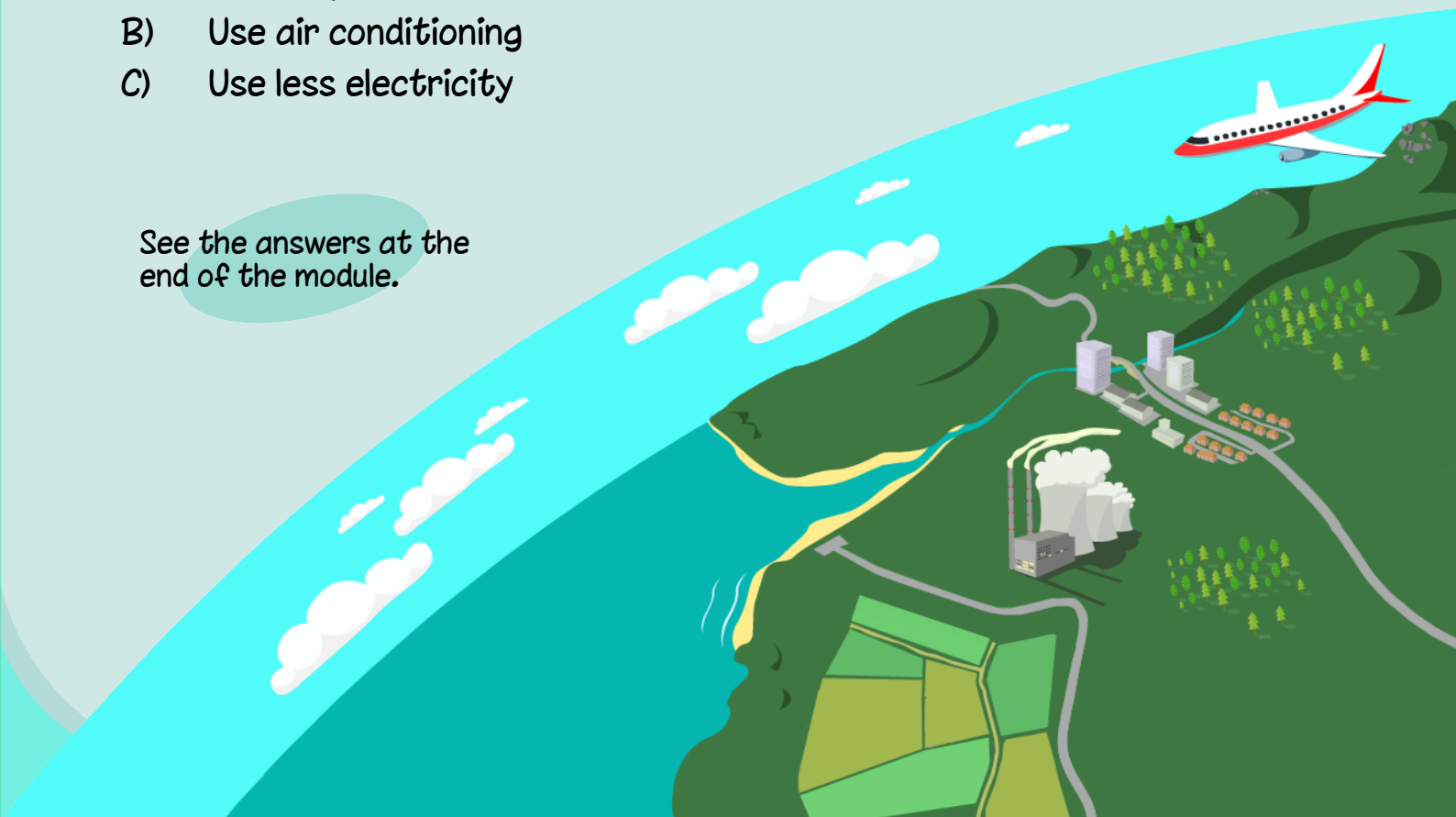
5. What effects are seen with global warming?

- A) Droughts, melting ice caps, more bacteria
- B) Droughts, melting ice caps, less bacteria
- C) Droughts, rising sea levels, less bacteria

6. What can we do to reduce global warming?

- A) Travel by car
- B) Use air conditioning
- C) Use less electricity

See the answers at the
end of the module.



Energy is everywhere!

... in our homes, in our gardens, in our schools
and of course, in our bodies!

Using too much energy from non-renewable sources
can harm our environment, however with your help
we can protect the world around us.



There are many energy
sources in this picture,
lets find out more about
them...

Out and about...

The Sun

The Sun is the closest star to our planet. Ultimately, planet Earth gets all of its energy from the Sun. The sunshine landing on one square metre in your garden has 10,000 times more energy than an ordinary light bulb!

