

ENERGY WORKS

Energy Works KS2 Resource Pack

Produced by Nicky Ayscough & Richard Green,
Cambridgeshire Environmental Education Service (CEES)
from materials developed by Ruth Ruthven of Innovative
Learning Projects for ScottishPower.



The **co-operative**

ScottishPower
renewables





Energy Works KS2 Resource Pack

This KS2 Resource Pack is designed to support teachers whose pupils are taking part in the **Energy Works** programme. This pack is designed to offer a variety of activities for your class for you to pick and choose which ones will benefit and suit your pupils. There are 18 sheets divided into four areas:

- Electricity (1 - 6)
- Wind Power (7 - 12)
- Weather (13 - 18)

Most of the sheets are stand alone worksheets. However, Sheet 12 includes suggestions for teacher-led demonstrations.

If you would like help or would like to comment on the pack, please contact Nicky Ayscough at Stibbington Centre on 01780 782386 or email Nicola.Ayscough@cambridgeshire.gov.uk.

Contents

	Page
Energy Works	2
Curriculum Links	4
Coldham Wind Farm Facts	5
Index of Activity Sheets	6
Activity Sheets	7 - 25
Appendix 1 - Detailed Curriculum Links	26
Appendix 2 - Answers to Activity Sheets	27



ENERGY WORKS: AN INNOVATIVE ENVIRONMENTAL ENERGY PROJECT

Energy Works is a unique new education programme which gives school children and adults across Fenland the opportunity to learn all about the environment and renewable energy alongside other forms of energy generation.

The programme is a joint arrangement between The Co-operative, ScottishPower Renewables, Fenland District Council and Cambridgeshire Environmental Education Service (CEES). The project is funded from annual environmental education payments made by the operators of several wind farm projects within Fenland District.

Energy Works is run by the Cambridgeshire Environmental Education Service (CEES), and is based in the dedicated education centre in the farm buildings at Coldham.

The **Energy Works** programme is tailored to each class and designed to cover a range of subjects including science, geography and design and technology for primary pupils from ages 6-11. The programme is also available to secondary school pupils and community groups. A typical primary programme will last two weeks and includes school workshops and a visit to the education centre, led by a CEES teacher, together with this resource pack for use in school.



During visits to the education centre, schools and community groups have the opportunity to get close to the eight 2 MW wind turbines, which generate enough to power over 9000 homes.

The **co-operative**

ScottishPower
renewables

 Fenland
CAMBRIDGESHIRE
Fenland District Council

 Cambridgeshire
County Council

The Visit to Coldham Wind Farm

The visit will normally last either half a day or a full day depending on the number of classes (the facilities are suitable for one class at a time). On a half day visit the class will be fully briefed during the introduction and safety talk before travelling out to the turbines themselves where they will do a variety of fieldwork exercises as well as having the opportunity to see a turbine up close.

On a full day visit there will also be the chance to take part in one of our workshops based in the education Centre.

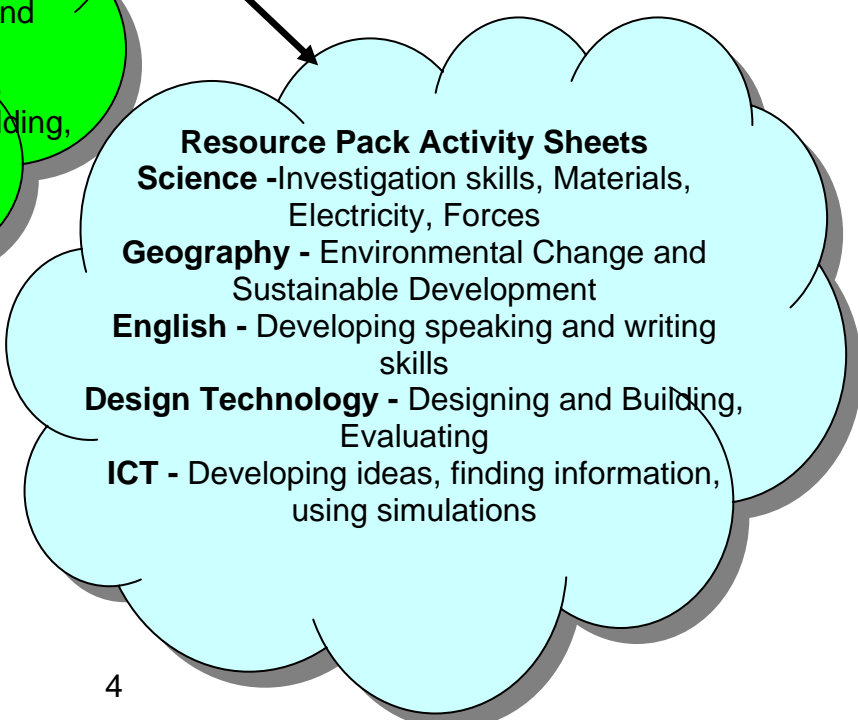
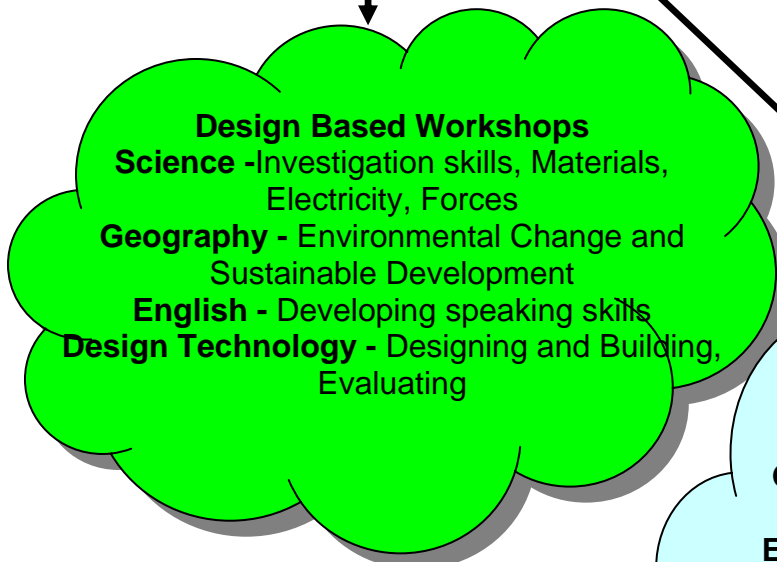
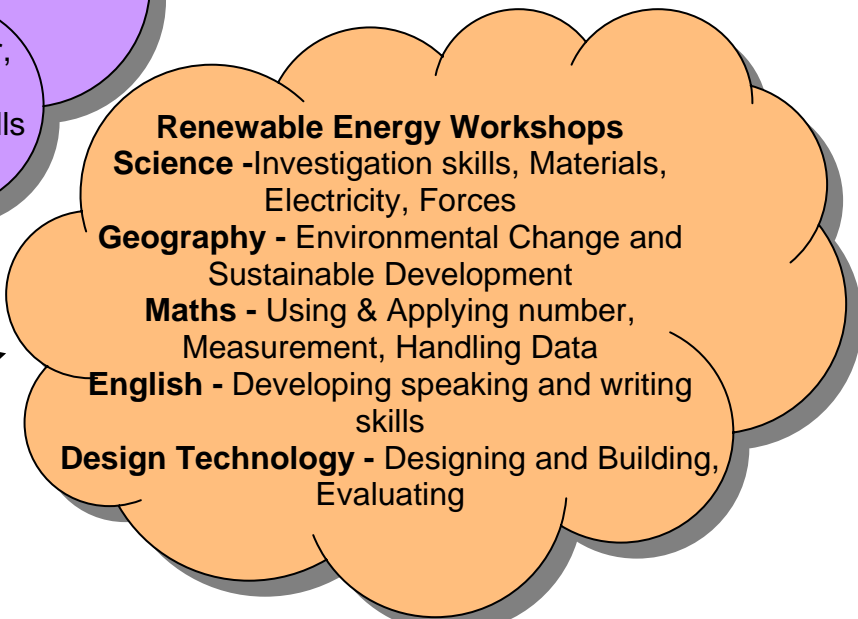
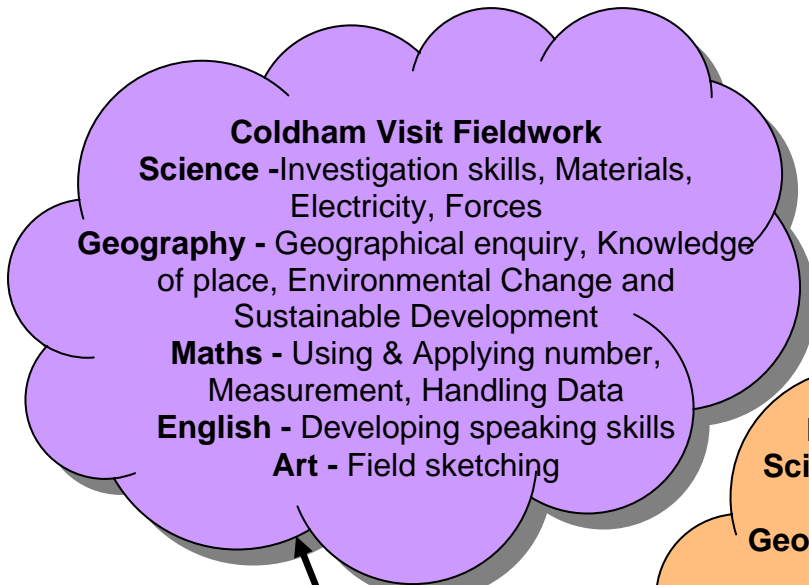
The Workshops

