

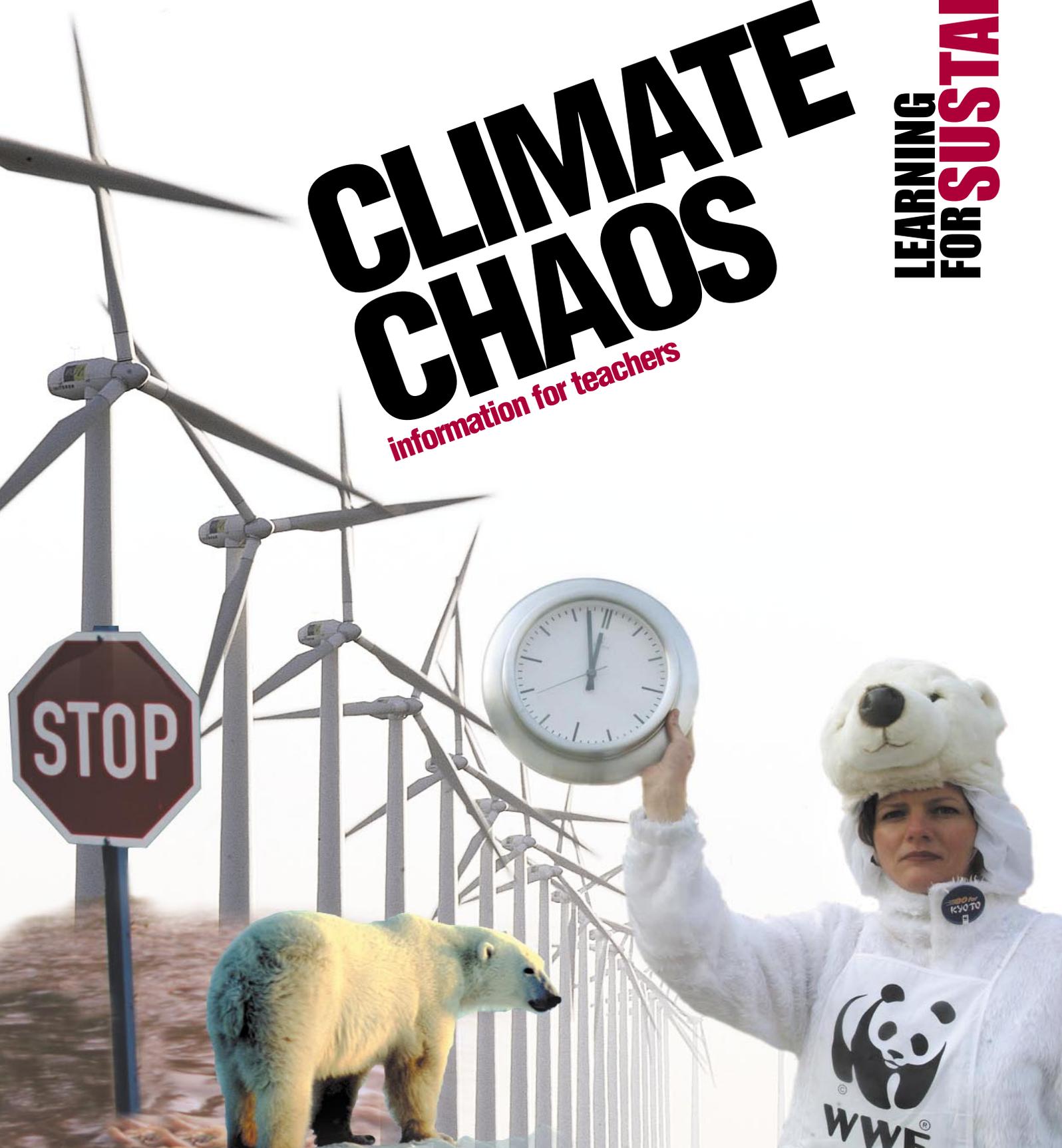


for a living planet

CLIMATE CHAOS

information for teachers

LEARNING
FOR **SUSTAINABILITY**



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Words marked by an asterisk are explained in the glossary.*



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Climate change* is considered to be the most serious environmental challenge facing our planet. Our way of life, our wildlife and our environment* are threatened: the polar icecaps are melting, coral reefs are dying and extreme weather events are increasing in frequency.

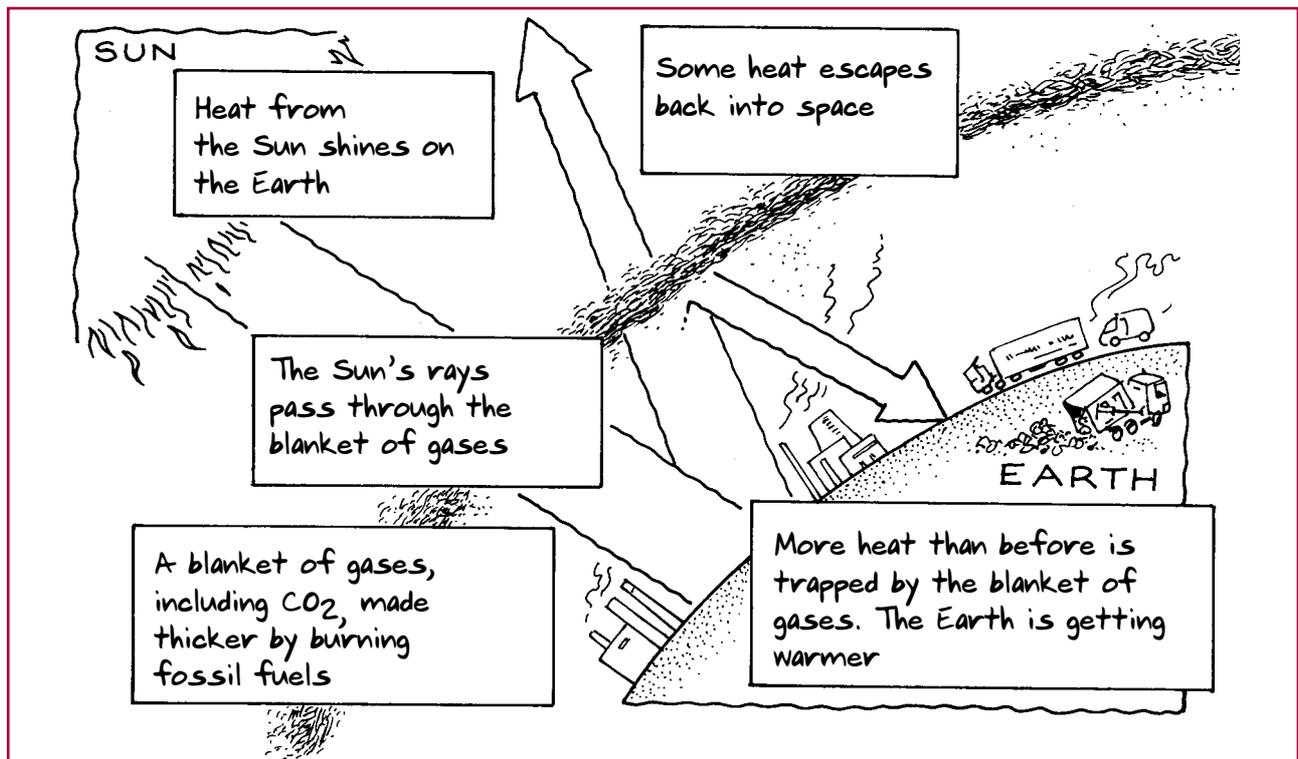
Together we can prevent climate chaos by limiting emissions of carbon dioxide – a major cause of global warming* – to help ensure that the average rise in global temperature stays below 2°C. This is a crucial tipping point for the environment*: to go beyond a 2°C rise would have devastating impacts for people and wildlife.

INTRODUCTION

THE GREENHOUSE EFFECT

The Earth retains its temperature thanks to a 'blanket' of greenhouse gases* that trap near the Earth's surface heat that would otherwise escape into space. In this way the blanket of gases acts like a greenhouse and makes the Earth a warmer place – without it the average global temperature would be more than 30°C colder than it is now. The greenhouse effect is a natural phenomenon that is vital to life on Earth.

Source: The Greenhouse Effect, David R. Wright, WWF-UK/Hodder and Stoughton, 1990.



WHAT IS CAUSING CLIMATE CHANGE?

Human activities are increasing the concentration of naturally occurring greenhouse gases in the atmosphere, especially carbon dioxide, causing the world to heat up unnaturally and the weather to become more extreme. The heating process is often referred to as 'global warming' and the overall effect is known as climate change.

Carbon dioxide is the principal contributor to climate change. Every time we switch on a light, use a computer, watch television or travel by any form of motorised transport, we are creating carbon dioxide. As human activity increases, the concentrations of greenhouse gases – particularly carbon dioxide, but also methane and nitrous oxide – build up in the atmosphere.

About two-thirds of greenhouse gas pollution* comes from the carbon dioxide emitted when we burn fossil fuels* such as coal, gas and oil. The two leading sources of carbon dioxide are now energy and transport.