The Sea

We are lucky in the UK that we live on an island; we are surrounded by the sea. The power of the waves can be used in different ways to create electricity.

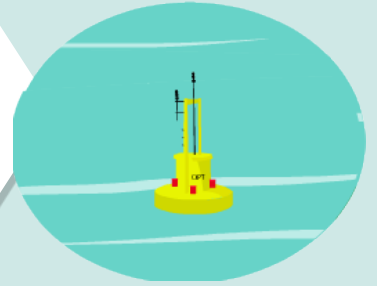
Just 1 square kilometre of coast off Scotland will have about 70 Megawatts of energy contained within the waves. This could be used to produce about 30 Mega Watts of electricity - enough for around 20,000 homes.



Power Bouy

This looks like a huge floating doughnut. In the middle of it there is a piston. The piston moves up and down with the rise and fall of the waves.

This movement drives a generator and produces electricity. Within a year, it produces more energy than was used to build it.



Pelamis

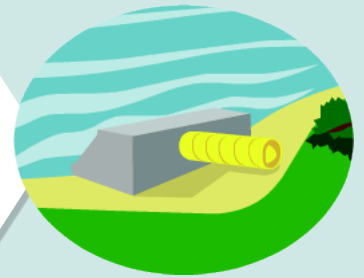
This is like a giant caterpillar bobbing up and down on the sea! It is made of lots of cylinders all linked together. As the waves move each cylinder up and down, the movement drives a generator which makes electricity.



LIMPET

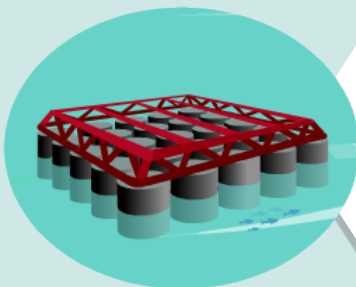
LIMPET - Land Installed Marine Powered Energy Transformer - is the world's first commercial wave power station. It is situated on the shore of the Scottish island of Islay.

As waves surge into LIMPET's chamber, air is pushed out. The rising and falling water levels turn a pair of turbines. Each turbine drives a generator to produce electricity.



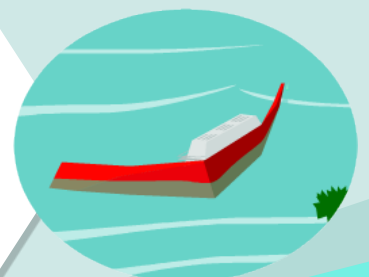
Bobber

Here at the University of Manchester engineers are developing a new device to harness the power of the waves. It is called 'The Manchester Bobber'. As it bobs up and down on the sea, it uses a pulley system to spin a flywheel. The flywheel is connected to a gearbox which operates the generator.



Wave Dragon

Waves slop over into the mouth of the Wave Dragon. As the waves flow out they turn turbines which produce electricity. This dragon will drink all day and night.





Home & Garden...

①

Trees

During daylight hours, trees use the energy of sunlight to remove the greenhouse gas carbon dioxide from the air and combine it with oxygen to make sugar. The plants use this sugar to grow. This process is called photosynthesis - Carbon Dioxide and Water and Sunlight give Sugar and Oxygen and Water.



...remember, we do need some carbon dioxide in our atmosphere to keep us nice and warm. Some scientists think that if there was no carbon dioxide at all in Earth's atmosphere then the average surface temperature would fall to -18°C . Brrrrr!

②

Vegetables

A lot of the food that you eat is transported many miles from where it is grown to the supermarkets where you buy it. The lorries and aeroplanes that transport them produce lots of carbon dioxide. By growing your own vegetables, or by buying them from local growers, you could help reduce the amount of carbon dioxide in the atmosphere. Why not have a look at the food in your cupboards or in the supermarket. Can you see where it came from?

③

Compost

There's lots of waste in your home that you can reuse yourself. Why not put your kitchen waste, things like vegetable peelings, tea bags, grass cuttings and leaves, into a compost bin? This will turn into compost which you can use to feed your garden plants.

4

Domestic Wind Turbine

A small wind turbine could be used to provide some of the electricity that you use in your home or school. This would reduce the amount of fossil fuels that you use and cut down on the carbon.

5

Car

Think about walking to school or the shops with your parents or guardians! It only takes 15 minutes to walk one mile. Walking helps reduce carbon dioxide emissions as it doesn't burn petrol, and it's much healthier! Remember: use reflective clothing when you are out to help keep you safe.