These can be based at the education centre or back at your school. There are a number of workshops on **renewable energy** using mini-kits to explore how renewable resources are used to produce energy. In addition there are **design based** workshops developing DT, Art and English skills in addition to Scientific and geographical understanding.

An 'at a glance' breakdown of curriculum links follows, or you can find a more detailed breakdown in appendix 1

For details of the workshops currently on offer please contact Nicky Ayscough at Stibbington Centre on 01780 782386 or email Nicola.Ayscough@cambridgeshire.gov.uk.

Curriculum links



**ENERGY
WORKS**

For a detailed breakdown of the curriculum subject links from each activity see appendix 1

Coldham Wind farm facts

Coldham Wind Farm is located at Coldham Hall Farm, a Co-operative Farm in between March and Wisbech in Cambridgeshire. Coldham Wind Farm Ltd is a joint venture between The Co-operative Group and ScottishPower Renewables and the wind farm is managed by Natural Power.

Wind turbine facts

- There are 8 Vestas V-80 wind turbines at Coldham.
- A further 7 turbines will be built in 2009 in the same area.
- There are 9 turbines in the adjacent Stags Holt wind farm and other wind farms can be seen on a clear day.
- The Coldham turbines are 60 m high to the hub and have three 40 m long blades.
- The amount of electrical power produced depends on the wind speed at the rotor (or blade) height.
- The turbines start to generate electricity at a wind speed of around 4 m s^{-1} and generate the maximum power of 2000 kW or 2 MW from a wind speed of around 14 m s^{-1} .
- Computer linked wind-measuring equipment and a turning (yaw) mechanism ensures that the wind turbine faces into the wind to gain the maximum wind power.
- The turbine blades can swivel (pitch) in the rotor to increase or decrease their wind resistance.
- At a steady strong wind speed of 25 m s^{-1} , the turbine will turn off by pitching the blades to 86° to provide minimum resistance to the wind to prevent blade damage.
- A control system (called SCADA) operates and monitors the wind turbines. It can be accessed from anywhere in the world with Internet or mobile access with password protection.
- The 8 wind turbines at Coldham provide enough power to supply around over 9,000 homes each year.
- Each turbine costs around £2 million, or £1 million per MW maximum power.

Index of Activity Sheets

Electricity

Sheet 1	What do we use electricity for?
Sheet 2	What is energy?
Sheet 3	How long will fossil fuels last?
Sheet 4	How much electricity do we use?
Sheet -5	Electricity travels!
Sheet 6	Supply and demand

Wind power

Sheet 7	The wind turbine - diagram
Sheet 8	How a turbine works?
Sheet 9	From a wind farm to our homes
Sheet 10	Thinking about the wind
Sheet 11	Where does the wind come from?
Sheet 12	Teacher Activity: It's a blow out!

Weather

Sheet 13	Wind measurements
Sheet 14	The Beaufort Scale
Sheet 15	Recording the weather (7 days)
Sheet 16	Make your own weather kit
Sheet 17	Make your own weather kit 2
Sheet 18	Weather symbols

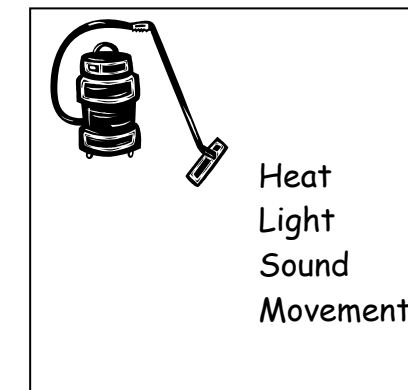
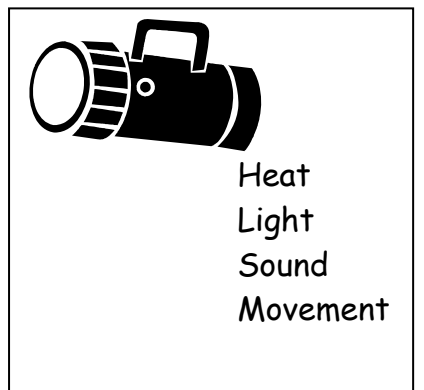
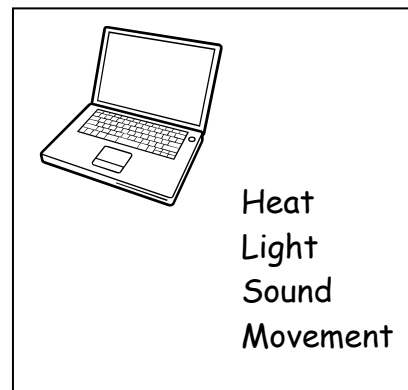
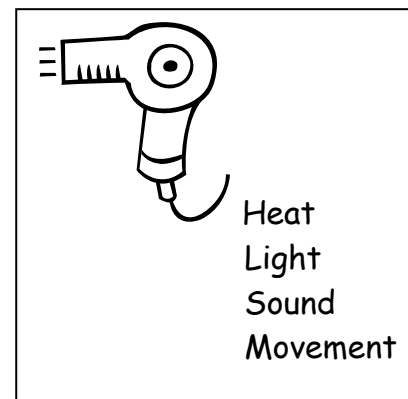
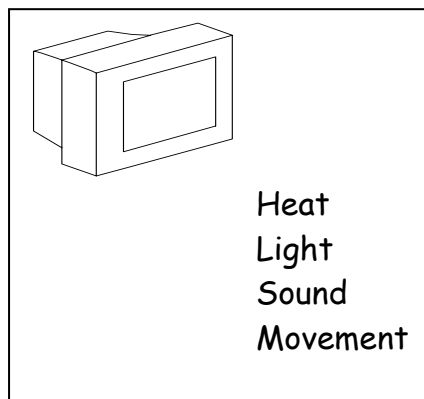
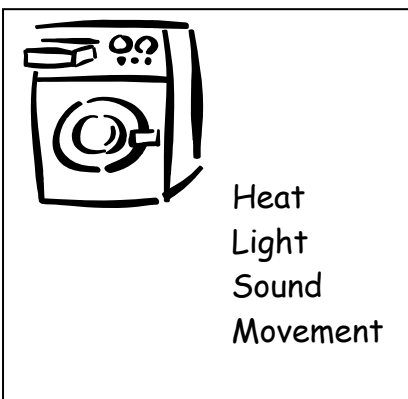
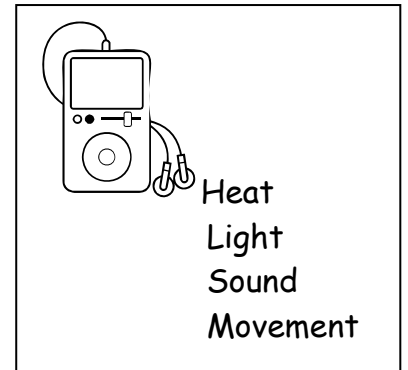
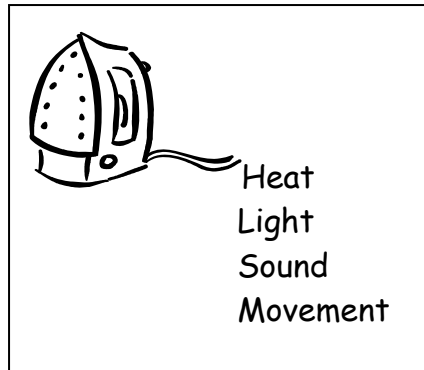
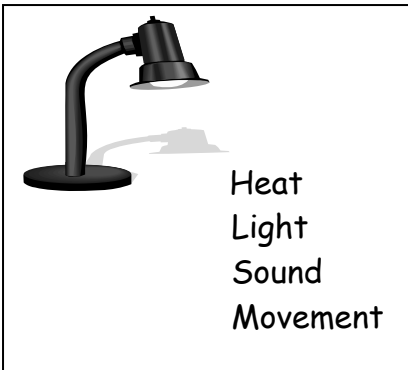
Name:

Date:

Sheet 1 - What do we use electricity for?

We use electricity for many items in our homes. Look at the objects below and tick whether you think they turn electrical energy into heat, light, sound or movement.

Warning: Sometimes you may need to tick more than one!



Name:

Date:

Sheet 2 - What is energy?

- Use the words in the box to fill in the blank spaces.
- Use each word only once.

renewable work forms electricity fossil uranium nuclear generate

Energy is the ability to do _____. It comes in many different _____. These are heat, light, mechanical, electrical, nuclear and kinetic (movement) energy. We use energy in everything we do, from jumping to watching television.

There are two main sources for the energy we use every day:

- Energy that is made using natural resources that can be replaced, like wind, water and sunshine, is called _____ energy. This is also called 'clean energy' or 'green power' because it does not pollute the air or water.
- Non-renewable energy sources are those that cannot be replaced once they are used, such as the _____ fuels oil, natural gas and coal. Most of our electrical energy comes from burning non-renewable energy sources. Non-renewable energy sources also cause pollution.

Renewable and non-renewable energy sources can both be used to produce _____.

Another non-renewable energy source is the metal called _____. Electricity made this way is called _____ energy.

We use all these energy sources to _____ the electricity we need for our homes, work, schools and factories.

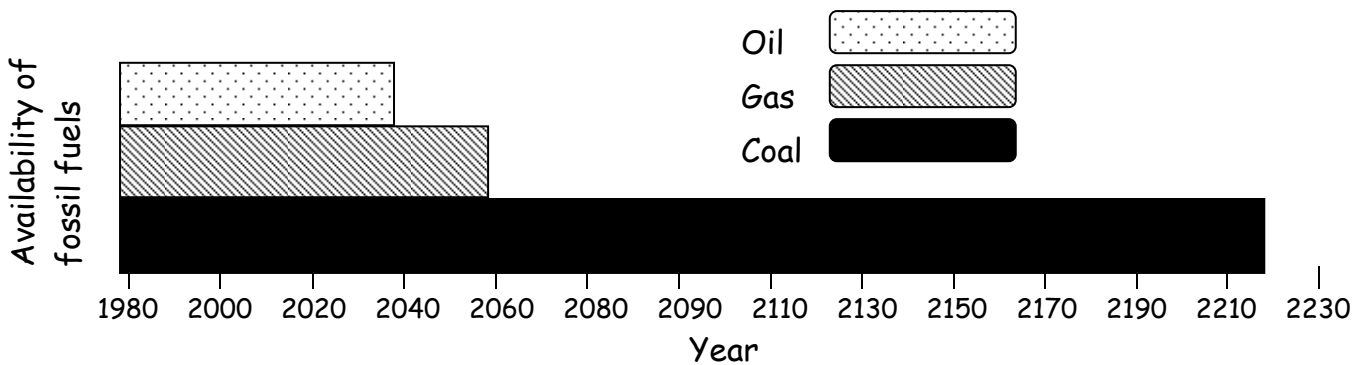
Name:

Date:

Sheet 3: How long will fossil fuels last?

Fossil fuels are coal, gas and oil. They were formed millions of years ago when dead plants and animals were pressed under layers of rock. They are non-renewable as once we have used them we cannot make any more.

No-one knows exactly when they will run out, or how much we have left. However, the bar chart below shows what some scientists think may happen in the next 200 years or so:



- Look at the bar chart
- What year is it now? Write the letter N on the time line.
- What year were you born? Write M (for me!) on the time line.
- What year will you be 50? Write X on the time line.
- What fossil fuels will you be able to use when you are 50?

- Will this change anything in your life?

- What could we do to save fossil fuels to make them last longer?

Name:

Date:

Sheet 4 - How much energy do we use?

Electrical power lines come into your house or school through an electricity meter. The energy company uses these meters to measure how much electricity has been used. The meter measures electricity in units called kilowatt hours (kWh).

Note: 1 kWh is equal to 1000 watts of electricity used for one hour.

- Remember electricity kills - never play with electricity.
- At home (WITH AN ADULT) or at school with your teacher, take readings from the meter for a week and write the numbers in the table.
- If you can't take the readings every day, take one on the first day and the same day the following week.
- The number of units used each day will be that day's reading minus the reading the day before.
- Ask your teacher for an approximate cost per unit.
- Can you work out the cost per day and for the whole week?

Day	Time	Reading (kWh)	Number of units used (kWh)	Cost per unit (approx)	Cost of electricity (number of units x cost per unit)
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					
Day 8					
One week					

- Are there any big differences in the week?
- Can you explain why?

