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## Climate Change

**Do you like Polar Bears? Well every time you switch on the light you are probably helping them... to become extinct.**

Alarming as it may seem, we are ALL contributing to the sad story of animals dying out – a story that we hear about in the news every day. This is not even including the other devastating effects that climate change is predicted to have on us and the Earth. Start doing your bit now by reading on to find out exactly what climate change is, how it is caused, what effect it is having on our planet and how you can do your bit to help. Because if we all ignore climate change our planet will become more and more out of balance until it is too late.

'Climate change = the build-up of man-made gases in the atmosphere that trap the sun's heat, causing changes in weather patterns around the world'. Before we look at climate change and its related issues – Global Warming, the Greenhouse Effect, Greenhouse Gases, melting ice caps and rising sea level, let's be sure that we understand what is meant by these big technical words.

## What is Climate?

Climate is 'the general weather in one place over a long period of time'. So it's not what the weather is like today, it is the average weather conditions over a few years. Meteorologists (scientists who measure the weather) collect detailed information about the weather every day, often using high-tech satellite and computer systems. Hundreds of measurements are calculated and the results compared to previous readings.

## Climate Change

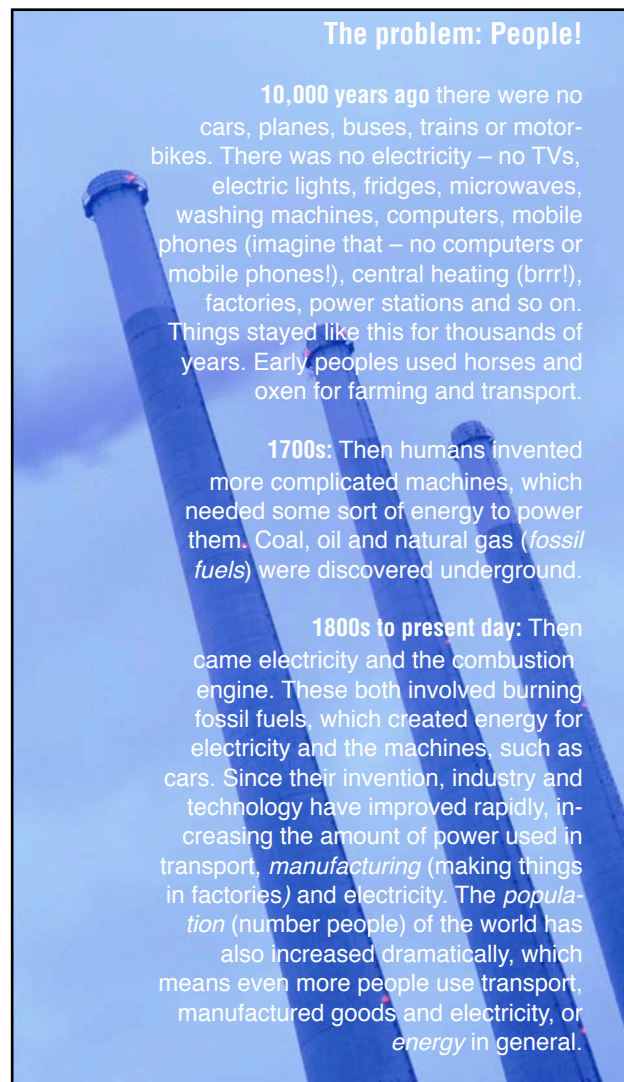
From their readings, meteorologists have noticed that the world's climate is getting warmer. But they also know that changes in the climate are nothing new. For example, 50 million years ago there was no ice at the Poles, but 18,000 years ago there was ice 2 miles thick in Scotland.

Have you heard of the Ice Age? Not the film, but the condition that the earth was in many thousands of years ago! Earth has been in and out of ice ages all through its billions of years of existence. Much of the planet was regularly covered in huge ice sheets and glaciers as the air temperatures plummeted then rose again, causing the ice to melt. This is one reason why the woolly mammoth is thought to have become extinct. Its habitat melted and it couldn't cope with the warmer climate.