6

Solar Panels

Solar panels can be used in two ways:

1. To heat water for the radiators which keep your house warm - pipes carry water through the solar panel. Sunlight shines through the glass onto the pipes and heats the water.
2. To make electricity - These solar panels are called Photovoltaic Cells. They usually contain silicon which produces electricity when sunlight falls upon them. Remember, once the solar panels are put onto your roof, the electricity that they make is free!

7

Roof and Cavity Wall Insulation

More than 40% of the heat that is lost from a house escapes through the walls and roof.

Roof - Putting 250mm of insulation in the loft can reduce the heating costs of a house by up to 25%. If every house in the UK had 250mm of loft insulation, the country would save enough money to pay the energy bills of 635,000 families for a year.

Cavity Walls - If every house in the UK had cavity wall insulation it would reduce carbon dioxide emissions by 9 million tonnes and would save enough energy to power 1.8 million homes.

8

Outdoor Lights

Ensure that outdoor lights are directional, otherwise we waste energy lighting up the sky. We need the light on the ground, not obscuring our view of the stars.

9

Recycling Bin

REDUCE, REUSE, RECYCLE - that's all you need to help the environment.

REDUCE the amount of waste that you generate by only buying what you really need. You can also look for food, clothes and toys that have less packaging.

REUSE anything you can - plastic bags, reusable water bottles and rechargeable batteries. Why not have a car boot sale or donate the toys, books, clothes etc that you have finished with to a charity shop? That way, other people can get a use out of them too!

RECYCLE glass, cans, plastic, clothes, shoes and garden waste using your home bins or the local recycling centre, look at the labelling on plastics to find out whether the material can be recycled.

10

Hang out your washing!

Hanging your washing out makes it smell much fresher and saves energy too. If it's raining or you haven't got a garden, try spinning your clothes dry and then hanging on a clothes rack or a radiator. Remember, drying your clothes in a tumble drier can use up to 4 times as much energy as washing them!

Let's take a
look inside the
house...



The Kitchen

Pipe Insulation

A lot of heat is lost from pipes carrying hot water around your home. Use pipe insulation to keep the water in the pipes warm.

Draught Excluder

A draughty house can lose up to 20% of its heat so make sure that your home has draught excluders or seal those draughts!



Boiler

Change to a more energy efficient boiler, it will use 20% less fuel than a 15 year old boiler.

Kettle

When boiling the kettle, only fill it with as much water as you need. That way you won't waste energy heating water you don't use.

Living Room

Jumper

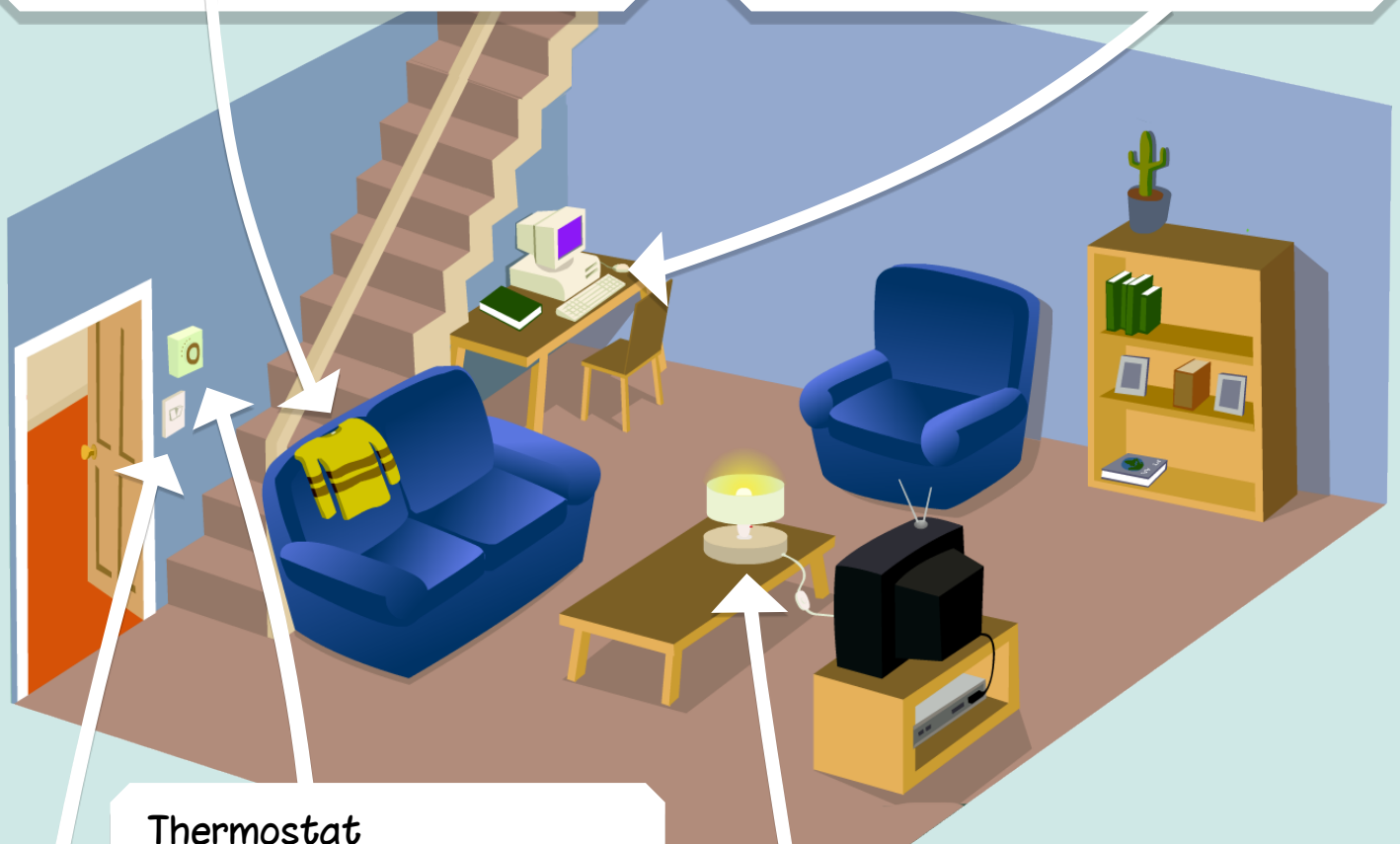
Make sure that you are wearing sensible clothes that are suitable for the time of year.