Y/N

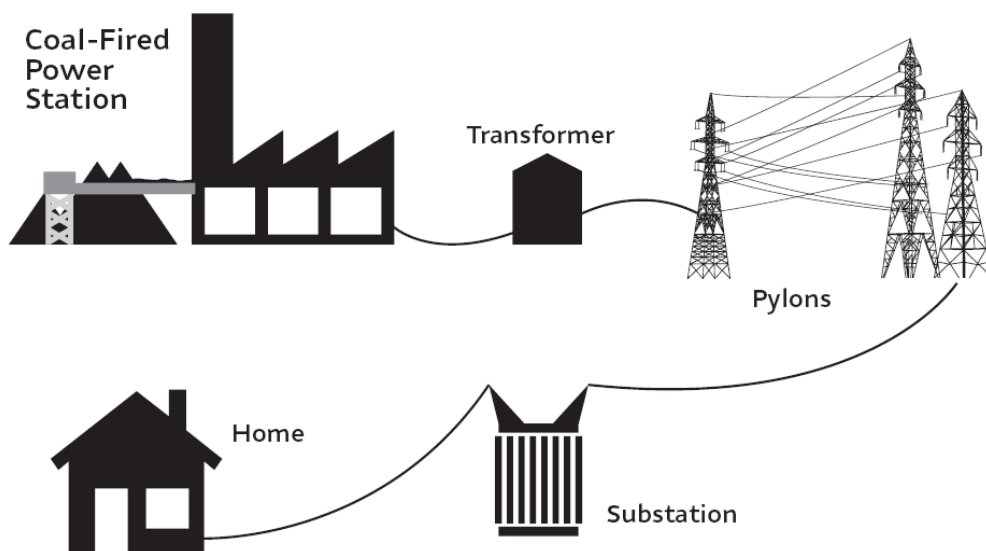
Name:

Date:

Sheet 5 - Electricity travels!

How does electricity get into our homes?

- Look at the diagram below.
- Cut out the sentences below and put them in the right order - the first one is in the right place.



Firstly coal, gas and nuclear power stations make most of the electricity we need. The rest comes from wind farms and other types of power station.

In our homes a meter measures the amount of electricity we use and this is used to work out how much we have to pay.

The electricity from all the power stations goes into a system of power lines called the National Grid.

Finally the sockets in our houses are connected by wires to the mains supply so that we can plug in the TV and other electrical items.

The National Grid supplies mains electricity to our homes.

The mains electricity supply passes through fuses in our homes to prevent electrical accidents.

All of these power stations work together to generate and supply enough electricity for the UK.

Name:

Date:

Sheet 6 - Supply and Demand

We use more or less electricity depending on what we are doing. For example, putting the lights on at dusk means that the energy companies need to supply us with more energy. This is called supply and demand.

All power stations are linked to the national grid. This means that if the power station nearby has to shut down, the electricity can be supplied from other ones. The other power stations could be miles away.

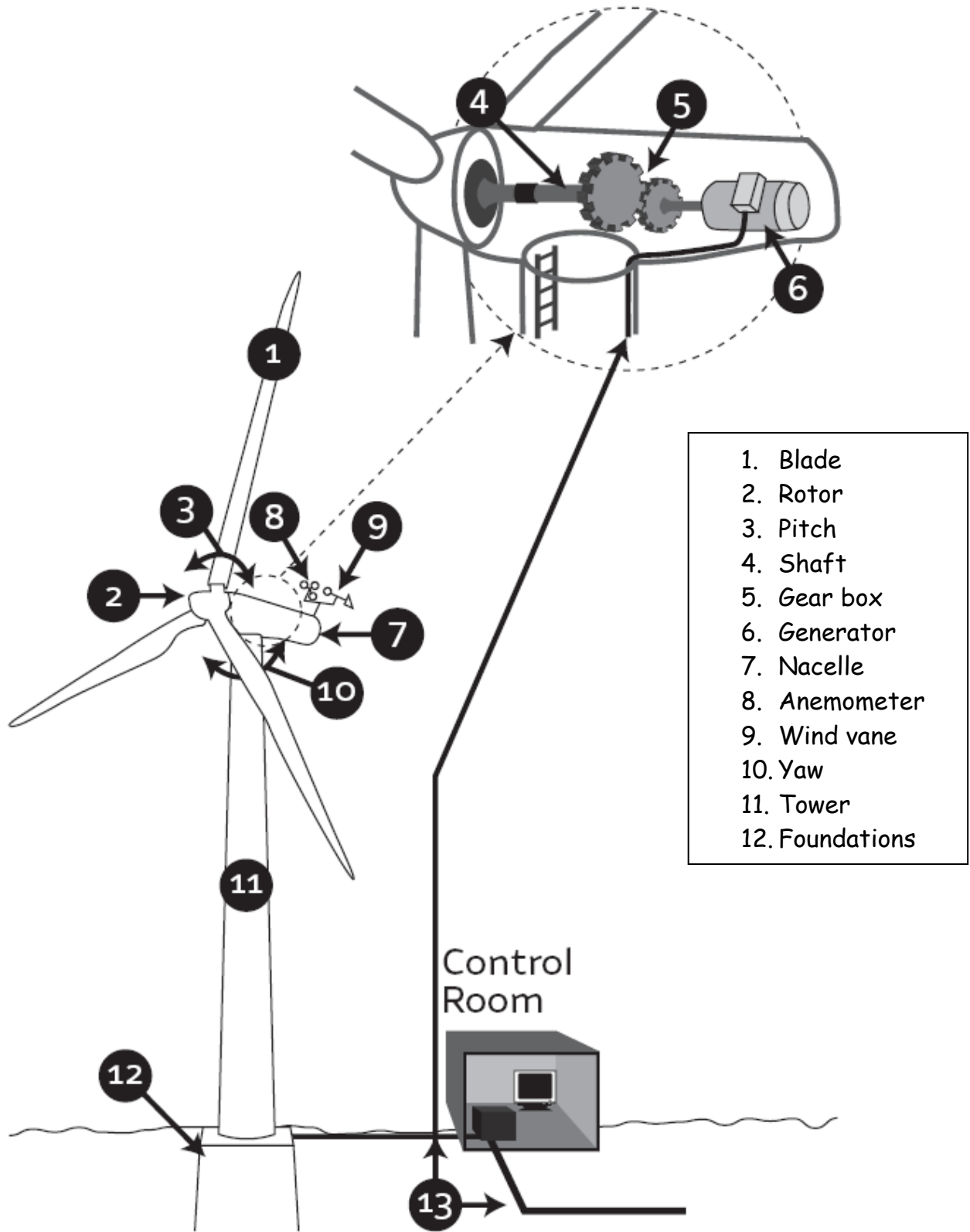
- Look at two electricity bills - one from the summer and one from the winter.
- Which asks for the most money?
- Can you think of any reasons why more electricity would be used in this part of the year?

In the UK, most of the electricity we need comes from coal and nuclear power stations. Some also comes from gas fired power stations and the rest from renewable sources such as wind or biofuel power stations. Each power station has times when it is not able to generate as much or perhaps any electricity - for example wind power stations if the wind drops or coal power stations if maintenance is needed.

Visit www.eon-uk.com/EnergyExperience/156.htm to play a game based on this:

- Be in charge of supply for a town in Energy Town
- You will need to switch power stations on and off to meet demand.
- See if YOU can meet the demand ALL the time.
- Beware, it is a fast and furious game!