## A fuss about nothing?

So why does it matter that climate change is happening again? Because it is happening more quickly now than ever. Humans are believed to be speeding up the rate at which the climate is getting warmer, and many plants and animals cannot adapt quickly enough to the changes in order to survive, like the poor old woolly mammoth.

We are making climate change worse...



**The problem: People!**

**10,000 years ago** there were no cars, planes, buses, trains or motor-bikes. There was no electricity – no TVs, electric lights, fridges, microwaves, washing machines, computers, mobile phones (imagine that – no computers or mobile phones!), central heating (brrrr!), factories, power stations and so on. Things stayed like this for thousands of years. Early peoples used horses and oxen for farming and transport.

**1700s:** Then humans invented more complicated machines, which needed some sort of energy to power them. Coal, oil and natural gas (*fossil fuels*) were discovered underground.

**1800s to present day:** Then came electricity and the combustion engine. These both involved burning fossil fuels, which created energy for electricity and the machines, such as cars. Since their invention, industry and technology have improved rapidly, increasing the amount of power used in transport, *manufacturing* (making things in factories) and electricity. The *population* (number people) of the world has also increased dramatically, which means even more people use transport, manufactured goods and electricity, or *energy* in general.

## Fossil Fuels – what are they?

**Coal** - The 300 million years old fossilised remains of forests that died and sank underground where they became squashed and turned to coal.

The carbon found in coal today came from the carbon dioxide that the trees absorbed all those millions of years ago when they were alive and photosynthesising.

**Oil** - Fossilised prehistoric and microscopic sea creatures and plants (plankton and diatoms) from under the sea floor. Many of these tiny sea creatures had shells, which are made of calcium carbonate and the minute plants would have absorbed carbon dioxide during photosynthesis. When they all died, sank and got squashed under the sea floor, the pressure and heat of squeezing turned the carbon in their remains to liquid.

**Natural Gas** - Gas is also formed when prehistoric plants and animals decay and is usually found in areas where there is coal or oil.

This period in geological history was known as the carboniferous era because the coal, oil and gas that was formed is full of carbon.

Let's take a look at how and why burning fossil fuels releases greenhouse gases and causes climate change.

## Greenhouse Gases and the Greenhouse Effect

Greenhouse gases are responsible for the Greenhouse Effect. But before we investigate that, let's find out what greenhouse gases are. Can you name any of them?

The most well-known greenhouse gas is Carbon Dioxide or CO<sub>2</sub>. Other greenhouse gases are methane, carbon monoxide, sulphur dioxide, nitrous oxide and water vapour.

But greenhouse gases are not always bad. We actually need some greenhouse gases in the atmosphere in order for life on Earth to exist:

- 🌱 Trees and plants would not survive without CO<sub>2</sub> as they need it for photosynthesis.
- 🌱 The plants in turn provide food for animals and they give out oxygen for animals to breathe.
- 🌱 Greenhouse gases also keep the planet warm enough for life to exist. Without them the world would be 33°C colder than it is now (and life would not be possible (the average temperature for November in the UK is around 6°C. This means it would be more like -27°C here instead. Brrrrr!). This is because the greenhouse gases form a protective layer in the atmosphere that stops all the sun's warmth disappearing back up into space.

### So why are they thought of as bad?

The trouble now is that the amount of greenhouse gases in the atmosphere is higher it would be naturally, and this is upsetting the world's climate.

### Where are all the extra greenhouse gas emissions coming from?

**Power stations:** When we burn coal, oil or gas to make electricity.

**Factories** - you've all seen pictures of factory chimneys belching smoke into the sky?

**Transport:** Cars, lorries, buses, motorbikes, trains, boats and aeroplanes. Petrol and diesel are fossil fuels and we burn them in engines to make energy – waste greenhouse gases come out of the exhaust.