Feeling a bit cold? Put on a woolly jumper instead of turning up the heating!

Feeling a little hot? Take a layer off in summer, don't turn on a fan or air conditioning.

Electrical equipment

Leaving electrical items such as televisions, ipads and computers on standby can still use as much as 1/3 of the electricity that they use when they are on. This means that your electricity bill will be unnecessarily high and more carbon dioxide will be pointlessly released into the atmosphere. So switch them off!



Thermostat

Turn your thermostat down by just 1° - you will hardly notice the difference but it could reduce your heating bill by 10%.

Light Bulbs

If every home in the UK installed just 3 Compact Fluorescent Light bulbs this would save enough energy in a year to power all of our street lights.

Switch off the lights!

When you don't need them. Do not waste energy illuminating empty rooms in your house.

Quiz Time!

1. Which of these devices use waves to produce electricity?

- A) Pelamis, Manchester Bobber, Limpet
- B) Manchester Bobber, Wave Dragon, Geothermal
- C) Power Buoy, Solar Panel, Manchester Bobber

2. What process do trees use to remove carbon dioxide from the air?

- A) Respiration
- B) Photosynthesis
- C) Digestion

3. Which of these types of waste can you use to make compost?

- A) Grass cuttings, tea bags, meat
- B) Tea bags, fruit, cooked vegetable
- C) Vegetable peelings, tea bags, grass cuttings