Sheet 7 - The Wind Turbine



Name:	Date:
-------	-------

Sheet 8 - How a Turbine Works

Look at Sheet 7 (The Wind Turbine) to help you match the description of each part of the wind turbine to the names below:

Description	Name
The large tall structure which holds up the wind turbine	_ _ _ _ _
These turn in the wind - there are three of them!	_ _ _ _ _
This word means "turn" and describes how the nacelle and blades turn to get the best from the wind	_ _ _
This word describes how each blade changes shape in the wind	_ _ _ _ _
This connects the rotor to the gearbox	_ _ _ _ _
This machine contains a magnet spinning inside a wire coil to generate electricity	_ _ _ _ _
This measures wind speed and sends the information to the control room	_ _ _ _ _
These are wires which carry the electricity from the turbine	_ _ _ _ _
This is a pod which contains all the working parts of the turbine	_ _ _ _ _
The three blades are attached to this and it moves round and round	_ _ _ _ _
This stops turbine towers from falling over!	_ _ _ _ _

<div style="display: flex; justify-content: space-between;"> cables nacelle anemometer tower shaft rotor </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> pitch generator foundations yaw blades </div>
--

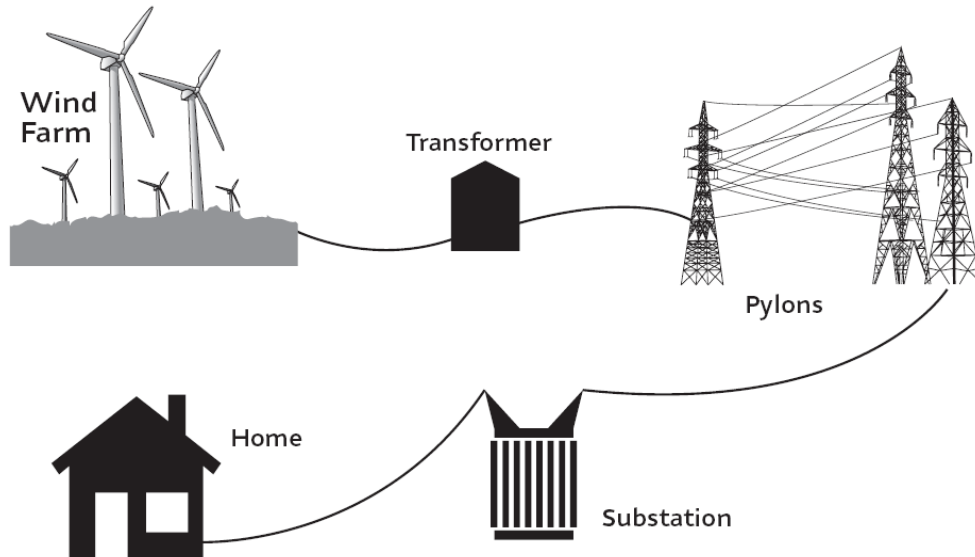
Name:

Date:

Sheet 9 - From the Wind Farm to our Homes

Electricity has to travel from the wind farm to our homes.

- Look at the diagram below which shows the route the electricity takes.
- Cut out the sentences below and put them in the right order - the first one is in the right place.



Firstly, the electricity is generated at a power station.

The blades spin a generator.

This power station is called a wind farm.

High voltage electricity flows from pylon to pylon across the countryside.

Cables carry electricity to a transformer which changes the low voltage electricity to high voltage electricity to make it travel better over long distances.

The electricity flows away from the wind farm along thick wires (cables).

Lastly, cables carry the electricity from the substation to our homes.

Inside the generator, a magnet spins inside a coil of wire to generate electricity.

In substations, the high voltage electricity is changed back to low voltage electricity because we can't use high voltage electricity in our homes.

The wind spins the wind turbines' blades.

Name:

Date:

Sheet 10 - Thinking about the Wind

Wind blows from an area of high pressure to an area of low pressure. You can show this using a balloon:

- Blow up the balloon and hold the opening closed
 - the air in the balloon is now at high pressure
- Release the air by letting go of the opening
 - the air rushes out like a wind into the room (an area of low pressure)

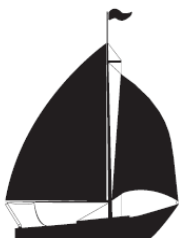
We can't see the wind but we can see its effects - good and bad!

- Write or draw something that tells you that the wind is here.



Now wind can be used to generate electricity in wind turbines.

- Can you think of two other ways in which wind is used by people nowadays or in the past?



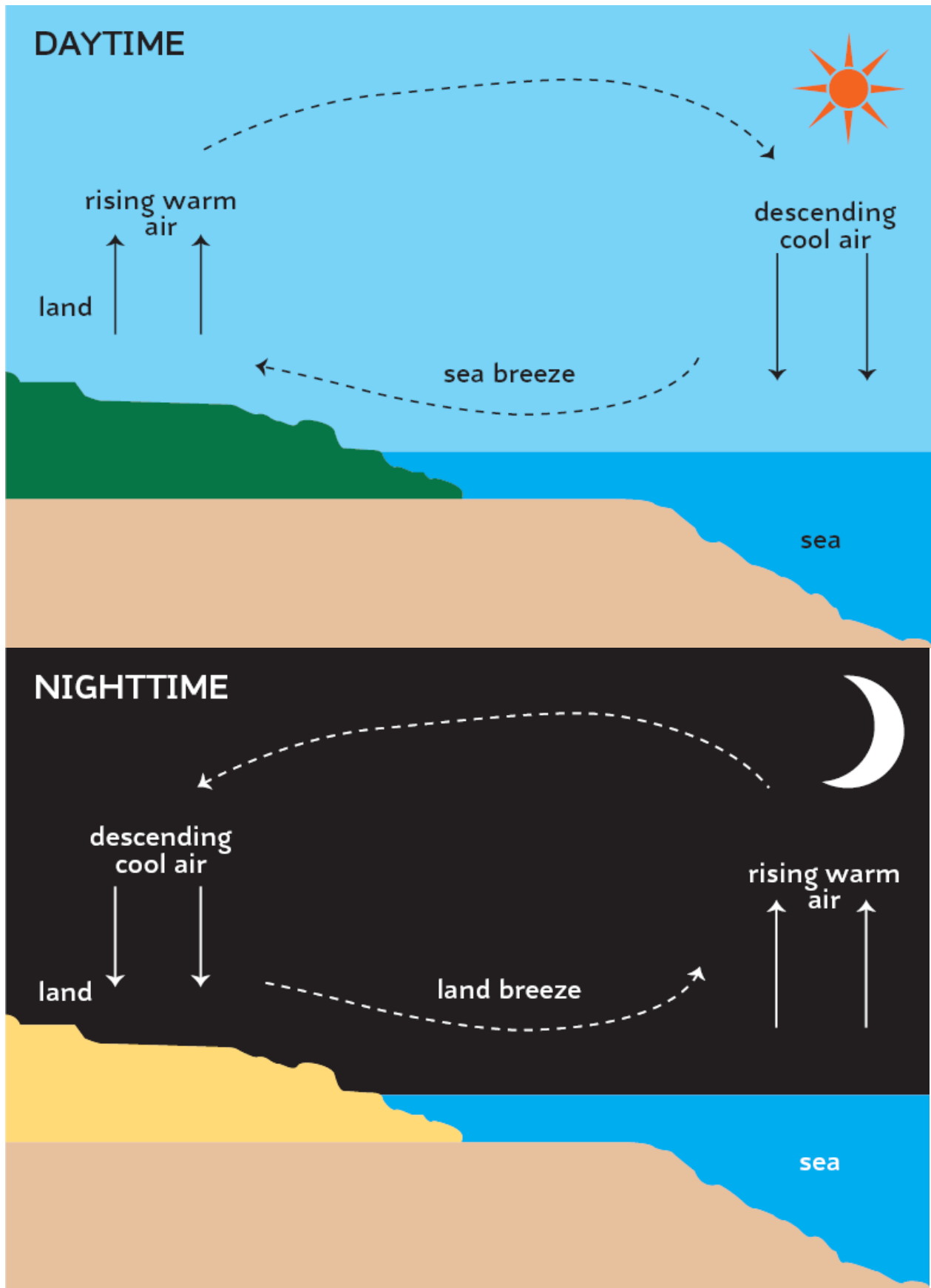
1.	2.
----	----

Generating electricity from the wind is good for the environment as it doesn't make carbon dioxide or pollute the air but there are challenges to face.