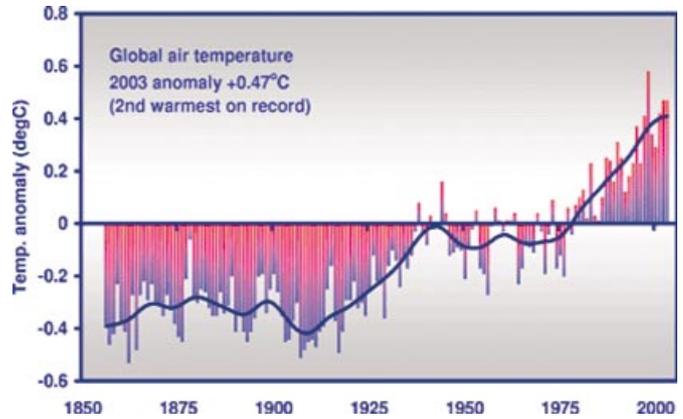
The average coal-fired power plant wastes twice as much energy heating up the planet as it converts to useful electricity. Each large 1,000 Megawatt coal-fired plant typically emits 5.6 million tonnes of carbon dioxide every year.

An average car with a fuel consumption of around 7.8 litres/100 km (36 miles per gallon) travelling 16,000 km (10,000 miles) per year emits almost 3 tons of carbon dioxide every year. That's roughly equal to three times the vehicle's body weight.

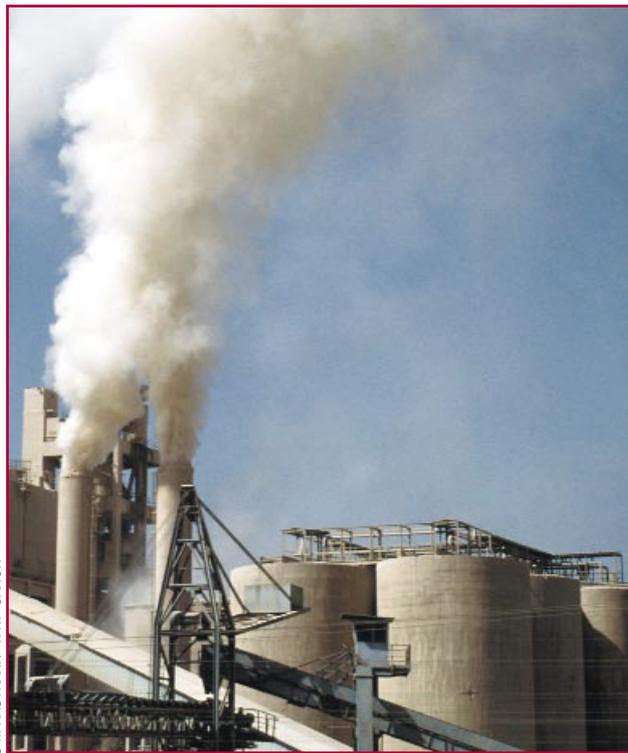
A 2004 WWF report revealed that the world's leading power companies are not investing enough in renewable* and efficient energy in order to reduce their greenhouse gas emissions. The report gives two-thirds of the world's leading power companies a score of less than 1 out of 10 for their response to global warming, and more than 90 per cent rank less than 3. US companies come out worst and European companies are hardly any better.

Carbon dioxide emissions are now around 12 times higher than in 1900 as the world burns increased quantities of coal, oil and gas for energy. Coupled with this, we are also depleting the Earth's biggest natural absorbers of carbon dioxide – the world's forests. In combination, these factors are seriously disrupting the natural balance of the world's climate*.

Global warming is now happening at an alarming rate. Figures compiled for the World Meteorological Organisation show that the 10 warmest years globally since 1856 occurred in the 1990s and 2000s. 1998 was the warmest year recorded, followed jointly by 2002 and 2003.



Source: data compiled jointly by the Climatic Research Unit and the UK Meteorological Office Hadley Centre for the World Meteorological Organisation.



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WHO IS RESPONSIBLE FOR CLIMATE CHANGE?

The Power sector (or energy industries) are the largest contributor to global climate change, accounting for over one-third of total CO₂ emissions. The 'G8' countries – the world's seven leading economies (Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) plus Russia – pumped out nearly half (48.7 per cent) of world carbon dioxide emissions in 1999.

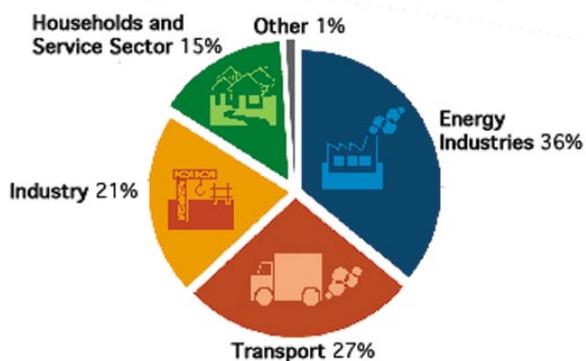
Industrialised countries have the responsibility to begin the process of emission reductions because:

- they are currently, and historically, the largest carbon dioxide emitters;
- their emissions per person are many times higher than those of developing countries;
- they have the finance and the technologies to kick start energy-saving and clean energy industries*.

WHAT ARE THE IMPACTS OF CLIMATE CHANGE?

You might think that global warming would be rather nice. Perhaps we will enjoy longer, warmer summers? Isn't that one of the reasons we go on holiday to other countries? But climate change won't be a pleasant experience at all; indeed, it is turning out to be very dangerous.

Sources of CO₂ emissions from fuel burning (1995)



Global impacts

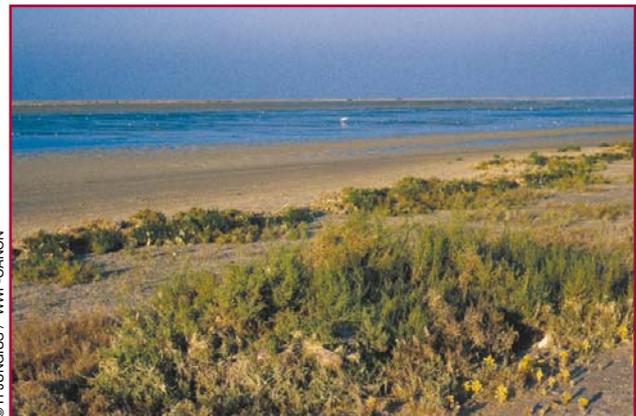
- At the speed our climate is changing, the world will soon be warmer than at any time in the last 10,000 years. Climate scientists are telling us to expect an average temperature increase of between 1.4°C and 5.8°C over the next 100 years.
- Climate change will affect all countries, although in different ways. The Middle East, Africa, India and some other countries could face drought and millions of people could face more problems with their water supplies. Other regions, including North America and parts of Asia, are predicted to receive more rain than they do now.
- Developing nations are likely to suffer the most and are less able to adapt* because of their poor financial resources. Many developing nations that lie in the tropics and subtropics may suffer from declines in agricultural production.
- Global warming is already melting glaciers in every region of the world, putting millions of people at risk from floods, droughts and lack of drinking water.
- Sea levels are predicted to rise due to thermal expansion of the sea, and the melting of ice sheets, glaciers and snow. By 2050, sea level rise is predicted to threaten coastal zones which are amongst the world's most densely populated areas. Entire nations on low-lying islands in the Pacific and Indian Oceans are at risk.
- It is not just warmer weather that is causing concern. Climate change has an impact on climate patterns more broadly and is likely to cause more weather extremes, such as heavy rainfalls, prolonged drought, storms and super-hurricanes. El Nino periods, which already radically alter the weather in the Pacific every few years, may become more frequent and intense.
- There are likely to be wide-ranging and damaging impacts on human health with significant loss of life caused by heat waves and the spread of diseases such as malaria.
- Many coastal wetlands around the world are likely to be flooded by rising sea level.
- Some plants and animals will be able to adapt to a warmer world, but for many, the change will be too rapid and they will die. Climate change could result in the extinction of more than a million terrestrial* species* in the next 50 years.
- Some species will simply have no suitable habitats* to which they can move because we have destroyed so many wild places. An estimated one-third of plant and animal habitats could be fundamentally altered by the end of this century.
- The rapid rate of global warming puts one-third of the world's forests at risk, as well as the species that depend on forests for their survival.
- Many rainforests and tropical grasslands in South America and southern Africa could die, but carbon dioxide increases in the atmosphere will encourage growth of temperate forests in North America, northern Europe and northern Asia.