4. When you are cold in your house what should you do?

- A) Put on a jumper
- B) Turn up the heating
- C) Put more coal on the fire

5. Which of these light bulbs use the least electricity?

- A) Halogen
- B) Incandescent
- C) Compact Fluorescent

6. When you leave a room what should you do?

- A) Put the TV on standby
- B) Turn off the lights
- C) Put coal on the fire

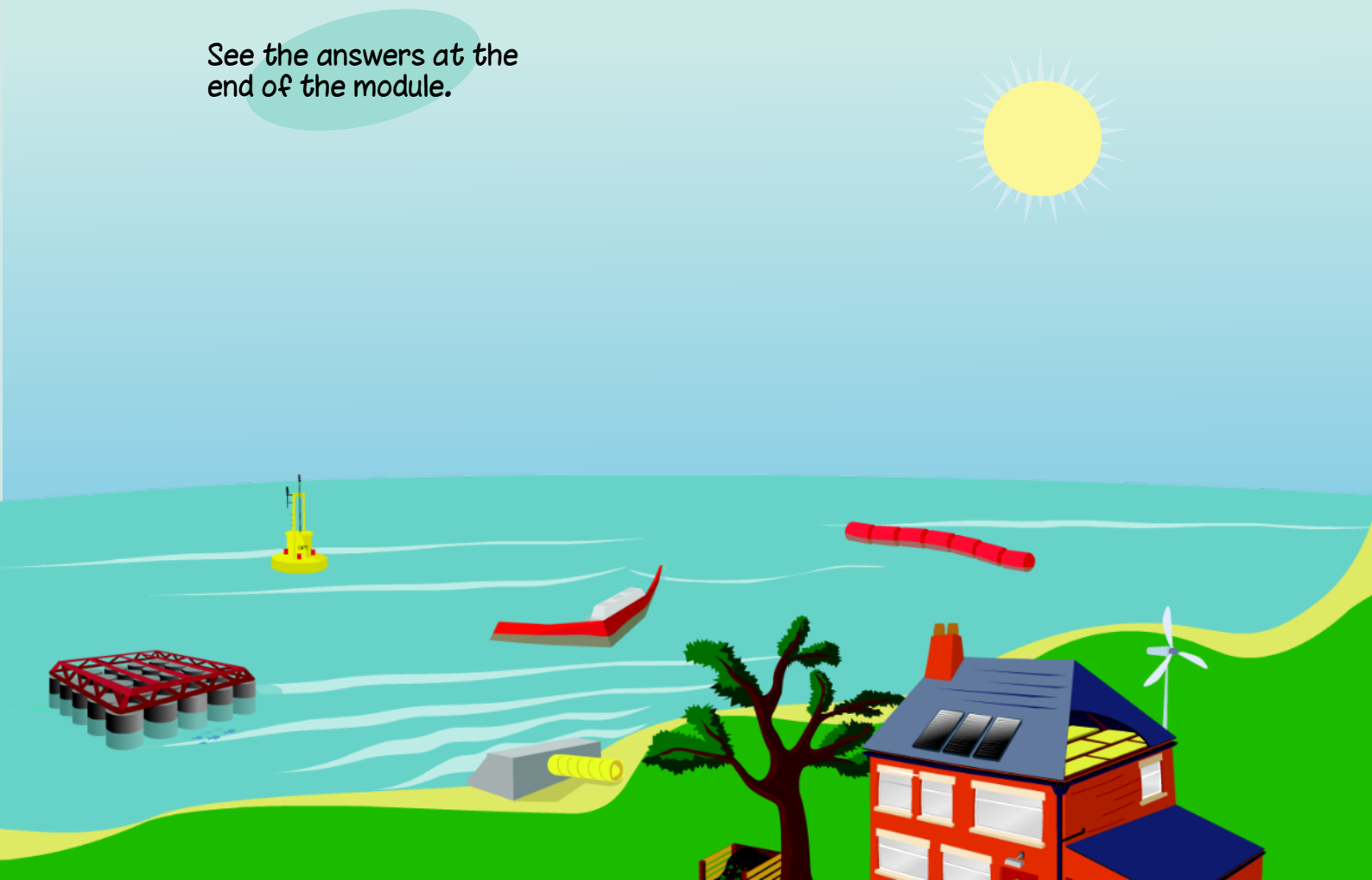
7. Which energy source do photovoltaic cells use to make electricity?

- A) The Sun
- B) The wind
- C) The waves

8. Which of these were originally designed to grind corn?

- A) Photovoltaic cells
- B) Wave dragons
- C) Wind turbines

See the answers at the
end of the module.



Wordsearch

Find the hidden words...