- Can you think of any disadvantages of wind turbines for energy companies or other people?



Sheet 11: Where does wind come from?



Sheet 12 - Teacher Activity: It's a Blow Out!

How is the wind made? The following activities can help to show this.

1 - Land and sea

- Fill identical trays, one with sand and the other with water (land and sea)
- Leave to acclimatise overnight
- Place a thermometer or probe in each and note temperature
- Place identical desk lamps in the same position over each tray and leave on for at least 2 hours
- Take temperature readings again
- Which is higher, land or sea temperature?

2 - Hot air rises!

- Remove the shade of a table lamp (normal bulb)
- Put a small amount of talcum powder on the top of the bulb
- Switch on the lamp
- Note the movement of the powder, it should rise as the bulb heats up.
- Switch off the lamp to see the air falling.

3 - Make the wind

- Place a fan heater in a small anteroom or cupboard (check for safety!)
- Leave on until the room is heated then switch off but leave door closed. Hold a lighted candle up to show the steady flame.
- Open the door and let the air settle
- Hold a lighted candle at the top of the doorway and ask your pupils to look at the flame.
- The flame should point to the cooler room as wind is created at the top of the doorway as warm air is coming into the cooler room and rises
- Now hold the candle at the bottom of the doorway. The flame should point to the warmer room. As the warmer air rises, it makes way for the cooler air to blow in underneath to the warmer room.

4 - Diagrams and web activities

- The diagrams on sheet 12 can be used to show the development of wind in the day and nighttime
- Pupils can find out more at:
www.windpower.org/en/kids/choose/wind/index.htm
 - Then click on Where does wind come from?
 - Then click on Wind and the troposphere
 - Then click on Warm air floats towards the poles

Name:

Date:

Sheet 13 - Wind Measurements

Wind speed is measured by an anemometer on the top of a wind turbine's nacelle. It is usually measured in metres per second (m/s) or sometimes in miles per hour or Kilometres per hour.









Hand held anemometers can be used to measure wind speed in the school grounds, but they can be expensive. Instead we can use a wind sock or windicator. Make your own version using Sheet 16.

These can measure wind speed using the Beaufort scale, which was created by a British Naval commander, Sir Francis Beaufort around 1806.

- Take a windicator or wind sock and a weather vane into the school grounds
- Look carefully at the way the wind sock or windicator is moving in the wind and compare to the diagrams and descriptions in the table on sheet 14.
- Check other signs around you - how are the trees moving?
- Record the Beaufort number in the table below.
- Use the wind vane to find out the direction the wind is coming from and add to the table. Remember if it points North, then it is a North wind and the wind is coming from the North.
- See how it changes from day to day - record for 5 days below:

	Day 1	Day 2	Day 3	Day 4	Day 5
Wind speed (Beaufort number)					
Wind direction					

Sheet 14: The Beaufort Scale

Windicator	Strength	Land conditions	Beaufort No	Km/hour	m/sec
	Calm	Calm	0	0 - 1	0 - 0.3
	Light air	Wind motion visible in smoke	1	1 - 5	0.3 - 1.5
	Light breeze	Leaves rustle	2	6 - 11	1.5 - 3
	Gentle breeze	Smaller twigs in constant motion (Wind farms start generating)	3	12 - 19	3 - 5
	Moderate breeze	Small branches begin to move	4	20 - 29	5 - 8
	Fresh breeze	Smaller trees sway	5	30 - 39	8 - 11
	Strong breeze	Large branches in motion (Wind farms at maximum power)	6	40 - 50	11 - 14
	Near gale	Whole trees in motion	7	51 - 61	14 - 17

Name:

Date:

Sheet 15 - Recording the Weather (7 days)

Use weather measuring equipment to record the weather for seven days - they don't have to be in the same week.

Wind Speed

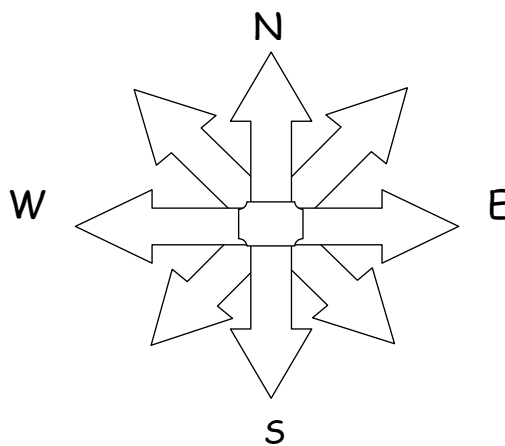
(Beaufort Scale)

7							
6							
5							
4							
3							
2							
1							
	1	2	3	4	5	6	7 (Day)

Wind direction

Measure the wind speed and put a coloured dot on the right arrow each day:

Day 1- red Day 2 - blue Day 3 - yellow Day 4 - green
Day 5 - orange Day 6 - purple Day 7 - pink



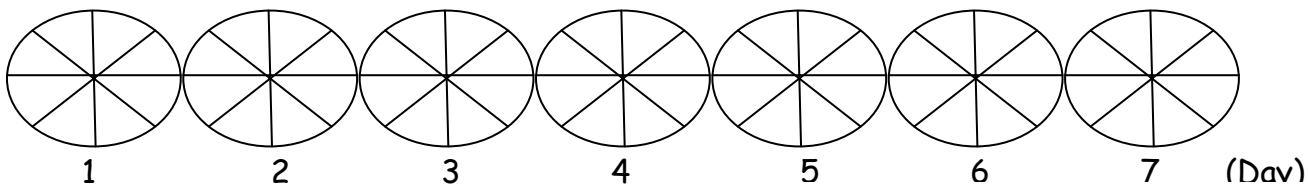
Cloud type and cover

Colour in the octas

Red = cumulus cloud

Blue = stratus cloud

Green = cirrus cloud



Temperature

(°C)

30							
25							
20							
15							
10							
5							
0							
	1	2	3	4	5	6	7 (Day)

Rainfall

(mm)

12							
10							
8							
6							
4							
2							
0							
	1	2	3	4	5	6	7 (Day)

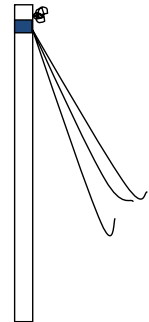
Sheet 16 - Make your own weather kit

Windicator

You will need:

- 1 cm diameter dowelling or a stick about 30 cm long
- 3 ribbons (1cm wide and about 25 cm long)
- Tape - masking or electrical tape

1. Take the three ribbons and put them on top of each other.
2. Tie them together at one end.
3. Tape the ribbons to one end of the stick so that the knot is above the tape. The ribbons will then be flat against the stick.
4. Go outside, hold up the stick and see how the wind moves the ribbons.
5. Can you measure the wind speed using the Beaufort scale?



Wind sock

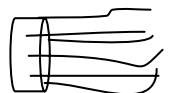
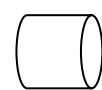
You will need:

- 1 sheet of printer paper
- 1.2 m of very thick strong thread
- 1 piece of tissue paper or piece of plastic bag (28 cm x 28 cm)
- Glue, sticky tape, scissors and a ruler
- Paper punch and a paper clip

1. Roll the A4 sheet of printer paper width ways into a tube and put tape around both ends.
2. Lay the tissue paper or plastic flat on the table and draw a line 3 cm from one edge.
3. Make 2 cm wide cuts from the side furthest away from the line to the line to make strips - don't cut them off! There should be about 14 strips.