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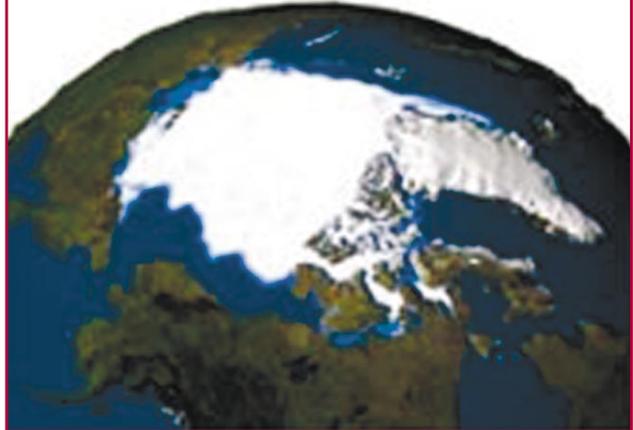
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Arctic* melts

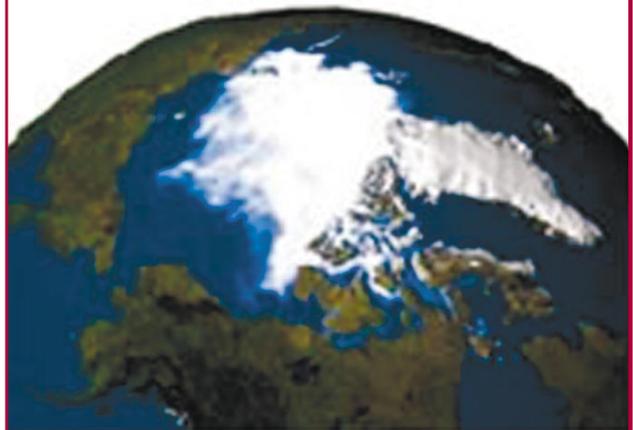
A 2004 report revealed that:

- Human-induced changes to the Arctic climate are among the largest on Earth. Warming in the Arctic will be around two or three times greater than the rest of the world.
- Polar bears could become extinct by the end of this century. They are very unlikely to survive as a species if there is an almost complete loss of summer sea ice cover, which is projected to occur before the end of this century by some climate models.
- Some Arctic fisheries could disappear.
- A warmer climate is also likely to see more forest fires and storm damage to coastal communities in the Arctic.
- Glaciers, sea ice and tundra will melt, contributing to global sea level rise. By the end of the century, sea levels could rise by nearly 1 metre. A warmer Arctic will contribute up to 15 per cent of this rise.
- The area of the Greenland Ice Sheet that experiences some melting has increased by about 16 per cent from 1979 to 2002. The area of melting in 2002 broke all previous records. Global warming could eventually lead to a complete melting of the Greenland Ice Sheet and a resulting sea level rise globally of 7 metres over several hundred years.
- As Arctic snow and ice melt, the ability of the Arctic to reflect heat back to space is reduced, accelerating the overall rate of global warming.
- A warmer Arctic could possibly halt the Gulf Stream, which brings warmer water and weather to north-western Europe.

Arctic Ice Cover, 1 January 1979



Arctic Ice Cover, 1 January 2003



Source: NASA, November 2003



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UK impacts

Climate

Some parts of the UK, including Scotland, will become wetter, whereas others, notably south-east England, will become drier. There is likely to be an increase in strong winds, especially in autumn. Severe and freak weather events are already affecting people in the UK. Events like the flooding at Boscastle in Cornwall and the landslide in Lochearnhead in Scotland in 2004 – and such disasters are predicted to increase.

Sea level

Sea level will continue to rise, threatening the south and east coasts in particular.

Homes

The risk of major disasters caused by gales and coastal flooding is likely to increase significantly. For instance, it has been estimated that two million homes could be at risk from flooding and coastal erosion in the UK by the middle of the century.

Health

Cold-related winter deaths are likely to decline substantially – possibly by as much as 20,000 per year. Over 20,000 died in the European heatwave of 2003. Heat-related summer deaths in the UK are likely to increase to around 2,800 per year. Cases of food poisoning are likely to increase by about 10,000 cases per year.

Farming

Rising temperatures and longer growing seasons will give farmers the opportunity to grow a greater range of crops, but changing rainfall patterns might require irrigation or water storage to ensure water supplies in summer. A changing climate could see new pests and diseases affecting crops and livestock.

Tourism

Skiing in Scotland is likely to become a thing of the past as the amount of snowfall decreases by up to 90 per cent.

Fisheries

Climate change has been identified as a factor in the dramatic decline in cod fisheries.

Species

Mountain species, such as snow bunting and mountain hare in Scotland, will be particularly affected. The suitable climate for a species moves uphill by 200-275 metres for each 1°C rise in temperature. As these species move uphill, the area of suitable habitat becomes smaller and more isolated.

Habitats

Sea level rise will change coastal habitats resulting in loss of some saltmarshes and mudflats that support internationally important numbers of wildfowl and wading birds. Some habitats may be altered. For instance, Caledonian pinewoods, a special habitat found only in Scotland, may be colonised by other tree species, such as beech and oak. Flood damage to floodplains and rivers is likely to affect habitats for otters and some river birds, such as kingfishers. Flash floods can change river habitats and so damage fish spawning grounds. Storms can alter the structure of coastal and estuarine habitats, such as shingle banks and mudflats.

The future

An average global increase in temperature of 2°C by the 2050s could result in an additional:

- 200-300 million people at risk from malaria;
- 12 million at risk from hunger as crop yields fall;
- 2,240 million at risk from water shortages, particularly in the subtropics;
- 20 million at risk from coastal flooding.

Impacts on great tits

Species depend upon various cues from the environment to start life cycle* events, such as breeding. Some depend on warm spring temperature. Warmer springs mean that life cycle events for some species happen earlier. However warmer temperatures do not affect all species in the same way. This can damage ecosystems* which depend on well timed interactions between their species.

For instance, butterflies and tree leaves appear earlier in the UK than before. A recent study of great tits in England found that caterpillars, the chief food of the species' young, were hatching earlier. However, the study revealed that the great tit was only nest-building after the caterpillars had hatched. This meant that there were very few caterpillars left to eat and the young birds died. As the hatching of young great tits no longer came at the same time as the availability of a plentiful food supply, the species disappeared from the area.

Source: Based on a recent study of great tits in the UK described in Ellis, N, "Climate change impacts: loss of synchrony between species". *Natural Heritage Trends*. April 2002. Scottish Natural Heritage, Battleby, UK.

WHAT HAS BEEN DONE TO STOP CLIMATE CHANGE?

At the United Nations climate summit in Kyoto in 1997, legally binding targets were agreed in order to achieve a reduction in industrialised countries' emissions of the six main greenhouse gases by just over 5 per cent by 2012, compared with 1990 levels. It took over four years for the world's leading industrial nations to agree on rules that would allow the Kyoto Protocol's recommendations to be put into practice. But the US had rejected the agreement. This is bad news: the US – which has four per cent of the population – accounts for around one quarter of global emissions, and is therefore the world's largest carbon dioxide emitter. The good news is that a large enough number of nations have ratified the protocol for it to become international law, the Kyoto Treaty*, on 16 February 2005.

In Kyoto, the UK agreed to a 12.5 per cent cut in emissions. The British government has also set itself a separate domestic target for carbon dioxide: to emit 20 per cent less in 2010 than in 1990; but by its own admission it is unlikely to meet this target.

UK emissions

In December 2004, the British government admitted that it had not done enough on climate change. Emissions actually rose in 2003 and 2004 and the government is letting the power and big industry sectors off the hook by failing to set them challenging targets. In transport emissions are running away, with continued growth in car use, the railways in crisis and unquestioning government support for increasing air travel.

A 2004 WWF report found that the UK is responsible for almost 30 per cent higher carbon dioxide emissions than the figures released by the government. The figures are so much higher because the government only counts those emissions generated by factories, power plants and vehicles in the UK. Since a majority of our food, manufactured goods and raw materials are imported, the economy generates carbon dioxide emissions elsewhere in the world, as well as those from aviation.

Now we only have five years left to get tough on industry and transport, and deliver the government's promise of a 20 per cent cut in carbon dioxide by 2010.

HOW CAN WE HELP STOP CLIMATE CHANGE?

To stabilise climate change altogether, emissions of carbon dioxide would have to be reduced by around 70 per cent globally by 2050. The current international agreements do not propose reductions of anything near this level.

Climate scientists say our planet must not be allowed to warm by more than 2°C. But without urgent action to reduce our carbon emissions we will go beyond this critical tipping point, with devastating consequences.

It is not too late. By reducing emissions, the rate of climate change will be less and therefore there will be less impact on our planet and our lives. We can also work on adapting to climate change at the same time.

Tony Blair's commitment to use the UK's position in 2005 as leader of the G8 and president of the EU to advance international action on climate change is vitally important, but he must do much more at home as well.

The UK government must continue to acknowledge the importance of staying below a 2°C increase in average global temperature through its international climate change negotiations. It must also take action at home to cut the UK's carbon emissions by 20 per cent by 2010 and by 60 per cent by 2050.

Individuals can also help through energy savings in the home (see R3 on page 15), including selecting 'green' energy providers, and by lobbying for action on climate change.



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The main approaches to reducing carbon dioxide are:

- suppling and using energy more efficiently, which requires the production and purchase of highly efficient appliances, cars, homes, etc;
- developing renewable energy sources – wind, sun, geothermal, sustainable* biomass;
- as a short-term step, shifting to less-polluting fossil fuels – for instance, switching from coal to natural gas, especially in the power sector.

If we are to achieve the target set, the UK government must implement policies and measures that will make the above happen. For instance, it must provide much greater investment in renewable energy technologies – not coal. Businesses need to invest in more efficient production processes, in renewable energy and in ‘climate-friendly’ products.

The benefits these measures bring are:

- savings on energy bills;
- improved comfort and quality of life, for instance from better-insulated homes;
- reductions in other air pollutants such as sulphur dioxide and nitrogen oxides;
- opportunities for cleaner industries to create new jobs;
- more rapid technological innovation and increasing industrial competitiveness;
- most importantly, avoiding unnecessary loss of human life and costly damage from extreme weather events such as floods and droughts.