**Rice 'padi' fields** give off huge amounts of methane as well, because of all the bacteria 'breathing' away in the wet fields.

**Cows** constantly burp methane while they chew the cud! And there are approximately 1,500,000,000 (that's 1.5 billion!) cows in the world, all happily burping away (and breaking wind from the other end!). That's a lot of methane...

**Landfill sites.** Methane is produced by the bacteria working really hard to rot all the rubbish down.

**Deforestation:** Chopping down and burning trees. This releases all the carbon dioxide that the trees have absorbed whilst growing (it also means there are fewer trees left to re-absorb the extra CO<sub>2</sub> going up into the atmosphere).

Picture a padi field

## The Greenhouse Effect

Where do all these fumes go? Up into the sky and they keep going up into the atmosphere until they can rise no further. Here they hang around, forming a kind of gassy blanket around the earth.

What happens next is similar to what happens in a greenhouse. In a greenhouse:

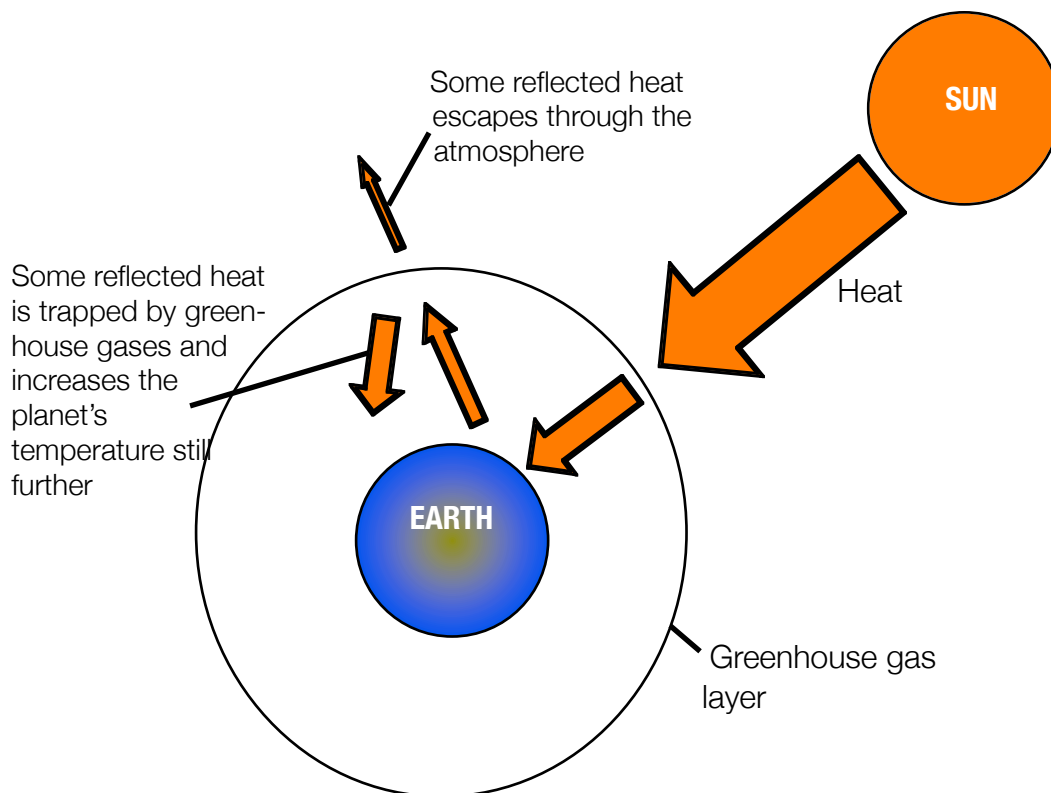
1. The sun shines through the glass and warms up the inside of the greenhouse, helping the plants to grow and the tomatoes to ripen.
2. The heat can't escape out of the glass roof again
3. It slowly but surely gets hotter and hotter in the greenhouse until someone opens the door or night falls.