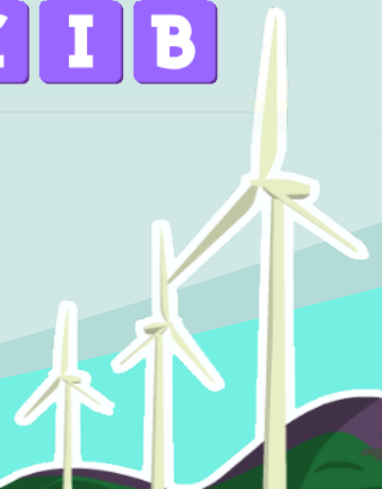
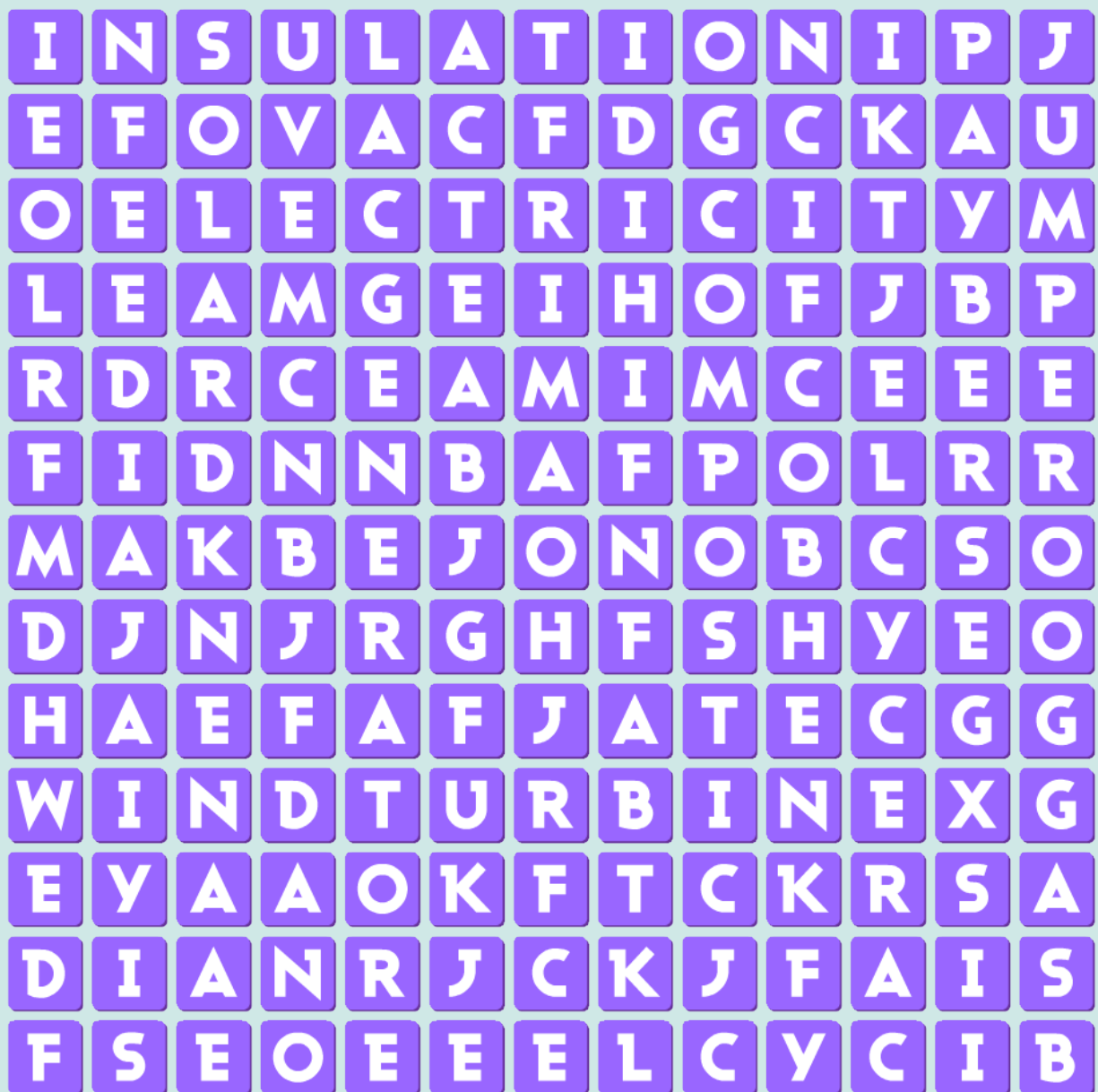
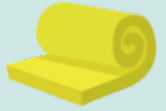
Solar
Jumper
Bicycle



Electricity
Compost
Recycle



Insulation
Wind Turbine
Generator



Quiztime Answers!

What is energy?

1. We've just blown up a balloon. Can you work out which type of energy it has?

A) Potential ✓

B) Kinetic

C) Light

As the balloon is inflated and stretches, it gains potential (elastic) energy.

2. Which type of energy does the balloon's potential energy turn into when we let the balloon go?

A) Chemical

B) Electrical

C) Kinetic ✓

When you let go of the balloon, it moves around the room so it has kinetic energy. Try it at home and see if you can guess the other type of energy that is made when you let a balloon go!

3. In which order does energy change from one type to another when you ride a bike and then stop?

A) Chemical-Heat-Kinetic

B) Chemical-Kinetic-Heat ✓

C) Heat-Kinetic-Chemical

You change the chemical energy in your body to make the bike move giving it kinetic energy. When you apply the brakes on your bike this becomes heat energy.

4. Which type of energy does a runner have?

A) Electrical

B) Elastic

C) Kinetic ✓

Runners have kinetic energy when they are moving along.



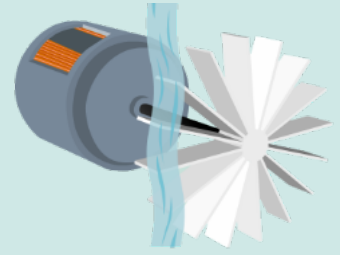
Turbines & generators

1) Which of these is used to make electricity?

A) Generator ✓

B) Transformer

C) Turbine



Electricity is made using a generator. A simple generator can be made by spinning a magnet around inside a coil of wire.