What WWF-UK is doing

Stop Climate Chaos!

The power sector emits 37 per cent of the world’s carbon dioxide (World Coal Institute, 2003) and many electrical utilities are still operating inefficient power plants and burning fossil fuels such as coal. WWF-UK has launched the ‘Stop Climate Chaos!’ campaign as – part of WWF’s international PowerSwitch initiative – to challenge electrical utilities, financial institutions, politicians and consumers to make a rapid transition from fossil fuel to clean power.

One Million Sustainable Homes Campaign

In August 2002, at the World Summit on Sustainable Development in Johannesburg, WWF launched its ground breaking One Million Sustainable Homes Campaign.

Most of the UK’s housing stock has significant social and environmental impacts. For example, in typical new-built homes, total energy use is three and a half times more than in Denmark and Germany. The residential sector in the UK contributes around 27 per cent of the total carbon dioxide emissions associated with energy use, and domestic energy use is projected to rise by 6 per cent by 2010. It is therefore essential to reduce emissions from homes.

WWF has established a Sustainable Homes Task Force comprising partners including the Town and Country Planning Association, the Building Research Establishment and the Environment Agency. The Task Force will lobby the government, bring sustainable homes into mainstream thinking and make WWF’s one million sustainable homes target a reality.

Yes2Wind

WWF has joined forces with Greenpeace and Friends of the Earth to launch a new weblink aimed at promoting wind power. The site – www.yes2wind.com – provides information on wind technology, facts and figures about the benefit of wind power for the UK, and puts you in touch with others who are promoting wind power locally and nationally. In 2003, wind power was again the world’s fastest growing energy source.

WWF-UK is working with the corporate power sector, legislators and the financial sector. It is calling on:

- utilities to significantly improve their energy efficiency and increase their share of new renewable energy sources to at least 20 per cent by 2020;
- financial institutions to switch their investments to a low-carbon portfolio such as renewable energy; and
- politicians to legislate in order to create market conditions where low carbon investments are financially rewarded.

ACTIVITIES FOR 7-11 YEAR OLDS

The Greenhouse Effect in a Jar

Purpose

- To help pupils understand how the greenhouse effect works.

Curriculum links

Science

Preparation

You will need:

- 2 small thermometers;
- a sunny day;
- a large clear glass jar
- photocopies of the diagram and 'labels' on R1. The labels should be copied separately.

Procedure

- On a sunny day, organise groups of pupils to lay two thermometers side by side on the same kind of surface outdoors, and to record the temperature shown by each thermometer. They should then cover one of the thermometers with the large jar. Explain that this is their greenhouse.
- Pupils then read the temperature of the two thermometers after 30 minutes and again after an hour. What difference in temperature, if any, is there?
- Ask them what happens to the temperature inside a real greenhouse on a sunny day.
- Explain that scientists call the way in which the gases high in the sky are affecting the Earth's temperature, the 'greenhouse effect'.
- Hand out copies of the greenhouse effect diagram on R1 saying that, unfortunately, the labels for the diagram have been missed off. Hand these out and ask pupils, based on what they have learned, to put the labels in the right places on the diagram.

Introducing climate change

Purpose

- To help pupils understand global warming and climate change and some of the problems that these are causing around the world.

Curriculum links

Science, English

Preparation

You will need:

- EITHER to provide photocopies of the narrative and word list provided on R2, OR to write up both onto the chalkboard or flipchart;
- pupil access to the internet and library so that pupils can undertake some research to learn more about climate change – see 'Signposts to further information'.

Procedure

- Explain that many scientists believe that climate change could pose major problems for both people and planet.
- Read through the narrative on R2 with the class: pupils could clap their hands when you come to the missing words. Then ask pupils, in pairs or groups, to conduct research to enable them to fill in the missing words. Explain that a word list has also been provided to help them. NB They should use each word only once.
- Completed narratives could be illustrated and combined into a class display supplemented by facts, figures and questions arising from their research.

Bringing the message home

Purpose

- To encourage pupils to save energy and so help reduce climate change.

Curriculum links

PSHE/citizenship, science

Preparation

You will need:

- pupil access to websites for research on energy saving approaches;
- copies of R3 to share with the pupils.

Procedure

- Explain that all of us contribute to climate change through the energy that we use. To illustrate the point, ask pupils to write an account of a typical morning before school – getting up, washing, having breakfast, travelling, etc. Some of these stories could subsequently be read out in class and pupils asked to clap or put up their hands every time they think an action has involved the use of energy.
- Pupils should rapidly come to the conclusion that energy is being used most of the time! Follow this up by brainstorming a class list of simple tips for cutting down the energy they use, thereby reducing their contribution to climate change. The list on R3 could be used, as appropriate, to prompt for suggestions.
- Pupils now use this list to produce a class action plan for reducing their energy consumption. Discuss with them what might be needed to turn this into a school action plan (eg taking the idea to the School Council, discussing with the school management, carrying out ‘campaigning’ activities within the school to get others on board).
- Finally, pupils could be invited to produce personal energy saving tables to monitor how often they saved energy each day for a week. An example is shown below.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Cycled to school	Switched off lights when I left the room					
Went to recycling bins with bottles	Had a shower instead of a bath					
Switched off computer after using it						

Cars – choice matters

Purpose

- To learn more about the new technologies available in car manufacture and how these impact on the environment.
- To explore what influences people's choices when choosing cars.
- To consider what can be done to encourage more environmentally friendly choices.

Curriculum links

PSHE/citizenship, science

Preparation

What you need:

- a collection of car advertisements (eg from magazines, from TV and car manufacturers' websites) – you could also ask children to bring in their own examples;
- access to or downloaded information from the websites listed below. These give an overview of cars using a range of alternative energy sources: fuel cells, vegetable oil, battery, solar, electric and hybrids. There are clear diagrams and links to more in-depth information on individual manufacturers' websites. Children could also do their own search through search engines such as Ask Jeeves.

Some car manufacturer sites:

www.ford.com
www.renault.co.uk
www.toyota.com

Sites with information about alternative technologies:

www.evworld.com
www.egovehicles.com
www.hondaev.org

Procedure

- Explain that modern transport is a major contributor to climate change.
- Brainstorm reasons why many cars are not environmentally friendly – eg use of fossil fuels, contribution to greenhouse gases, non-biodegradable materials, etc.

- Using the listed websites, ask pupils to research some of the new, more 'environmentally friendly' technologies and make up lists of the advantages and disadvantages of each.
- Now look at the collection of car advertisements. Identify the key selling points with the class and write up on the chalkboard. What do car manufacturers appear to think people want? (Power, comfort, room, smart/trendiness, value for money?) Make a list of headings that cover these 'wants'. How much does 'impact on the environment' feature in the adverts? With the class, group the adverts under these different headings.
- Invite the class to conduct a survey amongst friends and family to find out what they want from a car. The questions could be 'open', or children could use the headings above. Does 'impact on the environment' feature? Why/why not?
- Brainstorm with the class what could be done to encourage sales of cars featuring more environmentally friendly technologies? Whose responsibility is it? The government? Car manufacturers? Individuals?
- As an extension, children could be invited to choose the new car technology they think has the most advantages and compose an advert to promote its 'sustainable' selling points.

Source: Activity taken from www.wwflearning.co.uk

Other online transport activities

Life story of a car

Topic: The environmental impact of cars

Description: Pupils research the life and use of cars now and in the future.

Curriculum links: English; art; science, maths

Weblink: www.wwflearning.co.uk/activities/pac000000039.asp

Action traffic!

Topic: The environmental impact of cars

Description: To explore local transport issues and consider sustainable solutions

Curriculum links: ICT, geography, English, mathematics

Weblink: www.wwflearning.co.uk/activities/pac000000016.asp

Global warming quiz

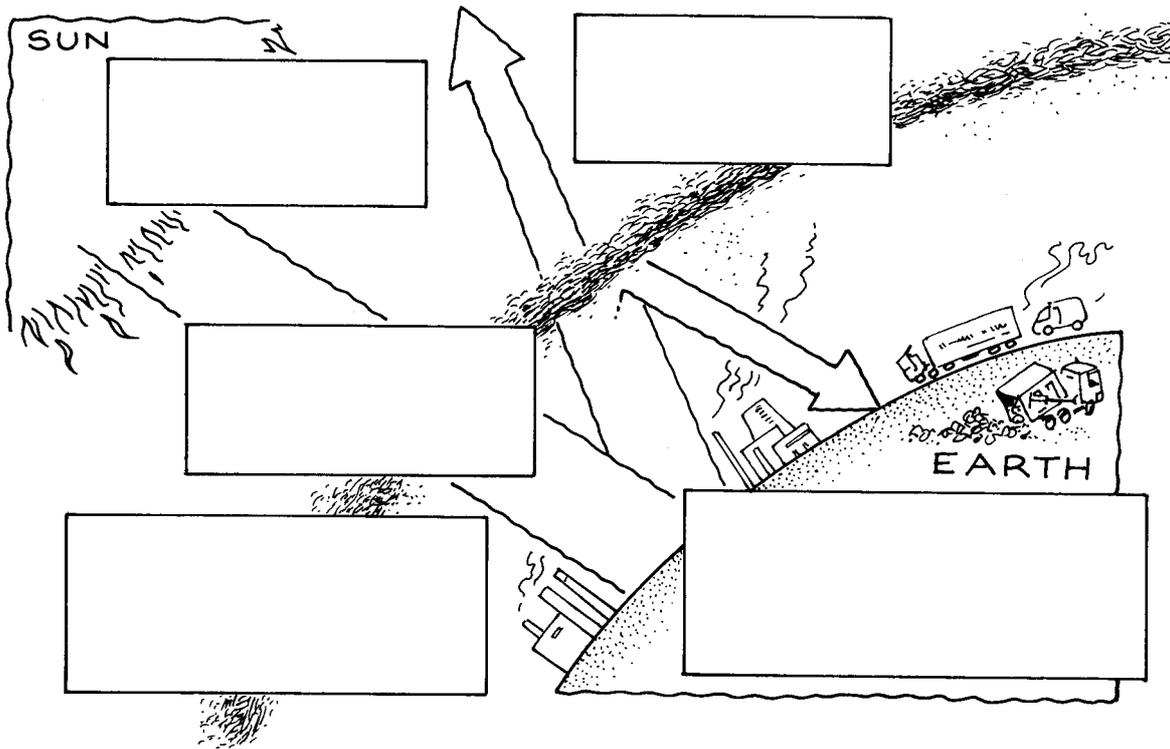
www.defra.gov.uk/environment/climatechange/schools/7-11/quiz/index.htm