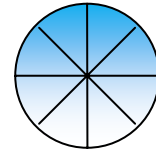
4. Make the tissue paper/plastic into a cylinder to just fit over the end of the paper cylinder with a 2 cm overlap and secure with tape.
5. Punch 3 holes evenly round the paper cylinder at the opposite end to the tissue paper/plastic.
6. Knot 3 threads (25 cm long) through the holes, tie the loose ends together to the paper clip. Use the rest of the thread to tie to the other end of the paper clip.
7. Take outside and tie the long thread to a pole or fence post.
8. Use a compass to check where the wind is coming from (wind direction) or use the Beaufort scale to measure wind speed.



Sheet 17 - Make your own weather kit 2

Octameter

The amount of cloud cover is measured in octas. The sky is viewed through a tube which gives a circular view cut into eighths - known as octas. The number of octas of cloud cover is simply the number of the octas which have clouds in them. For example, the view here shows 4 octas with clouds in them.

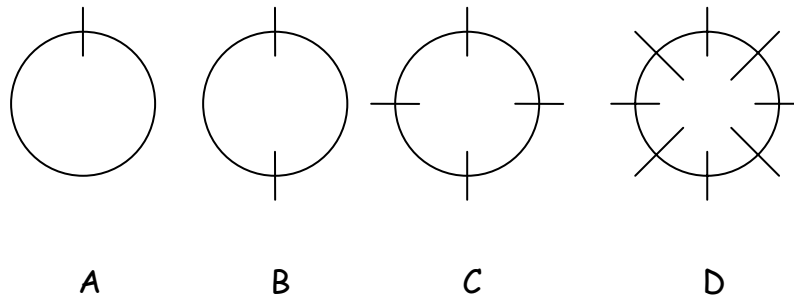


Make your own octameter:

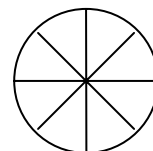
You will need:

- A cardboard tube open at both ends
- String, sellotape and scissors

1. Cut a 1cm slot at one end of the tube (see A).
2. Cut another 1cm slot at the opposite side of the circle (B)
3. Cut two 1 cm slots each side of the circle half way between the first two slots (C)
4. Cut four 1cm slots, each one half way between two of the slots (diagram D)



5. Cut 4 pieces of string or wool 4 cm longer than the diameter of the circle.
 6. Thread one piece of string through one slot and the opposite slot so that there is an overhang each side
 7. Tape the overhanging thread to the side of the tube.
- Repeat for the other three pieces of string so that all the slots have been used.
 - The octameter should look like this:
 - Go outside and test
 - REMEMBER never look directly at the sun!

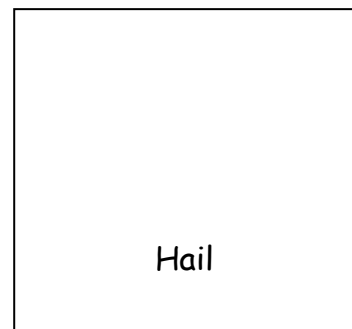
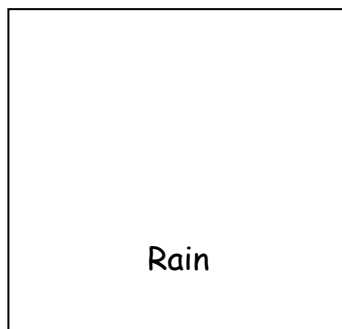
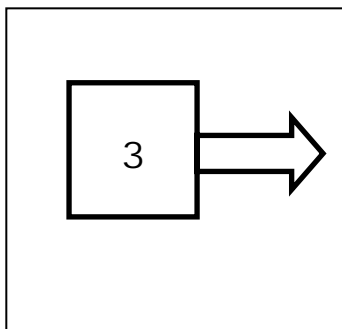
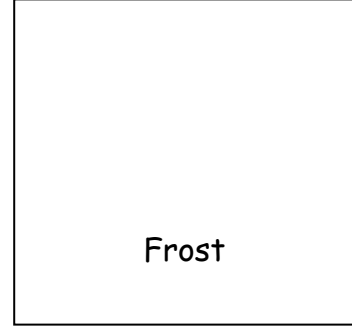
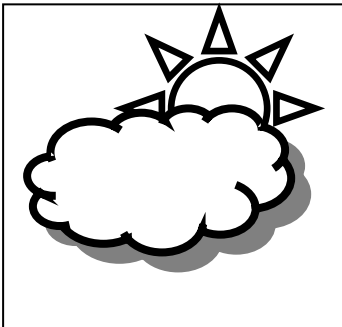
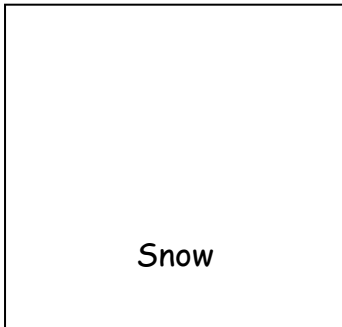
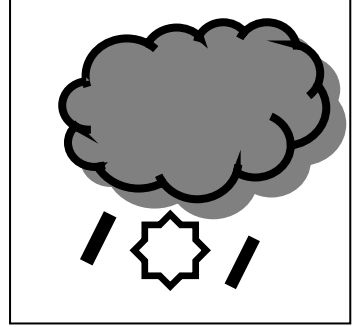
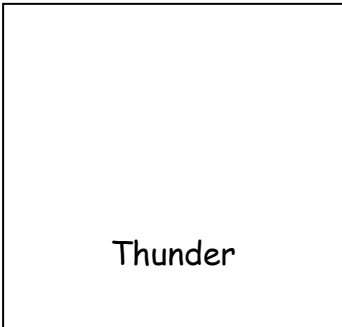
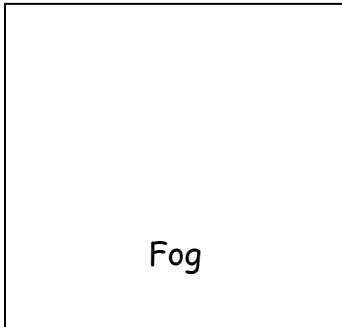
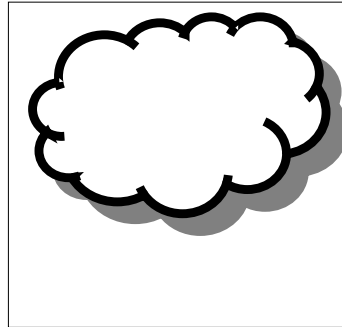
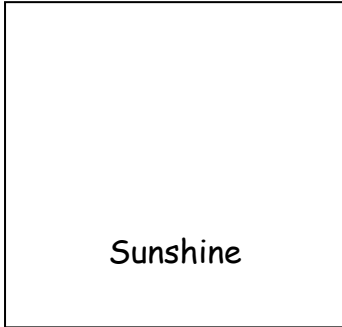


Name:

Date:

Sheet 18 - Weather Symbols

- Name the symbols below and then design your own for the missing ones.
- Can you use them to tell the weather forecast to the rest of the class?