Well the same sort of thing is happening to Earth!

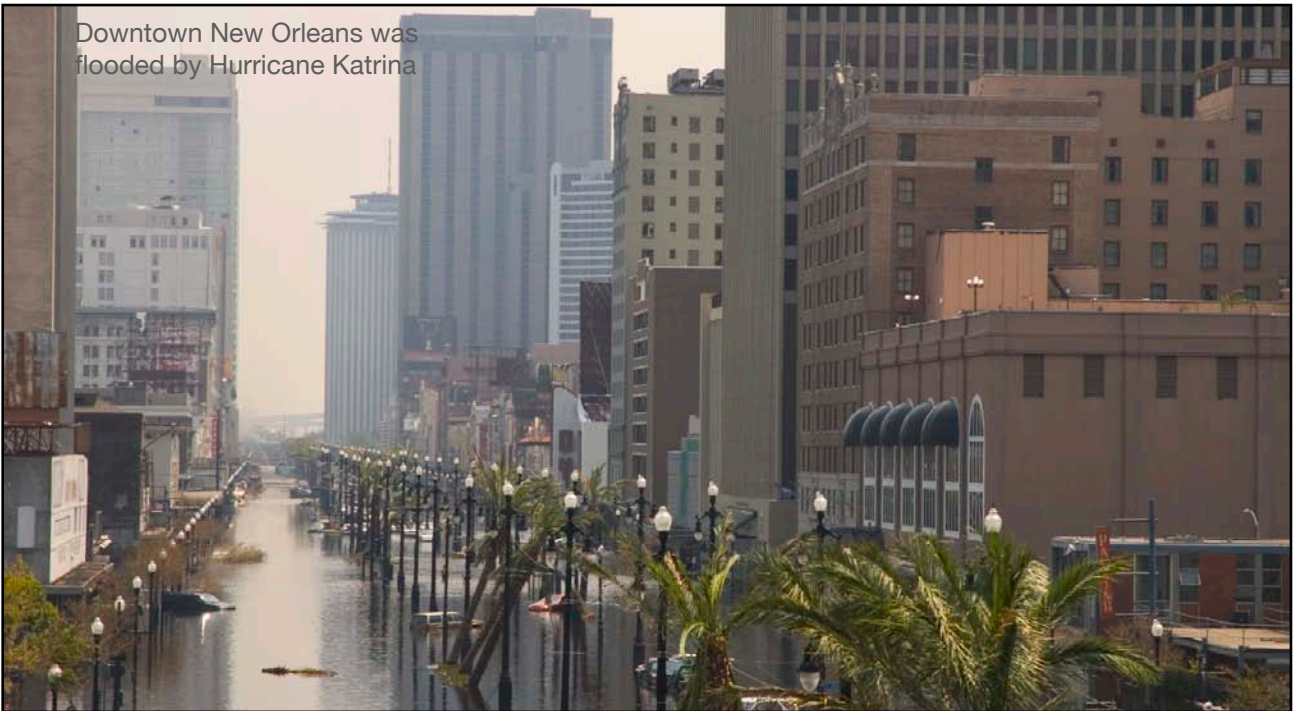
1. The sun shines through the layer of gases (which act like the greenhouse roof) and provides Earth with the light and heat it needs for all the plants and animals to survive.
2. When it reaches the ground, the sunlight is reflected back up into the sky as infra-red waves.
3. In the past, most of these rays used to travel up and up beyond the atmosphere, out of harm's way.
4. Now, however, the thicker layer of greenhouse gases absorbs more of the heat on its way back through the atmosphere, and reflects much of it back to Earth.

5. The heat is then trapped between the layer of gases and the ground, just like in a greenhouse. This means that the air gradually heats up more and more, only it's not as hot or rapid as it is in the greenhouse – thankfully!