Energy quiz

www.thinkenergy.com/Students/ks2_students/activities/activity7/index.asp

The greenhouse effect in a jar

Look at this diagram. It shows something called the GREENHOUSE EFFECT.



Unfortunately, the labels for the diagram were forgotten. Here they are. Put them in the right boxes:

The Sun's rays pass through the blanket of gases

Some heat escapes back into space

Heat from the Sun shines on the Earth

More heat than before is trapped by the blanket of gases. The Earth is getting warmer

A blanket of gases, including CO₂, made thicker by burning fossil fuels

Introducing climate change

"The temperature of the Earth is because of the greenhouse gases produced by peoples' activities. This is known as global The most dangerous greenhouse gas is carbon dioxide. Much larger amounts of this gas are now being produced by people burning fuels such as coal and to produce energy and to travel by....., bus or plane.

As the Earth becomes warmer, the is changing. This is bringing problems around the world. In places like Africa, less and less rain means that people are facing and finding it difficult to grow the crops they need. Storms and very winds are affecting some countries, such as in Central America, much more than in the past causing loss of lives and enormous damage to peoples' homes. is happening more and more often now in the UK. In the Arctic the ice cap is melting and have a much smaller area of ice on which to hunt in summer and so often cannot find enough food for their"

Word list

droughts, cubs, oil, increasing, strong, car, climate, flooding, polar bears, warming

Bringing the message home

- Get on your bike, walk or use the bus or train instead of travelling by car.
- Ask your Mum or Dad if they will change to using low energy light bulbs in some of the rooms in your house.
- Switch off lights when you leave the room.
- Switch the TV, computer, or stereo off when you are not using them – don't leave them on standby with the red light showing.
- Have a shower instead of a bath.
- Only boil up the amount of water you really need in the kettle, you'll get your drink made quicker too.
- If you are in your T-shirt and the heaters are on, then turn down the heat a little and put on a jumper.
- Recycle and re-use paper, glass, aluminium, tin, plastic, clothing and plastic bags.
- Plant a tree in your garden – this will absorb carbon dioxide from the air that is causing global warming.
- Eat local food and foods that are in season as much as you can. Many of our foods are imported from distant countries – this means a lot of energy is used to bring them over here.
- Only turn on the tap when you need it. It takes a lot of resources and energy to purify the water that is supplied to our homes and schools.
- Turn off a dripping tap whenever you see one.
- Only use a garden sprinkler in summer if you really have to.

ACTIVITIES FOR 11-16 YEAR OLDS

Preparing climate change data for an international conference

Purpose

- To give pupils the opportunity to practise research and data analysis skills.
- To help pupils understand the chief cause of climate change.
- To help pupils appreciate who is mainly responsible for climate change.

Curriculum links

Science, PSHE/citizenship

Preparation

You will need:

- access to the following weblinks:
www.panda.org/about_wwf/what_we_do_climate_change_problems
www.grida.no/climate/vital/index.htm
- photocopies of R4.

Procedure

- Ask pupils to imagine that they have been given a position in a research institute dealing with global climate change. A research scientist has given them some data on carbon dioxide in the Earth's atmosphere. Next week there will be a major international conference on climate change around the world and they have been asked to present and explain the data to the conference.
- Pupils should develop their presentations using the information on R4. They can craft their presentations as a short speech with OHPs or handouts, or as a PowerPoint, etc depending on pupil skills and the equipment available.

Climate change – an artistic view

Purpose

- To give pupils the opportunity for discussion and interpretation of cartoons.
- To illustrate that current and planned actions to stop climate change are far from strong enough.
- To show some impacts of climate change on developing nations.

Curriculum links

English, PHSE/citizenship, geography

Preparation

You will need:

- photocopies of the cartoons on R5 (either one per individual or one per group).

Procedure

- Working alone or in small groups, pupils look very carefully at each cartoon. What do they think are the messages the cartoons are trying to put across?
- Discuss the findings of each group as a whole class.
- As an extension, pupils could be invited to look at other 'takes' on climate change, eg the film "The Day After Tomorrow". How much is fact and how much is hype, in their opinion? Do they feel that this type of film helps or hinders the cause of people working to combat climate change? Why?

Climate change in the news

Purpose

- To help pupils understand the problems facing the world caused by climate change.
- To give pupils practice in research.
- To help pupils develop their writing skills.
- To give pupils practice in ICT.

Curriculum links

Science, biology, English, PHSE/citizenship, ICT

Preparation

You will need:

- photocopies of R6;
- access to the following weblinks or access to other background information:

Impacts of climate change:

www.panda.org/about_wwf/what_we_do/climate_change
newsvote.bbc.co.uk/1/hi/in_depth/sci_tech/2004/climate_change/default.stm

Climate change images:

Changes in Arctic ice cover, see maps at:
www.panda.org/about_wwf/what_we_do/climate_change/problems/warming.cfm

Changes in Arctic ice thickness, see diagrams at
www.grida.no/climate/vital/30.htm

Changes in ice-breaking date of River Torino in Finland, see graph at
www.grida.no/climate/vital/31.htm

Predicted impacts of sea level rise on the Nile delta coastline, crops and fisheries in Egypt, see maps at
www.grida.no/climate/vital/34.htm and
www.grida.no/climate/vital/34a.htm

Predicted changes in coffee-growing area in Uganda, see maps at
www.grida.no/climate/vital/36.htm

Procedure

- Invite pupils to write a front page article covering the dangers of climate change, two news stories from around the world illustrating the devastating impacts that climate change has already had on people and their environment, and some predictions for future impacts if climate change is not halted.

Remind pupils to:

- research the issues – the websites listed opposite should help;
 - choose a suitable headline – R6 includes some news headlines from 2050 which may give them some ideas;
 - include quotations, eg from people who have suffered the impacts, scientists or conservationists, to illustrate some of the points they want to make;
 - decide on the pictures that they want to use in their article – the list opposite left should offer a useful starting point, but otherwise they should choose their own from the resources available. Remind them to think about what they want the images to show and what messages they want to put across.
-
- Before commencing, they should choose the type of paper or magazine in which their finished work will appear, eg serious broadsheet, tabloid newspaper. This will affect the headline, writing style, etc.

Design a renewables energy poster

Purpose

- To help pupils understand the benefits of renewable energies.
- To give pupils practice in research and ICT.
- To help pupils develop their writing skills.
- To give pupils practice in design.

Curriculum links

Science, English, ICT

Preparation

You will need:

- access to weblinks on renewable energies. Here are two sites that may help you:
www.panda.org/about_wwf/what_we_do/climate_change/our_solutions/renewable_energies/index.cfm
www.bbc.co.uk/climate/adaptation/renewable_energy.shtml

Procedure

- Ask pupils to imagine that are members of a design team in a locally-based environmental charity. They have been tasked with producing a poster to promote renewable energy to different groups in their local community.

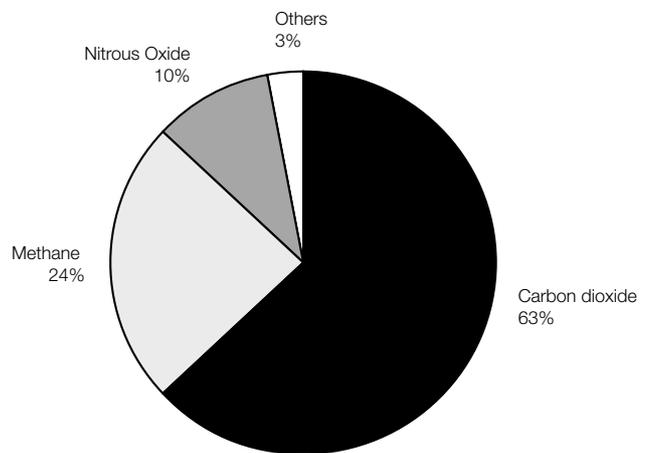
Remind them to:

- research the issues using the above weblinks or other;
- work out the main messages that they want to put across;
- find a few statistics from the weblinks that they think will interest people;
- look for pictures or other visual images to illustrate their poster – they could try looking online or in magazines or newspapers;
- think of a catchy phrase that puts across their main message;
- carefully plan the design of their poster so that it is clear and easy to read but also most likely to catch people's attention.

