

The climate change film pack – Guidance for teachers



department for
children, schools and families

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1. Introduction - Using this guidance

In recent years climate change has become an issue of global significance. It has moved from being a subject covered in science magazines to one that is approached and discussed by governments, world leaders and the United Nations. It is recognised as one of the most significant challenges facing the world and international community today. However, many of the facts surrounding climate change and the evidence relating to the issues involved have been presented in ways that may be confusing or distracting. Climate change is in fact not one subject but a number of interwoven themes that together create an overall picture. Breaking down those themes and understanding and interpreting those facts can be confusing for all of us, especially young people. That is why this resource has sought to pull together some of the central arguments and apply them to the existing National Curriculum of science, geography and citizenship to encourage pupils to explore questions in a way that is familiar to them.

An Inconvenient Truth is a film that has had a big impact. Its aim is to make the science and the arguments about global warming and climate change and its effects accessible to all audiences. For that reason the film has a huge potential in schools. The film takes the audience through the themes with each one presented in its own segment. Holding the films segments together is Al Gore's narrative of his own journey in trying to come to terms with this information and then trying to get the rest of the world to do the same.

The two styles enable the audience to relate to the global facts and to the individual person, helping to introduce the questions 'What are the facts?' 'What does this mean to me?' 'What differences can I make?' 'Should I be doing anything?' - Questions with real significance to pupils.

This pack seeks to help teachers to engage pupils with those questions, discuss the facts and test the science. The film is divided into parts or scenes that can be applied to different parts of the curriculum. This pack intends to help Key Stage 3 teachers draw on their own expertise and use the film as a stimulus for teaching existing subject issues. The information presented here is not additional to current teaching activities instead it is intended to illustrate areas of existing programmes of study. The pack is not intended to be prescriptive, but to provide a resource that teachers will find useful, with or without modification. Parts of the film express political opinions and when showing those parts teachers should bear in mind the legal duties which apply to them, which are discussed below.

Throughout this guidance the film has been broken down into scenes, which match the scene selection on the DVD. Before using the scenes advised by any of the subjects it is advisable for teachers to watch the whole film to become familiar with the scene separations and the overall delivery style.

Teaching of climate change, alternative views and the need for balance.

Despite the growing scientific and political consensus around the causes of climate change, it is still a subject that arouses debate – particularly with regard to how the global community should respond to our changing environment. Under sections 406 & 407 of the Education Act 1996 teachers have a duty to give a balanced presentation of political issues and to avoid political indoctrination.

In light of this duty, it is important for teachers to make a clear distinction between the science of climate change and those areas which are debated in the political arena.

To this end, teachers may find it helpful to break down the issues into different strands:

- areas where there is undisputed scientific consensus, such as the clear evidence that global temperatures are rising.
- areas where there is a strong scientific consensus but where a small minority of scientists do not agree, for example the evidence that gas emissions from human activity are the main cause of climate change. When dealing with such issues teachers may wish to refer to alternative views but make it clear that they do not accord with the weight of scientific opinion.
- areas where there is political debate, such as how we should respond to climate change. When addressing these areas, teachers must take such steps as are reasonably practicable to ensure that pupils are offered a balanced presentation of opposing views. It is important that pupils are exposed to differing views on how we should respond to climate change and that they are encouraged to explore questions around how they as individuals and the wider world should react.

The law does not prevent teachers or schools from showing material which includes expressions of political opinion but it does require that when such material is shown, the opinion is presented in a balanced way. Climate change is a rich topic for young people to develop their analytical, investigative and critical skills. This guidance is designed to help teachers encourage their pupils to assess the validity and credibility of different information sources and explore different points of view to form their own opinions.

The Citizenship component

The citizenship opportunity with this film has been addressed in three ways:

- In each of the subject grids there is an additional column providing information as to how citizenship needs can be met discretely by science and geography teachers. That information can also help citizenship teachers with an arts background understand how the arguments may apply to other subjects.
- Topic debates - sections of the film have been selected that could be used to illustrate or introduce a short debate, taking about 15 to 20 minutes in total. Those segments can be used in tutor group time or using 2 or three together can help deliver a whole citizenship lesson.
- A structure for holding a whole day examining climate change that can be supported by the other subject areas and using other resources in addition to the 'An Inconvenient Truth' film.