### THE GREENHOUSE EFFECT



Downtown New Orleans was flooded by Hurricane Katrina



## The Effects of the Greenhouse Effect and Global Warming

The greenhouse effect means that in general, the planet is getting hotter. But in some places around the world it is also getting wetter; some (like the Sahara Desert, which is getting bigger by 10 metres every year) are getting drier and others are getting windier. So it depends on where you live as to what effect climate change may have on you:

The Inuits in the Arctic regions have noticed the ice melting more in the summer months and freezing less in the winter months.

The Shanty towns in Asia and Latin America are suffering more floods and storms than in the past.

The Europeans are witnessing more forest fires, melting glaciers and heat waves than ever before. SE England had to have a hosepipe ban this summer because it was so hot and dry.

### Global Wetting more like!

Did you know? Serious floods around the world, which used to occur every 100 years are now occurring between every 10 to 20 years. Why? Because warmer air temperatures lead to more evaporation, which eventually causes more heavy rainfall.... Remember the Carlisle floods of January 2005?

Unfortunately it's not just happening in the UK. The USA suffers from hurricanes every year, but the number and intensity is rising:

Between 1975 and 1989 there were 171 severe hurricanes in the USA. Between 1989 and 2005 there were 269 severe hurricanes in the USA.

Hurricane Katrina in New Orleans last year was the costliest and one of the deadliest hurricanes in the history of the United States. Hurricanes develop as a result of air warming up over warm seas, causing the air to rise rapidly and develop into major storms. The warmer the sea, the warmer the air, the worse the hurricane.

### Activities

1. Ask your teacher if they think the number of bad-weather disasters around the world is going up each year?
2. Find out about big storms that have happened either in the UK or abroad over the last year (this does not include volcanoes, earthquakes and tsunamis – these are not climate-related).

Cities like London could be under threat from flooding if sea levels continue to rise



## Coastal flooding

The ice caps at the North Pole (The Arctic) and the South Pole (The Antarctic) are slowly melting and this is causing the sea levels to rise. One scientist has predicted that the sea level rises will be approximately 49cm over the next 100 years. Another has said the rise could be as much as 8m! This shows that we don't really know what's going to happen, but we are sure that something is and the effects could be devastating:

If the sea levels continue to rise, many countries and cities could be flooded by the sea and lost forever. Bangladesh is one example (they already suf-

fer from severe annual flooding); nearer to home, cities like London, Bournemouth, Cardiff, Newcastle, Carlisle and Edinburgh could also be at serious risk.

Even if the ice caps don't melt, the oceans are likely to expand as they warm up and could cause coastal flooding anyway.

Water is also good at absorbing carbon dioxide – but becomes less good at it as it warms up, which means that as the seas warm up due to global warming, caused by increases in carbon dioxide in the atmosphere, it becomes less efficient at soaking up the extra CO<sub>2</sub>! Frustrating, isn't it?





### The effect on wildlife

Many, many species of plants and animals are likely to be affected by climate change. Let's pick out a few examples:

**Polar Bears** – These wonderful animals need ice to live on; it is their habitat and they are specifically adapted to hunting and breeding on and around it. Seals need ice flows too – to rest and give birth to their pups on. If the ice flows continue to melt as quickly as they are, the seals and polar bears will die out as their habitat disappears. If the seals die out it means less food for the polar bears, too.

**Plankton and Krill** – at the beginning of the food chain, microscopic plankton and the tiny krill provide food for a huge number of animals in the sea, from barnacles, to fish and even sharks and whales. Plankton and krill is very easily affected by changes in sea temperatures and will move away or die if the temperature changes, even slightly. This reduces the amount of available food for other species in the food chain.

For many animals, such as mosquitoes and egrets, global warming could be a good thing as it means they can spread further afield into parts of the world that were previously too cold. The little egret used to be a rare sight in the UK; now it can be seen regularly in good numbers in estuaries in the South of England. Sadly slower animals like snails and frogs are not faring so well (they can't move away as easily).

Many plants are not coping as well with climate change either. At least many of the faster animals (ones that can fly, in particular) can move or migrate to other areas if the conditions in their habitat change for the worse. But plants can't move at all, so they are particularly vulnerable.