Preparing climate change data for an international conference

The contribution to global warming by the main greenhouse gases

- Look carefully at the piechart and then write a sentence explaining which gas contributes the most to global warming.



Source: The UK Hadley Centre for Climate Prediction and Research.

Change in carbon dioxide concentration

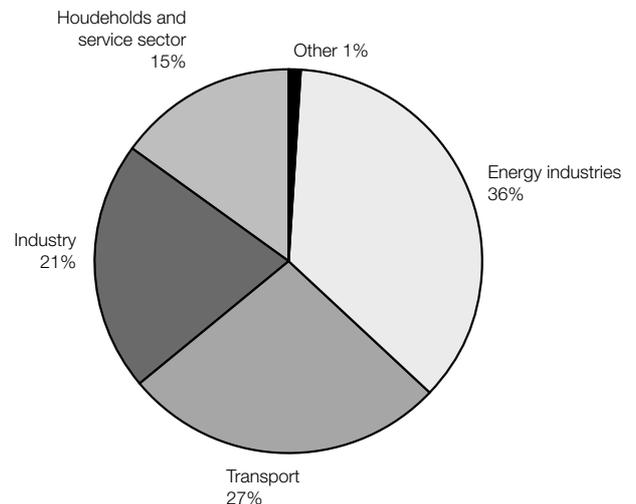
- Use the weblink www.grida.no/climate/vital/07.htm to find out and explain how global carbon dioxide concentration has changed between 1870 and 2000.

Change in global surface temperature 1860 to 2000

- Use the weblink www.grida.no/climate/vital/17.htm to find out and explain how global surface temperature has changed between 1860 and 2000.

Sources of carbon dioxide emissions from fuel burning (1995)

- Use the piechart (right) to explain:
 - which are the two main sources of carbon dioxide from burning fuel; and
 - which of these is the most important.

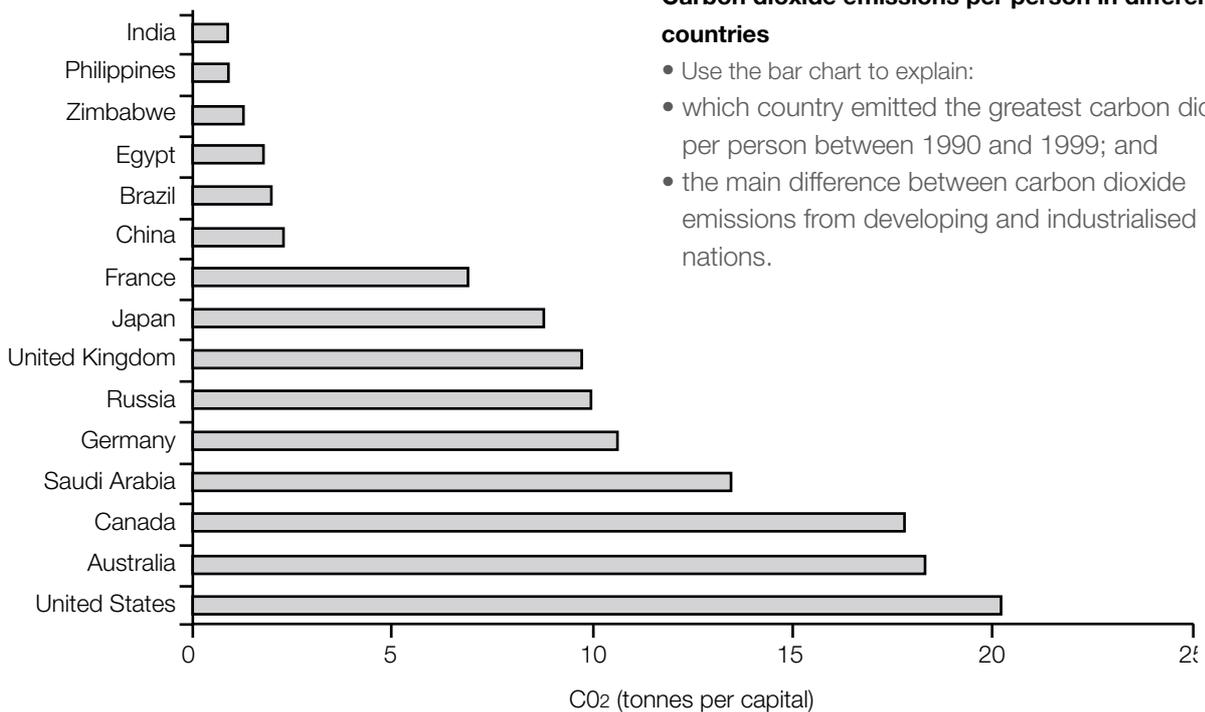
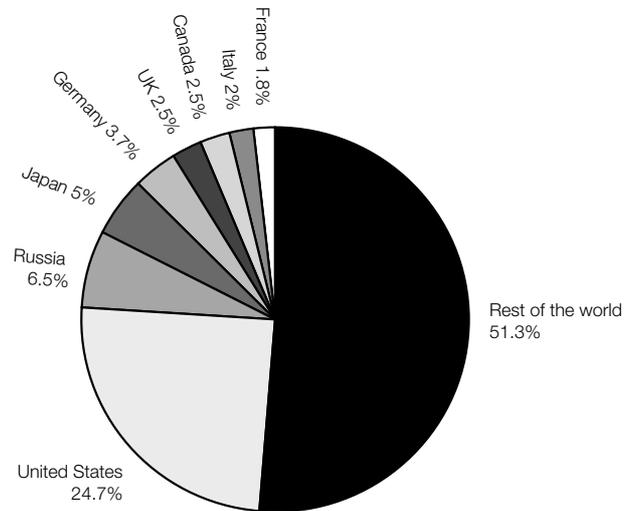


Source: UFCC/SBI/1997/19/Add.1. Available from www.unfccc.int. Data for 18 industrialised countries.

The main carbon dioxide polluters

- Use the piechart to:
- explain which country is the world's greatest polluter of carbon dioxide; and
- classify most of the countries in the piechart as developing or industrialised nations.

Source of world carbon dioxide emissions from fossil fuels, 1999



Carbon dioxide emissions per person in different countries

- Use the bar chart to explain:
- which country emitted the greatest carbon dioxide per person between 1990 and 1999; and
- the main difference between carbon dioxide emissions from developing and industrialised nations.

www.panda.org/about_wwf/what_we_do/climate_change/problems/polluters.cfm

Source: Carbon dioxide emissions data for 1998 from Energy Information Administration, US Department of Energy: World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1990-1999.

Climate change – an artistic view



Welcome to the Maldives Climate Conference



Climate change in the news

Global temperatures have risen
by 2°C in the last 150 years!

**228 million people now at risk
from malaria!**

Starvation now affecting 12 million!

2 billion short of fresh water!

Millions move inland due to coastal flooding!

**Thousands of species have become
extinct in the last 50 years!**

**Ministers lament not taking action
50 years ago!**

Online climate change activities

Basics of climate change

Theme: Climate change

Description: Science of greenhouse effect, etc.

Curriculum links: science and geography

Weblink: www.wwflearning.co.uk/activities/sac0000000005.asp

Fuelling climate change: what's the situation?

Theme: Climate change

Description: Use patterns of fossil fuels, especially in transport.

Curriculum links: PSHE, English, geography, economics, sustainable development

Weblink: www.wwflearning.co.uk/activities/sac0000000009.asp

No worries?

Theme: Climate change

Description: Critique the argument that most CO₂ is Earth produced and that human contribution is unimportant.

Curriculum links: geography, earth sciences

Weblink: www.wwflearning.co.uk/activities/sac0000000013.asp

Climate change calculator

Theme: Climate change

Description: Using online calculation software.

Curriculum links: using statistics, geography, maths and science

Weblink: www.wwflearning.co.uk/activities/sac0000000006.asp

Global warming and disease

Theme: Climate change – impacts

Description: Spread of malaria in a warming globe?

Curriculum links: science, geography

Weblink: www.wwflearning.co.uk/activities/sac0000000011.asp

Solar homes – an exciting future?

Theme: Climate change – solutions

Description: Futures imagining a positive 'low impact' home.

Curriculum links: science, PHSE, citizenship

Weblink: www.wwflearning.co.uk/activities/sac0000000024.asp

Green electricity?

Theme: Climate change – solutions

Description: Consumer choice in the context of electricity supply.

Curriculum links: science, PHSE, citizenship

Weblink: www.wwflearning.co.uk/activities/sac0000000018.asp

Hypercars

Theme: Climate change – solutions

Description: Getting around without poisoning the globe.

Curriculum links: science

Weblink: www.wwflearning.co.uk/activities/sac0000000012.asp

Eco-houses

Theme: Climate change – solutions

Description: Designing out the problem.

Curriculum links: English

Weblink: www.wwflearning.co.uk/activities/sac0000000007.asp

Future forests?