Use of this film can help meet the current citizenship schemes of work in:

- Key Stage 3: Units 1, 5, 9, 10, 18 and 21
- Key Stage 4: units 5, 7, 8 and 12

Visit www.standards.dfes.gov.uk/schemes for the schemes listed above.

For non-specialist citizenship teachers: the questions that are raised are often as important as finding answers. Encouraging pupils to seek solutions or formulate responses is important.

There is also a section at the end of this pack looking at FAQs and links to further resources.

The climate change film pack is just one of the resources being produced as part of the DCSF Sustainable Schools Year of Action. Sustainable Schools offers a National Framework and supporting materials to help schools on their journey to embed sustainable development – not only across the curriculum but also through how the school operates (e.g. energy and water use) and its links with the wider community. To find out more about Sustainable Schools visit www.teachernet.gov.uk/sustainableschools.

2.1 An Inconvenient Truth - Scene links to the science curriculum

This grid sets out where scenes from the film can be applied to explore scientific enquiry and develop knowledge, understanding and skills and how that can be applied to the information and the facts surrounding climate change. Curriculum content is paraphrased for brevity. Some suggestions are made for questions which can be used to approach the topic in this context. The final column encourages the use of citizenship issues and techniques to be used whilst teaching aspects of this curriculum. This can enrich the science content.

	Scene Description	Key stages: curriculum links and learning outcomes			Citizenship links
		KS3	KS4	AS/A2	
3	Basic Science of Global Warming (1min)	Distinction between temperature and heat. Differences in temperature can lead to transfer of energy. Energy is transferred directly by radiation.	Energy transfer by radiation. The atmosphere – its composition and history.	Electromagnetic radiation and its transmission, scattering and absorption. Energy flows through eco systems.	
	Activities document references	See 2.2 – Teaching climate change in science - Energy transfer by radiation			
4	Global Warming Cartoon (2min)	The Sun as the ultimate source of most of the Earth's energy resources.			Discuss if cartoons can help to understand the science or do they distract from the message. Do they create a 'dumbing down' of the science? - This would help understand media representations of issues.
	Activities document references	See 2.2 – Teaching climate change in science - Energy transfer by radiation			
6	CO₂ Measure since 1958 (2min)	Elements combine through chemical reactions to form compounds (e.g. water, carbon dioxide). Possible effects of burning fossil fuels on the environment -ways in which energy can be usefully transferred and stored. That plants need carbon dioxide, water and light for photosynthesis, and produce biomass and oxygen.	Formation of fossil fuels Extraction and uses of crude oil New materials from raw materials by chemical reactions. Changes in surface and atmosphere of the Earth since formation. Photosynthesis	Dynamic equilibrium between living organisms and their environment.	Raise the question: Does the science help people understand the issue of climate change? How can we relate this information to our everyday lives? Ask them to provide examples.

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		To summarise photosynthesis in a word equation.			
7	<p>Glaciers Recede (2min)</p> <p>Note: Opportunity to explore the links between glacial recession and climate change – could the melting of glaciers in some parts of the world be down to other factors? Do global trends in glacial recession provide evidence to suggest the influence of climate change?</p>	<p>Particle models and change of state.</p> <p>The rock cycle</p> <p><i>What is happening to the particles in the glacier as it moves downhill? What has changed about this over the last 20 years? Why is this important?</i></p>	The rock cycle		<p>Draw out the discussion around the impact of glacial recession – where does the responsibility lie for making that information known?</p>
	Activities Document references	See 2.2 – Teaching climate change in science – States of matter			
8	<p>Ice Cores (2min)</p>	<p>Investigation</p> <p>States of matter</p> <p>Solubility</p> <p>How can ice cores tell scientists about:</p> <ul style="list-style-type: none"> • Carbon dioxide concentrations thousands of years ago • The temperature of the Earth thousands of years ago • Air pollution in the last 50 years <p><i>In what way is the ice like sedimentary rock?</i></p>	<p>Composition of the atmosphere</p> <p>Isotopes</p>	Isotopes	
	Activities Document	See 2.2 – Teaching climate change in science – States of matter			