Appendix 1 - Detailed breakdown of Curriculum Links

The activities can contribute to the following points from the National Curriculum Subject Orders:

Turbine Visit

Turbine Visit

English	Geography	Maths	Science
1.1a	1a,d	Ma2.1a,e	Sc1.1a
1.2 a-e	2a	Ma2.4a-	Sc1.2a,b,f,
1.3 a,b	3a,b	c	Sc3.1a,c
1.9a	4a	Ma3.1a	Sc4.2c
	5a,b	Ma3.3a	Sc4.3e,g
	6a,e	Ma3.4a	
	7c		

Wind Measurement

Geography	Maths	Science
1a,b	Ma3.3a	Sc1.1b
2a,b	Ma3.4b	Sc1.2a-f
6a,e	Ma4.2b,c	Sc4.2c
7c		

Field Sketch

Art	Geography	Science
1c	1b	Sc1.1b
5a	2a,b	Sc1.2e,f,h
	6a	
	7c	

Watercolours, Weather & Words Workshop

Watercolours

Art	English
1a-c	1.2a,b,d
2a-c	9a
3a,b	
4a,b	
5a-c	

Weather

English	Geography	ICT
1.1abe	1ae	1abc
1.2acd	2acf	2a
1.4a	3a	3ab
1.8b	6a	
1.9a		
1.11a		

Words

Eng	Geog
1.1a	2a
1.2ab	
1.3ab	
1.8b	
1.9c	
2.1ab	
2.5b	
3.1b	
3.9a	
3.12	

Turbine Technology Workshop

Design & Technology	English	Science
1d	2abce	Sc1.2ce
2abde	9a	Sc3.1a
3ac		Sc4.2cd
4c		
5b		

Renewable Energy Workshops

Turbine Kits

Design & Technology	English	Maths	Science
2d	1.2abce	Ma2.2c	Sc1.1b
3a	1.3abcd	Ma3.4b	Sc1.2a-
4cd	1.9a	Ma4.2b	m
	1.10abc		Sc4.1a
	3.1be		Sc4.2ce
	3.9b		
	3.10		
	3.11		
	3.12		

Solar Power

Design & Technology	English	Science
2d	1.2abce	Sc1.1b
3a	1.3abcd	Sc1.2a-
4cd	1.9a	m
	1.10abc	Sc4.3bc
	3.1be	Sc4.4bc
	3.9b	
	3.10	
	3.11	
	3.12	

Solar Heating

Design & Technology	English	Maths	Science
2d	1.2abce	Ma4.2b	Sc1.1b
3a	1.3abcd		Sc1.2a-
4cd	1.9a		m
	1.10abc		Sc3.1b
	3.1be		Sc3.2b
	3.9b		Sc4.4bc
	3.10		
	3.11		
	3.12		

Newspaper Towers Workshop

Design & Technology	English	Science
1bc	1.2abce	Sc1.2abe
2abde	1.3abcd	Sc3.1a
3abc	1.9a	Sc4.2b
4ab	1.10abc	
5bc		

Resource Pack Activity Sheets

Design & Technology	English	ICT	Maths	Science
1cd	2.1d	2c	Ma2.1bde	Sc1.1b
2abde	2.2c	4bc	Ma2.2cij	Sc1.2a-
5b	2.3a-d	5b	Ma2.3aik	f
	2.5abdg		Ma2.4ab	Sc4.1
	2.9b		Ma3.3a	
	3.1ab		Ma3.4b	
	3.9b		Ma4.2b,c	
	3.12			

Appendix 2

Answers to Activity Sheets

Sheet 1 - What do we use electricity for?

Lamp - Heat and Light

Iron - Heat

MP3 Player - Sound (light on display?)

Washing Machine - Heat, Movement (Sound as by-product)

TV - Light, Sound (Heat as by-product)

Hairdryer - Heat, Movement (Sound as by-product)

Laptop - Light, Sound (Heat as by-product)

Torch - Light (Heat as by-product)

Vacuum Cleaner - Movement (Heat and Sound as by-products)

Sheet 2 - What is Energy

Energy is the ability to do **WORK** . It comes in many different **FORMS** .

These are heat, light, mechanical, electrical, nuclear and kinetic (movement) energy.

We use energy in everything we do, from jumping to watching television.

There are two main sources for the energy we use every day:

- Energy that is made using natural resources that can be replaced, like wind, water and sunshine, is called **RENEWABLE** energy. This is also called 'clean energy' or 'green power' because it does not pollute the air or water.
- Non-renewable energy sources are those that cannot be replaced once they are used, such as the **FOSSIL** fuels oil, natural gas and coal. Most of our electrical energy comes from burning non-renewable energy sources. Non-renewable energy sources also cause pollution.

Renewable and non-renewable energy sources can both be used to produce **ELECTRICITY**.

Another non-renewable energy source is the metal called **URANIUM** .

Electricity made this way is called **NUCLEAR** energy.

We use all these energy sources to **GENERATE** the electricity we need for our homes, work, schools and factories.

28

Sheet 3 - How long will fossil fuels last?

Oil and Gas will be depleted by the time the pupils are 50 (at current know reserves and rate of use) The other answers will depend on the pupils opinions but may include

-

- no gas and oil for producing electricity - reliance on other resources

- no oil to produce petrol, plastics, chemicals, drugs etc
- Replace use of fossil fuels with alternatives (e.g. biofuels, hydrogen or electricity for cars)
- Conserve supplies by using less energy

Sheet 4 - How much energy do we use?

Results and explanations will vary from pupil to pupil.

Cost per unit can be found from an electricity bill or on most electricity companies' websites.

Variations may occur due to number of people at home, weather, occasional use of high power device etc..

Sheet 5 - Electricity travels!

The correct order is:

1. Firstly coal, gas and nuclear power stations make most of the electricity we need. The rest comes from wind farms and other types of power station.
2. All of these power stations work together to generate and supply enough electricity for the UK.
3. The electricity from all the power stations goes into a system of power lines called the National Grid.
4. The National Grid supplies mains electricity to our homes.
5. In our homes a meter measures the amount of electricity we use and this is used to work out how much we have to pay.
6. The mains electricity supply passes through fuses in our homes to prevent electrical accidents.
7. Finally the sockets in our houses are connected by wires to the mains supply so that we can plug in the TV and other electrical items.

Sheet 6 - Supply and Demand

The winter bill is invariably higher due to use of extra heating and lighting in winter - also often more cooking of hot food etc.

Sheet 8 - How a Turbine Works

Description

Name

The large tall structure which holds up the wind turbine

TOWER

These turn in the wind - there are three of them!

BLADES

This word means "turn" and describes how the nacelle and blades turn to get the best from the wind

YAW

This word describes how each blade changes shape in the wind	PITCH
This connects the rotor to the gearbox	SHAFT
This machine contains a magnet spinning inside a wire coil to generate electricity	GENERATOR
This measures wind speed and sends the information to the control room	ANEMOMETER
These are wires which carry the electricity from the turbine	CABLES
This is a pod which contains all the working parts of the turbine	NACELLE
The three blades are attached to this and it moves round and round	ROTOR
This stops turbine towers from falling over!	FOUNDATIONS

Sheet 9 - From the Wind Farm to our Homes

The correct order is:

1. Firstly, the electricity is generated at a power station.
2. This power station is called a wind farm.
3. The wind spins the wind turbines' blades.
4. The blades spin a generator.
5. Inside the generator, a magnet spins inside a coil of wire to generate electricity.
6. The electricity flows away from the wind farm along thick wires (cables).
7. Cables carry electricity to a transformer which changes the low voltage electricity to high voltage electricity to make it travel better over long distances.
8. High voltage electricity flows ³⁰ from pylon to pylon across the countryside.
9. In substations, the high voltage electricity is changed back to low voltage electricity because we can't use high voltage electricity in our homes.
10. Lastly, cables carry the electricity from the substation to our homes.

Sheet 10 - 18

Some of these sheets are information sheets, some describe experiments the pupils can perform and on other the answers will vary from pupil to pupil.