Theme: Climate change – solutions

Description: Carbon sequestration – gimmick or goer?

Curriculum subjects: science

Weblink: www.wwflearning.co.uk/activities/sac0000000010.asp

Rethinking the car – fuel cells and hybrids

Years: 11-14

Theme: Alternative technologies and the car

Description: Fuel cell technology and the transition from fossil fuel vehicles.

Curriculum links: Science, ICT

Weblink: www.wwflearning.co.uk/activities/sac0000000037.asp

Global warming quiz!

www.defra.gov.uk/environment/climatechange/schools/12-16/quiz/index.htm

ACTIVITIES FOR 7-16 YEAR OLDS

Cut your food miles

Background

'Food miles' means the distance travelled by food from the place it is produced to the store where it is bought. Today our food travels increasing distances before we buy it; and as food miles increase, so do the environmental costs. For instance, flying goods by air uses nearly 40 times the amount of fuel as sea transport. The environmental organisation, Sustain, says that for every calorie of carrot flown in from South Africa, we use 66 calories of fuel. Even food grown in the UK has usually travelled hundreds of kilometres from farms where it is grown, to a central depot and then to the supermarket where it is bought. Little wonder then, that food miles make a significant contribution to climate change.

Other issues attendant on the transport of food over long distances include: loss of taste and nutrient value; use of chemicals to act as preservatives; and pollution from the road and air transport used to move food about.

Yet pupils may have given little thought to the distances travelled by the food they eat – a distance often totalling several hundred, perhaps even several thousand kilometres. As an example, a dinner comprising lamb from New Zealand, beans from Kenya, and carrots from South Africa would create a food miles total of 15,200 km!

We have also become used to buying any food whenever we like. Thanks to air transport, foods that are out of season in the UK can be imported from other countries far away. For instance, not long ago strawberries were only available to most people in summer, but now we can buy them throughout the year, from countries such as Spain and Israel.

Of course some foods that we consider basic to our diet, such as bananas and oranges, cannot be grown in this country because our climate isn't suitable. But in many cases we can easily opt for alternatives to foods that have come long distances by choosing local produce and by eating foods that are in season.

Purpose

- To help pupils understand the environment impacts of transporting food over large distances.
- To encourage pupils to take personal action to eat locally grown foods or to grow their own where possible.
- To give pupils practice in ICT.

Curriculum links

Science, ICT, PSHE/citizenship

Preparation

You will need:

- to give pupils 'advance warning' of the need to go shopping with their parents so they can note down the fruits and vegetables that their family buys for a week;
- photocopies of R7A and 7B;
- atlases;
- pupil access to the internet for research. The following weblinks give some more background information on food miles:

For 7-11 year olds:

www.alternativevet.org/food_miles.htm

www.dumgal.gov.uk/services/depts/oce/greenbook

For 11-14 year olds:

www.worthing.gov.uk/A-ZofServices/ServicesDG/Environmentalissues/WorthingHeraldGreenwath/GeneralEnvironmentalIssues/FoodMiles/

Procedure

- Ask pupils to go shopping with their parents and to make a list of all the fruit and vegetables they buy for a week. Their list should include a note of which country each of the fruit and vegetables comes from. (If the labels don't make this clear, they could ask at the store's customer care or help desk.)
- Pupils use the table of distances on R7A to work out how far each kind of fruit and vegetable has travelled. If they find foods from a country not listed below, they could look up the distance from the UK in an atlas.
- They then count up the food miles that their family's weekly food has travelled and record it in a table – see example below.

Name of food	Country where grown	Distance travelled by food (km)
Apple	Chile	11,700

- Gauge pupils' reactions to their food miles – if they are surprised, they may wish to take action to reduce their family's food miles. The class could brainstorm ideas. Pupils may then wish to develop their own food miles reduction plan. R7A gives some ideas.

Be a Nature Detective

Background

Over the last three decades, scientists have produced clear evidence that spring has been starting earlier and earlier. We can see this from the dates that trees come into leaf, the earlier appearance of flowers, butterflies and frog spawn, and the arrival of migrant birds. Summers are lasting longer too. Leaves are not developing their golden autumn colours and are not falling until later. More records are needed to extend our knowledge for most species.

The study of the timing of recurring natural phenomena, especially in relation to climate change, is called phenology. It can also be described as observing 'nature's calendar'. It includes recording when you heard the first cuckoo or saw the first blackthorn blossom.

The Woodland Trust, with the Centre for Ecology and Hydrology, monitor and evaluate changes to nature's events.

The study of phenology (nature's calendar) is important because it provides evidence that climate change is happening now and that it is already having a significant effect on our wildlife. The more records there are, the more reliable predictions will be, and the more effectively we can plan for the future.

Observing nature's calendar is easy. It can also be great fun. You can record as much or as little as you feel able to. All records are valuable. Full feedback on the season's results is available online a few months later and is sent out to all recorders.

Purpose

- To give pupils the opportunity to observe and record.
- To enable pupils to find out that climate change is already having a significant effect on our wildlife.
- To give pupils practice in ICT.
- To give pupils practice in interpreting data.

Curriculum links

Science, biology, ICT

Preparation

You will need:

- access to the following weblink:
www.naturedetectives.org.uk

Procedure

- Register at the above weblink and obtain the recording form and, if you need them, the colour wildlife identification guides.
- Organise a nature walk once a week during spring or autumn in the same area near your school. At particularly busy times in nature's calendar, you may want to encourage pupils to look at some trees or flowers more frequently if they are able.

In spring they can record the dates:

- that different tree species come into leaf;
- of the first flowers;
- of summer bird arrivals;
- of birds' nesting activity;
- when they first see frog spawn, tadpoles and different insects, such as bumblebees;
- that the grass at school is first cut.

In autumn they can record the dates of:

- the first arrivals of winter birds;
- the last dates of migrating summer birds;
- the changing colours of leaves of different tree species;
- ripe fruits of trees and shrubs;
- when the grass at school was last cut.

- Pupils then use the recording form to make their records and then enter their results online afterwards. This means that their records are instantly available for analysis and for viewing on the live maps. They can also see their records building season on season, and trends emerging in your area and across the UK.
- Suggest that pupils take a look at the live maps at www.naturedetectives.org.uk/Record/viewing.aspx. Maps available include those of bumble bee, frogspawn, lawn cut, nesting rooks, flowering primroses and snowdrops. Pupils could choose one of the maps and describe what they think it means.
- If you are in time, your class could take part in the BBC Springwatch Survey 2005. The BBC and the Woodland Trust have launched a major survey to record the arrival of spring across the UK. You can take part by logging the dates you first see a bumblebee, frogspawn or seven-spot ladybird. You can record your sightings on the BBC weblink, www.bbc.co.uk/springwatch or send them by post to The Woodland Trust, PO Box 8275, Grantham, NG31 6WY.

NB Pupils might also be interested in taking part in the survey as individuals, using sightings taken around their homes.

Energy Certification for Schools

Background

The Energy Certification for Schools scheme has been developed by the DfES to help schools to use energy more efficiently resulting in positive benefits for pupils, the school and the environment.

Purpose

- To help pupils understand the importance of energy efficiency.
- To enable pupils to practise research, measuring and recording skills.
- To help make schools more energy efficient.

Curriculum links

Science

Preparation

You will need:

- access to the weblink www.est.co.uk which gives full details of how to take part, how to register your school, links and resources, and case studies.

Procedure

Involve pupils in the following:

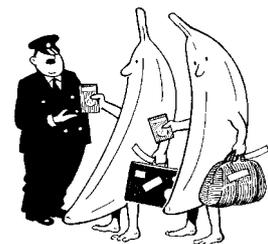
- undertaking School Energy Checks acting as detectives to find where energy is wasted;
- developing an Energy Plan for the school – this is a list of actions the school needs to take to use energy more efficiently;
- carrying out the actions detailed in the Energy Action Plan, for example by acting as energy monitors and designing posters to remind others to switch equipment off when not needed.

Cut your food miles

Country	Distance from UK (km)
Australia	16,000
Canary Islands	2,900
Chile	11,700
Colombia	8,500
Dominica	6,700
Ecuador	9,200
France	1,000
Israel	3,700
Kenya	6,800
The Netherlands	400
New Zealand	18,700
South Africa	9,700
Spain	1,500

Reducing your food miles

- Try and make sure that the food your family buys comes from nearby. You are more likely to find local food of all kinds in smaller shops and markets. Buy from farmer's markets if you can as food is guaranteed to be locally produced. You can find out the nearest farmers' markets to your home at www.bigbarn.co.uk
- Buy food that is season. You can find out which fruits and vegetables are in season now in the UK at www.bigbarn.co.uk/food/inseason/
- Grow your own: that way you'll be eating the freshest and most local produce! If you don't have a garden but would like to grow your own food, you could apply for an allotment or start a community garden in the corner of your school playing field. See the Federation of City Farms and Community Gardens website at www.farmgarden.org.uk/top.html for help – the site has sections for young people.



LINKS WITH THE CURRICULUM

For curriculum links, please see the following WWF-UK resources under 'Treasure Chest' in the Resource Bank section of our Education for Sustainable Development website www.wwflearning.co.uk

Teaching for Life: England

Teaching for Life: Northern Ireland

Teaching for Life: Scotland

Teaching for Life: Wales

GLOSSARY

Adapt – how people, animals and plants change to help them adjust to the conditions of the environment, making it easier for them to survive.