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	references				
9	<p>CO₂ Levels Back 650,000 Years (4min)</p> <p>Note: 650,000 graph provides opportunity to explore relationship between CO₂ concentration and Earth's temperature (see page 13 of guidance)</p>		<p>Composition of the atmosphere</p> <p>Isotopes</p>	<p>Isotopes, half lives.</p>	<p>Ask the pupils what Gore means by 'moral and ethical', - who is responsible for those moral and ethical questions?</p> <p>What role do scientists have in tackling moral and ethical questions? Are scientists just there to present the evidence?</p> <p>Calculate their own contributions to rising CO₂ levels and then ask them to see if they can find ways to cut it. Is it possible to set targets in their own lives?</p>
	Activities Document references	See 2.2 – Teaching climate change in science - States of matter and Combustion of fossil fuels and Production of Carbon dioxide			
11	Rising Temperatures (2min)	Heat energy and temperature	Data analysis		<p>Are individual countries responsible for monitoring rising temperatures or should it be an international arrangement? Who should co-ordinate it? Who should be told about the evidence and how?</p>
	Activities Document references	See 2.2 – Teaching climate change in science - States of matter, Energy transfer by radiation and Animals & adaptation			
14	Precipitation and Evaporation (2min)	<p>Particle model of matter</p> <p>States of matter</p> <p><i>Would you expect higher temperatures to lead to more or less rainfall? – what experiences do you have to help make this prediction?</i></p>			<p>Gore points to areas of the world associated with problems of conflict such as Darfur. Raise the issue that like many conflicts one of the underlying factors in the Darfur conflict originates in a competition over resources (water, fertile land etc). What could be the long term consequences for peace around the globe if climate change continues and threatens natural resources?</p> <p>What should be the priority for</p>

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					scientists – finding the evidence or finding solutions?
	Activities Document references	See 2.2 – Teaching climate change in science - States of matter			
16	The Arctic (4min)	<p>States of matter</p> <p><i>What is happening to the ice that is floating?</i></p> <p><i>Why is this important? (reduces reflection of light, polar bear habitat)</i></p> <p><i>What is happening to the ice that is on land?</i></p> <p><i>Why is this important (including loss of permafrost and rising sea-levels)?</i></p>	Interdependence and adaptation	Hydrogen bonding and the structure of ice.	<p>To what extent is the impact on wildlife a scientific concern? Who are the people responsible for protecting and managing wildlife? Who has the power to make a difference? What are the different alternatives?</p> <p>Extra information can be found at www.wwf.org.uk/news/n_0000003769.asp and www.unep-wcmc.org.</p>
	Activities Document references	See 2.2 – Teaching climate change in science - States of matter			
17	The Ocean Conveyor (3min)	<p>Physical properties of matter – density, solutions.</p> <p><i>In what way do the oceans act like a domestic central heating system?</i></p>			<p>Draw out a discussion about using scientific models to predict future events – what can they contribute to peoples actions today?</p> <p>How might they be used to understand the international dimensions of climate change?</p>
	Activities Document references	See 2.2 – Teaching climate change in science - States of matter			
19	Troubling Signs (3min)	Adaptation – food webs etc.	<p>Interdependence and adaptation</p> <p>Human effects on environment can be measured using living and non-living indicators.</p>	Interdependence and adaptations	<p>What responsibility do humans have to the environment in which they live?</p> <p>What evidence of climate change on the environment can be found in our own communities? Who is responsible for researching this information and who should be responsible for reporting this information?</p>
	Activities Document	See 2.2 – Teaching climate change in science – Animals and adaptations			

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	references				
20	Antarctica (3min)	Satellite technology States of matter Food webs What is happening to the ice that is floating? What is happening to the ice that is on land? Why is this important (inc loss of permafrost and rising sea-levels)	Interdependence and adaptation		The information presented in this scene creates a paradox that can confuse people about climate change – discuss if this can cause people to try to ignore what is happening.
	Activities Document references	See 2.2 – Teaching climate change in science – Animals and adaptations			
21	Sea-Level Rise (4min) Note: Opportunity to explore potential size, timescales and impact of sea-level rise. What would cause the sea-level rise of 20 feet (the IPCC refers to a 7m rise) that Al Gore refers to and over what timescale could it happen? What are the rises predicted for this century? What impact are they likely to have on people and the environment?	Density Physical properties of materials (expansion).	Energy transfer by radiation (warming of seawater)	Hydrogen bonding	Global responsibility. What is the responsibility of the international community to those societies most affected by climate change? Should countries less affected by climate change make changes to help the others – who should organise those changes and what should they be? The information presented in this scene creates a paradox that could confuse people about climate change – discuss if that is why people have tried to ignore what is happening.
	Activities Document references	See 2.2 – Teaching climate change in science – States of matter			
22	China (2min)	Renewable and non-renewable energy sources.			Draw out a discussion on the pressures put on scientists to find alternatives to fossil fuels.