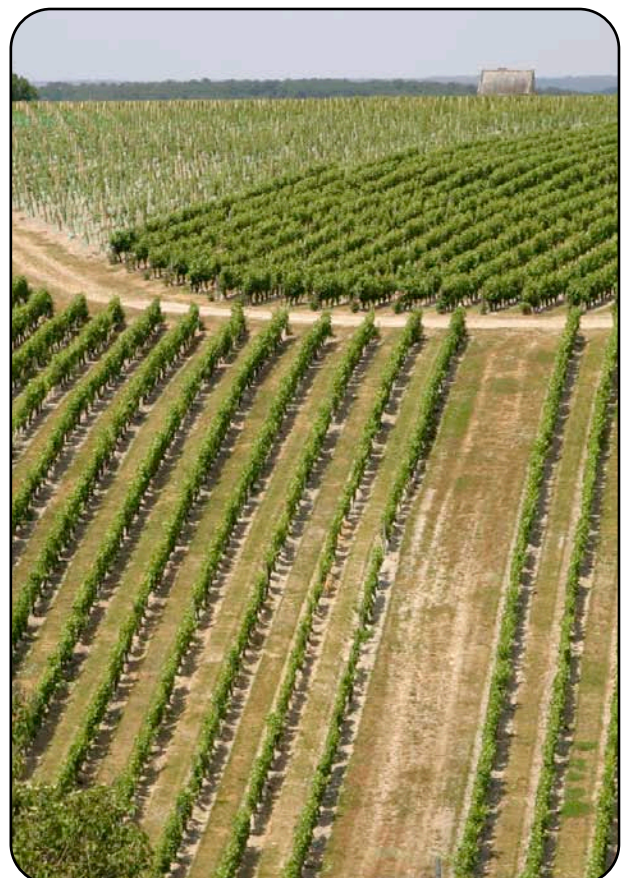
The climate is changing faster than the plants and some animals can adapt to the changes.

### The effect on farming

Some experts are predicting that by 2060 the British climate will be more like that of the Loire Valley, France. This means that crops of sunflowers, oil seed rape (for cooking oil and cattle feed) and vineyards (growing grapes for eating and for making wine) are becoming more popular in some parts of the UK – they like a warm, dry climate like parts of France.

So that is the good news. However, the bad news is that a lot of pests like locusts are now spreading into areas where they never used to be found. Aphids, (greenfly) are hatching earlier in the year and eating young, delicate seedlings.

*Below: Could England's farmland look like this by 2060?*



## The effect on our health.

Some scientists are worried that human health is at risk from some effects of climate change.

1. Our winters are now not cold enough to kill off nasty germs and bacteria, which means they



multiply and cause more of a problem.

2. Mosquitoes carrying the disease malaria used only to be found in hot Tropical countries; now they are spreading further northwards because the warmer climate suits them. There are fears that they could soon reach Britain.
3. There are more heat-related deaths and cases of heatstroke and dehydration in places like France every year.

## The History of Climate Change - A Timeline

**1827** Jean-Baptiste Fourier is the first to suggest that the earth is kept warm by a layer of gases acting like a greenhouse

**1862** The invention of the combustion engine – the beginning of the industrial revolution and the rapid rise in carbon emissions

**1957** American scientist sets up the first monitoring programme of CO<sub>2</sub> levels in the atmosphere and immediately finds regular annual increases.

**1985** The first major international conference on the Greenhouse Effect is held in Austria.

**1987** The warmest year on record so far.

**1980-1990** The warmest decade on record

**1990** The Intergovernmental Panel on Climate Change (IPCC) reports that the planet has warmed by 0.5°C since 1890.

**1995** The hottest year yet. A report by the IPCC predicts that, unless carbon emissions are reduced, global warming will be between 1°C and 3.5°C.