Arctic – the area lying above 66.5° North latitude that includes the Arctic Ocean and lies between North America and Russia.

Clean energy industry – industry that produces little or no pollution.

Climate – average weather over a long period (usually 30 years or more) in a particular region.

Climate change – a natural phenomenon whereby the Earth's climate warms or cools over long periods of time. However, the term is now more commonly used to refer to the accelerated rate of change which many scientists believe is the result of human activities. The burning of fossil fuels, which interferes with the natural balance of gases in the atmosphere, is largely to blame. As a result, global temperatures are rising and in the future we are likely to see an increase in weather extremes.

Ecosystem – the living communities of an area, together with their non-living environment.

Environment – all the factors (biological, chemical and physical) that affect an organism.

Fossil fuel – fuel, such as coal, oil or gas, that is formed from the decomposition of animal and plant remains.

Global warming – a gradual rise in temperature over all the Earth's surface.

Greenhouse gases – gases contributing to the greenhouse effect: the accumulation of carbon dioxide, water vapour and other gases in the upper atmosphere insulating the Earth, which prevents heat loss and raises atmospheric temperature.

Habitat – the place or type of site where a plant or animal naturally occurs.

Kyoto Treaty – a treaty to slow down climate change which was launched in 1992 in Rio de Janeiro, Brazil. The Kyoto Protocol was subsequently agreed in 1997 at an international conference on climate change held at Kyoto, Japan. The Kyoto Protocol includes binding emission targets for carbon dioxide, the main gas responsible for climate change. The treaty eventually came into force in February 2005.

Life cycle – all the different stages in the life of a plant or animal.

Pollution – the presence of harmful substances in the environment, often put there by people.

Population – a group of individuals of a single species.

Species – a group of organisms having common characteristics, formally recognised as distinct from other groups: the basic unit of biological classification.

Renewable energy – energy generated from sources that can be replaced or replenished, e.g. wind, wave, solar, tidal and geothermal.

Sustainable use – use of a resource that can be continued on an on-going basis without depleting or damaging it. Sustainable activities meet the needs of the present without compromising the ability of future generations to meet their own needs.

Terrestrial – belonging or living on the ground.

SIGNPOSTS TO FURTHER INFORMATION

Websites

Action at School

www.globalactionplan.org.uk

An environmental programme that is curriculum-linked and recognised by the United Nations Environment Programme. Schools can choose to tackle energy, transport, waste or water over three terms. The programme helps schools to save resources and money. Involves the formation of a school action team including pupils, teachers, school site managers, care-taking staff and governors. Programme suitable for 7-16 year olds.

BBC News

newsvote.bbc.co.uk/1/hi/in_depth/sci_tech/2004/climate_change/default.stm

Attractive news site with up-to-date news on climate change and much useful background information and graphics. Suitable for 11+ year olds.

BBC Weather

www.bbc.co.uk/climate/

Interesting website on climate change; includes information on renewable energy. Has a message board where you can have your say about climate change. Suitable for 11+ year olds.

Centre for Alternative Technology

www.cat.org.uk/education

Has good student worksheets on renewables that can be used in conjunction with a visit to the Centre.

Centre for Research, Education and Training in Energy (CREATE)

www.create.org.uk

Comprehensive website on energy. Has a newsletter for teachers, 'Energy Watch' – a guide to energy-related topics in the UK's national curricula, and some interesting activities for 7-11 year olds.

DEFRA

www.defra.gov.uk/environment/climatechange/schools/

Comprehensive and attractive website on global warming and climate change with useful facts, graphics, activities, quizzes and links to other sites. Suitable for 7-16 year olds.

EcoKids

www.ecokids.ca/pub/eco_info/topics/climate/co2effect/

Attractive website from Earth Canada for schools in Canada and internationally. Includes information and activities including games and quizzes on climate change. Suitable for 7-11 year olds.

Environment Agency

www.environment-agency.gov.uk/fun/

Attractive and lively website. Includes useful facts and figures and fun animations on climate change, flooding, and energy use, wastage and energy efficiency. Suitable for 7-16 year olds.

Intergovernmental Panel on Climate Change

www.ipcc.ch

The international group of scientists whose work drives the climate change debate. Suitable for adults.

Intermediate Technology Development Group

www.itdg.org

Demonstrates and advocates the sustainable use of technology to reduce poverty in developing countries. Includes a section on energy projects and factsheets.

Nature Detectives

www.naturedetectives.org.uk

Interesting website from the Woodland Trust giving full details on how to investigate nature's calendar (see Activities section). Includes background information and up-to-date news on climate change, activities (tree maze, puppets, wordsearch, leaf cards etc), details of plant and animal identification needed to carry out fieldwork, and an interactive feature showing the impacts of climate change in a garden. Suitable for 7-16 year olds.

PolarHusky.Com

www.polarhusky.com

Exciting website where classes can collaborate online with an Arctic expedition that is in progress until May 2005. Topics for videos and pupil activities include the Inuit people and their culture, nature in the Arctic, interpreting landscape and planning an expedition.

Royal Institution of Great Britain

insideout.rigb.org/ri/energy/notes.html

Interesting and colourful website on energy, including renewables. Includes information, activities, games, quizzes and topics for discussion.

TeacherNet

www.teachernet.gov.uk/wholeschool/sd/focuson/energy/curriculum

DfES website. Useful site that includes sections on curriculum and energy management.

Think-Energy

www.think-energy.com

Attractive website from British Gas with information and activities for 7-11 and 11-16 year olds on energy efficiency, and information for parents and teachers.

United Utilities

www.unitedutilities.com/teachers/htm

Includes useful background information and good activities on climate change and energy. Suitable for 7-16 year olds.

UK Climate Impacts Centre (UKCIP)

www.ukcip.org.uk

Has information and graphics on the impacts of climate change in the UK. Suitable for 16+ year olds.

World Resources Institute

www.wri.org/climate/topic_data_trends.cfm

Website packed with useful and up-to-date data, maps and other graphics on climate change and other environmental issues. Suitable for 14+ year olds.

WWF International website

www.panda.org/about_wwf/what_we_do/climate

Has comprehensive information on the causes and impacts of climate change, and the main polluters and solutions, including use of renewable energy sources, energy efficiency, what you can do, and climate change stories. Suitable for 11+ year olds.

WWF's PowerSwitch campaign

www.panda.org/campaign/powerswitch/index.cfm

Suitable for adults.

WWF-UK climate change

www.wwf.org.uk/researcher/issues/climatechange

Suitable for 14+ year olds.

WWF-UK's Climate Chaos campaign

www.wwf.org.uk/climatechaos/index.asp

Suitable for 11+ year olds.

Publications

Educational

Antarctica Royal Institution of Great Britain Christmas Lectures 2004. CD Rom.

An exciting, interactive CD for pupils on Antarctica. Packed with interesting and well-explained information, graphics, videos, activities, games and quizzes. Includes climate change, energy issues and the work of scientists in Antarctica. Suitable for 11–16 year olds. A free copy has been sent to the Head of Science of every secondary school. Also available for just £2.50 by writing to The Royal Institution of Great Britain, 21 Albemarle Street, London, W1S 4BS.

Climate Change Teachers' Resources

Lesson plans with good activities on climate change, transport and renewable energy, focusing on Scotland, 2004. Can be downloaded from Learning and Teaching Scotland at www.ltscotland.org.uk/climatechange/resources/lesson_plans.asp Suitable for 11-16 year olds.

Focus on Energy

Photopack with teachers' guide, 12 A4 colour photocards and an A2 poster. Looks at energy sources and energy-related issues, including climate change. Makes the local-global links. Suitable for use with 7-11 year olds. Available from WWF-UK – see back cover for address.

Nature Detectives: environmental science for primary children

Association for Science Education and the Woodland Trust, 2004. A book of practical environmental science activities for in the classroom and outdoors. Suitable for 4-11 years. A secondary book is in production.

Power Challenge

An extensive learning package, including a game. Association for Science Education, Hatfield, 1996. Suitable for 14-16 year olds.

Teaching Energy and Energy Efficiency Effectively

Colin Kruger, Mike Summers, Jenny Mant, Ann Childs, Jane McNicholl, Association for Science Education, Hatfield, 1998. Teacher education materials. Suitable for primary and secondary levels.

The Heat is Up and it's Raining

Education pack from Scottish Natural Heritage, 2004. Covers the effects of current climate changes across Scotland. Contains 15 lesson activities on climate change and energy, and a poster for use with the pack. Suitable for 14-18 year olds. Available as a download at www.snh.org.uk

Background information

Climate Change and Sustainable Development Prospects for Developing Countries

Anil Markandya and Kirsten Halsnaes, Earthscan, London, 2002.

Climate Change and the World Economy

Martin Parry, Earthscan, London, 2005.

Energy, Environment and Development

Jose Goldemberg, Earthscan, London, 1996.

Factor Four; Doubling Wealth, Halving Resource Use

Ernst von Weizsäcker, Amory B Lovins and L Hunter Lovins, Earthscan London, 1998. Covers energy efficiency.

Global Warming, The Complete Briefing

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The mission of WWF is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable resources is sustainable
- promoting the reduction of pollution and wasteful consumption

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