2) Which of these is used to turn the generator?

A) Generator

B) Transformer

C) Turbine ✓

To make lots of electricity we need a turbine to turn the massive generator. The turbine does the work of your hand on the simple generator.

3) Which of these provide energy to turn the turbine?

A) Sun, wind, water

B) Coal, wind, biomass ✓

C) Geothermal, Sun, nuclear

When coal and biomass are burnt, the heat turns water into the steam which turns the turbine. Wind turns the turbine directly. The Sun uses special photovoltaic cells not a turbine.

4) What is the fuel used in nuclear power stations called?

A) Coal

B) Uranium ✓

C) Titanium

Nuclear power stations use a radioactive fuel called uranium. When uranium atoms are split by neutrons they give off heat which makes the steam to turn the turbines.

5) What is the correct name for a solar cell?

A) Photovoltaic 

B) Photochromic

C) Photoreceptor

A solar cell is also known as a photovoltaic cell. It contains special light sensitive material called silicon.

6) What is the gearbox used for in a wind turbine?

A) To increase the speed of rotation 

B) To generate electricity

C) To catch the wind

The gearbox changes the low speed of the blades into the high speed needed to turn the generator and make electricity.

7) What is used to increase the voltage of the electricity?

A) Generator

B) Turbine

C) Transformer 

In the substation, a transformer increases the voltage of the electricity making it easier and more efficient to travel along the overhead line or underground cable.

8. What is used to decrease the voltage of the electricity?

A) Generator

B) Transformer 

C) Turbine

A transformer is used to decrease the voltage of the electricity from the overhead line, making it safe to be used in your house. They are very dangerous so don't go near them.

Renewable and Non-Renewable Energy



1) What is a non-renewable energy source?

A) One which will run out



B) One which won't run out

C) One which can be renewed

A non-renewable energy source is one which will eventually run out. Coal, oil and gas are non-renewable energy sources.

2) What is a renewable energy source?

A) One which will run out.

B) One which won't run out.



C) One which can't be renewed.

A renewable energy source is one which won't run out. The Sun, wind, waves, trees, plants and animal waste are all renewable energy sources.

3) Which of these are renewable energy sources?

A) Wind, Sun, tidal



B) Wind, nuclear, tidal

C) Wave, wind, coal

The wind, Sun and tidal energy sources are all renewable and do not generate carbon dioxide when used to make electricity.

4) Which of these are non-renewable energy sources?

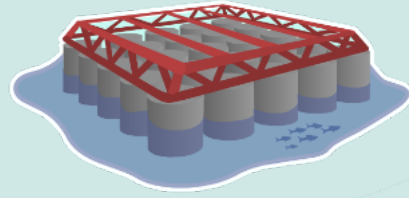
A) Wind, Sun, tidal

B) Nuclear, coal, oil



C) Coal, gas, biomass

Nuclear, coal, oil and gas are all non-renewable energy sources and produce the greenhouse gas carbon dioxide when burnt.



5) What makes wind?

- A) Wind turbines B) Movement of trees C) Differences in temperature ✓

Wind is caused by differences in temperature and pressure. The air above warmer surfaces rises causing an area of lower pressure. Air from cooler areas moves across causing wind.

6) Wood and animal droppings are examples of

- A) Biomass ✓ B) Biometrics C) Biomechanics

Wood from trees and shrubs, animal droppings, straw and sugar cane are all examples of biomass and are renewable. Biomass takes in carbon dioxide as it grows and gives off carbon dioxide when it is burnt so is said to be carbon neutral.

7) Which period was coal formed?

- A) Cretaceous B) Triassic C) Carboniferous ✓

Coal was formed millions of years ago in the carboniferous period before the dinosaurs, made from deeply buried plant material, it is non-renewable in our lifetime!

8) As we go deeper below the Earth's surface, the temperature:

- A) Stays the same B) Increases ✓ C) Decreases

The temperature increases as we go deeper into the Earth's surface. We can use this renewable geothermal energy to make the steam which turns the turbines and generates electricity.

Advantages and disadvantages...

1. Which energy sources produce least carbon dioxide?

A) Non-renewable

B) Renewable 

C) Non-sustainable

Renewable energy sources like solar, wind and wave don't give off the greenhouse gas carbon dioxide. Biomass does give off CO_2 when it burns, but is carbon neutral because it takes in CO_2 for growth.

2. Which energy source can lead to acid rain?

A) Coal 

B) Tidal

C) Solar

When coal burns sulphur dioxide is given off. This mixes with water to make dilute sulphuric acid or acid rain.