**1997** The Kyoto Protocol is drawn up to force industrialised countries like the UK and USA to cut carbon emissions significantly by 2010. The USA refuses to be part of the agreement.

**1998** The hottest year in the hottest decade of the hottest century in the last 1000 years.

**1999** The golden toad of Costa Rica is believed to be the first animal to become extinct as a result of climate change

**2000** Scientists warn that the earth could warm up by an alarming 6°C within the next 100 years if things continue as they are.

**2005** The warmest year on record in the Northern Hemisphere. The world is said to be at its warmest for 12,000 years and the CO<sub>2</sub> levels are at their highest than at any time over the last 650,000 years.

**2006** Scientists predict that the sea levels could rise between 9cm and 69cm by 2080, depending on future carbon emissions.





## Whose fault is it?

“Not mine - I walk to school every day, recycle my rubbish and turn off the lights when I leave the room!” you cry. But sadly we are all to blame and can all do something about it – more on that later.

## Did you know?

- The *European Union* (27 countries, including the UK) is responsible for sending 3.171 million (metric) tonnes of Carbon dioxide into the atmosphere EVERY YEAR! That’s 14% of all the carbon emissions in the whole world.
- Our houses account for 31% of all the emissions in the UK. The rest is from vehicles and industry.
- The USA emits 5,410 million metric tonnes of CO<sub>2</sub> every year – 25% (a quarter!) of global emissions.

It is now very unlikely that we can stop and reverse climate change and global warming. It’s too late for that, but if we can at least slow it down there will be more chance for the vulnerable plants and animals to adapt, as well as for us to prepare for sea level rises and a different climate.

It will need every person in every developed, rich country like the UK and USA to reduce their carbon emissions if we are to make a difference.

## But how can we make a difference? Reduce, Re-use, Repair, Recycle.

We’ve probably all heard of the 4Rs by now and if you are doing them then you are already doing your bit. Here are a few reminders of what you can do:

- 80% of our household waste is either re-usable, recyclable or compostable. We can significantly reduce the methane emissions from landfill sites and the energy wasted through the manufacture of new items all the time (and thus reduce the carbon emissions) if we all did the ‘4 Rs’ every day.
- Take a shower rather than a bath – you’ll use less hot water, which will require less electricity to heat

the water – less electricity being used means fewer carbon emissions. However, be warned – electric



‘power showers’ are just as bad as a bath. A non-electric shower is best!

- Walk or cycle to school – if you can. Share a lift if you can’t. Fewer car journeys means less petrol being used and therefore fewer carbon emissions.
- Turn the heating off in rooms, nobody is using. Turning the thermostat down by 1°C can make a massive difference to the environment and the electricity bill. Put a jumper on rather than turning up the heating!
- Use the tumble drier less and the washing line outside more – with warmer, drier summers this should be easier. It’s also cheaper and far better for the environment.
- Install energy-efficient light bulbs in your house – they may cost a little more but they last 10 times longer than a ‘normal’ light bulb, use much less energy and therefore save your money and help the planet.
- Encourage your parents to look into getting their electricity from an eco-friendly supplier. These companies try to get their energy from *renewable* sources like wind turbines and solar panels which are better for the environment (they do not release carbon into the atmosphere). You could even investigate getting your own solar panels fitted on your house. They are expensive but they are very eco-friendly and eventually your electricity will be free.



### Activity

Make a list of as many other ideas as you can think of for reducing the carbon-emissions in your everyday lives.

### Carbon Footprints

The contribution that each person makes to the UK's carbon emissions is known as your *carbon footprint*. The smaller your 'footprint' the more eco-friendly you are! Have a go at the quick quiz below to work out how big your carbon footprint is, and for ideas on how to make it smaller: Answer honestly and give yourself 3 points for every answer a), 2 points for every answer b) and 1 point for every answer c) you have.

1) How do you get to school each day?

- a) walk or cycle
- b) get the bus or train
- c) go by car

2) What do you recycle in your house?