3. Which of these energy sources are free?

A) Sun, wind, waves 

B) Sun, biomass, coal

C) Sun, oil, gas

The Sun, wind and waves are free, so once the solar panel, wind turbine or tidal turbine has been built and installed, they are quite cheap to run. Don't forget – at the moment the equipment is still quite expensive.

4. Pneumoconiosis is a disease associated with...

A) Too much Sun

B) Cold winds

C) Coal dust 

If coal miners breathe in too much coal dust, they may suffer from the lung diseases pneumoconiosis and emphysema.

5. What is a disadvantage of hydroelectric electricity generation?

A) Water is expensive

B) Greenhouse gases are given off

C) Nearby land is flooded



Land is flooded when the dam supplying water to hydroelectric power stations is built. This can affect nearby habitats and wildlife.

6. Which of these are the safest ways to generate electricity?

A) Nuclear, solar, wind

B) Wind, solar, tidal




C) Coal, gas, solar

There are comparatively few safety risks with wind, solar and tidal energy sources.



Energy and Global Warming

1. How much has the Earth's temperature increased in the last 100 years?

A) 0.5°C 


B) 5°C

C) 50°C

The temperature of the Earth's atmosphere has risen by about 0.5°C in the last 100 years. It is predicted to rise another 4°C by the end of the century.

2. Where does the Earth get its heat energy from?

A) Coal

B) Sun 

C) Oil

The Earth ultimately gets all of its energy from the Sun. The Sun gives off solar rays which travel down to heat the Earth and help living things grow.

3. Which gases help to control the Earth's temperature?

A) Noble gases

B) Condensed gases

C) Greenhouse gases 

Greenhouse gases in the atmosphere reflect the Earth's heat energy back down to Earth. Without greenhouse gases the Earth would be about 32°C lower. Brrr!

4. Why is the Earth's temperature rising?

A) Less greenhouse gas

B) More greenhouse gas 

C) Same greenhouse gas

Burning fossil fuels and wood leads to more greenhouse gas in the atmosphere. These gases reflect more heat back to Earth causing the temperature to rise.

5. What effects are seen with global warming?

A) Droughts, melting ice caps, more bacteria ✓

B) Droughts, melting ice caps, less bacteria

C) Droughts, rising sea levels, less bacteria

Global warming could result in droughts in some areas, loss of habitat for polar bears as ice-caps melt and an increase in bacteria and illness.

6. What can we do to reduce global warming?

A) Travel by car

B) Use air conditioning

C) Use less electricity ✓

If we use less electricity, less fossil fuel will be burnt and less greenhouse gas will be added to the atmosphere. This should mean less global warming.



Energy is everywhere!

1. Which of these devices use waves to produce electricity?

A) Pelamis, Manchester Bobber, LIMPET ✓

B) Manchester Bobber, Wave Dragon, Geothermal

C) Power Buoy, Solar Panel, Manchester Bobber

The Pelamis, Manchester Bobber and Limpet all use the power of the waves to generate electricity - and so do the Wave Dragon and the Power Buoy!

2. What process do trees use to remove carbon dioxide from the air?

A) Respiration

B) Photosynthesis ✓

C) Digestion

Trees use a process called photosynthesis to combine carbon dioxide from the air with water to make sugar and oxygen.

3. Which of these wastes can you use to make compost?

A) Grass cuttings, tea bags, meat

B) Tea bags, fruit, cooked vegetables

C) Vegetable peelings, tea bags, grass cuttings ✓

Vegetable peelings, tea bags and grass cuttings are great for the compost heap. You can also add fruit waste and crumpled up paper or cardboard.

4. When you are cold in your house what should you do?

A) Put on a jumper ✓

B) Turn up the heating


C) Put more coal on the fire

If you are cold, put on a jumper. That way you're not using more electricity or fuels which may contribute to global warming.

5. Which of these light bulbs use the least electricity?

A) Halogen


B) Incandescent

C) Compact Fluorescent 

Changing to compact fluorescent light bulbs (CFL's) will reduce the amount of electricity you use and help the environment. Just ask for energy saving light bulbs if you forget what they are called!

6. When you leave a room what should you do?

A) Put the TV on standby

B) Turn off the lights 

C) Put coal on the fire

When you are last to leave a room, you should turn off the lights, TV and computer. Don't leave things on standby as this still uses lots of electricity.

7. Which energy source do photovoltaic cells use to make electricity?

A) The Sun 

B) The wind

C) The waves

The Sun. Remember, all of the earth's energy ultimately comes from the Sun.

8. Which of these were originally designed to grind corn?

A) Photovoltaic cells

B) Wave dragons

C) Wind turbines 

Wind turbines or windmills were originally made to grind corn to make bread. One wind turbine can now generate enough electricity for around 500 homes.

**Thanks for
completing
this module!**