- a) paper, card, glass, tin/aluminium, plastic and more
- b) only 1 or 2 of the above
- c) None of the above – we don't recycle in our house.



3) In your house, how many energy-efficient light bulbs are there?

- a) 5 or more
- b) between 1 and 5
- c) none

- 4) When you have finished on the computer, or finished watching TV do you:
- Always turn them right off
  - Leave them on standby
  - Leave them on – someone else might want them later

- 5) For your holidays every year, your family tends to:
- Stay in the UK
  - Take the ferry or train to Europe (eg France, Spain, Italy, Greece)
  - Fly in an aeroplane within the UK or to another country



- 6) When your clothes are washed, are they
- Usually dried on the line or on clothes horses in the house
  - Sometimes on the line or horses, sometimes in the tumble drier
  - Always in the tumble drier

- 7) What type of car is used most often in your household (you might need help with this)?
- An efficient car with a small engine, running on bio-fuel or diesel
  - A large petrol car with a big engine
  - A big 4x4 car that is very powerful and fast.



- 8) Does your home electricity come from (ask for help on this one too):



- solar panels on your house and a wind turbine in your garden
- a new eco-friendly electricity company
- a large, well-known and well-established electricity company

### How did you do?

If you scored 8-12, you have a very big carbon footprint and you need to think of ways to make it smaller starting now! – think of those poor polar bears!

If you scored 13-18, your carbon footprint is quite big; you could still be ‘greener’ to do your bit to help the planet. But you are helping – thank you.

If you scored 19-24 well done – you have a small carbon footprint and your efforts are excellent. See if you can shrink it even more, and encourage your friends and family to do the same.

But really the biggest jobs are up to World Governments to reduce their carbon outputs.

We can all lead by example, and the more people that do their bit the more the World Leaders will have to listen. However, things are never that simple and we will have to change certain aspects of our lifestyles which will not be as convenient or cheap if we are to slow down the rate of climate change. For example, recycled goods, low energy light bulbs and solar panels are all more expensive than the less eco-friendly alternatives. But if we really want to help, we must be prepared to pay more.

### Activity

Carry out a teacher survey to find out how many of them would be prepared to pay more for their a) electricity b) low energy light bulbs c) holidays if they knew it would help slow down the rate of climate change.



## What do you think?

Do you think people who are 'greener' should be rewarded in some way? Or perhaps those people who have big carbon footprints should be made to pay a fine that 'greener' people wouldn't have to pay? Should people with big 4x4 cars be made to pay more for their car tax than people with small, eco-friendly vehicles? Should cheap flights abroad be abolished to discourage people from flying as much?

For more information, try these websites:

[www.yptenc.org.uk](http://www.yptenc.org.uk)  
[www.bbc.co.uk/climate](http://www.bbc.co.uk/climate)  
[www.greenpeace.org.uk](http://www.greenpeace.org.uk)  
[www.foe.co.uk/campaigns/climate](http://www.foe.co.uk/campaigns/climate)  
[www.est.org.uk](http://www.est.org.uk)  
[www.futureforests.com](http://www.futureforests.com)  
[www.phenology.org.uk](http://www.phenology.org.uk)  
[www.wwf.org.uk](http://www.wwf.org.uk)

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## Enter the Green School Awards Every time you enter, the World wins

The Green School Awards are an exciting new way to involve groups of young people aged 7-11 in learning about the environment and energy in all its forms through science and the arts. They are designed to encourage cross-curricular work on the environment and to create interest in all forms of energy production from conventional and alternative resources. There is a great range of prizes, and finalists will be invited to attend an Environmental Discovery Day at London Zoo in June 2007. Closing date for entries is 4th May 2007.

The Green School Awards have been devised by the Young People's Trust for the Environment and are supported by Total.

You can download everything you need to take part from:

[www.yptenc.org.uk/docs/greenschoolawards.html](http://www.yptenc.org.uk/docs/greenschoolawards.html)  
or call YPTE on 01460 249163