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	Activities Document references	See 2.2 – Teaching climate change in science – Energy transfer by radiation			
26	Is There a Controversy? (2min)	<p>Proposed 'how science works' approach.</p> <p><i>Who has observed the changes in climate? (a very open question as all of us have experienced the climate trends)</i></p> <p><i>Which scientists are researching climate change and who co-ordinates this research? Who is collecting data, how, where and why?</i></p>	<p>How Science Works</p> <p><i>Using the quote: "Repositioning Global warming as a theory rather than fact" – what is the scientific use of the word 'theory' and how is this different to everyday use of the word?</i></p>		<p>Where did the controversy come from?</p> <p>Using the quote: "Repositioning Global warming as a theory rather than fact"</p> <p>What are the implications for the science community from this statement?</p> <p>In March 2007 'The Great Global Warming Swindle' was shown on Channel 4. The impact of the programme provides a good opportunity to explore alternative views on climate change, the role of the media and reaction of the wider scientific community, visit www.greatglobalwarmingswindle.co.uk/.</p> <p>Alternative theories on the causes of climate change, such as those set out in the CH4 documentary, are not accepted by the vast majority of the scientific community. An analysis of these alternative theories is included on the Royal Society website, visit www.royalsoc.ac.uk/page.asp?id=6229&qclid=CNH6k_OPzIsCFQ3olAodd1UHAw.</p>
	Activities Document references	See 2.2 – Teaching climate change in science - Animals and adaptations			
27	Science Fraud (2min)	Investigative skills – fair test	Investigative skills , How Science Works	Use and interpretation of data (statistics)	Use the material from scene 26 above.
	Activities Document references	See 2.2 – Teaching climate change in science - Animals and adaptations			

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28	Balancing the Economy and Environment (2min)	Energy resources Renewable/non renewable energy.	Energy efficiency – economic and environmental costs.		Discuss what role does science have for building and supporting sustainable communities?
	Activities Document references	See 2.2 – Teaching climate change in science - Animals and adaptations			
30	The Solutions are in Our Hands (2min)	Energy efficiency Energy in action	Energy transfers can be measured and efficiency calculated – assessment of cost/benefit.	Nuclear power	What are the arguments around the use of alternative energy sources? Why are some people against some of the alternatives? Is there evidence for renewable energy being used in the community around you? Who should be responsible for introducing these initiatives?
	Activities Document references	See 2.2 – Teaching climate change in science - Animals and adaptations and Defra film 'My CO₂'			
31	Are We Capable of Doing Great Things? (2min)	Energy efficiency	Ozone layer initiatives Energy and energy efficiency		The ozone layer initiatives were a co-operation of science and mass popular support - what can this tell us for future initiatives?
		See 2.2 – Teaching climate change in science - Animals and adaptations and Defra film <i>My CO₂</i>			

Climate change: short films from Defra

This grid sets out how each Defra film links to key areas in the science curriculum and beyond. The films are available in the climate change film pack.

	Film Description	Key stages: curriculum links and learning outcomes		
		KS3	KS4	AS/A2
1. Tomorrow's Climate Today's Challenge (2 mins)	Gas emission sources	Renewable and non renewable energy. Fossil fuel formation and use	Electricity generation and transfer Rearrangement of atoms in chemical reactions.	Nuclear power
2. My CO₂ (2 mins)	Electricity use	Energy transfer	Generation of electricity	
3. Champions' Diaries (approx. 8 mins)	Young ambassadors			
4. Carbon Cycle animation (3 mins)	The Carbon cycle	Photosynthesis Respiration Combustion Fossil fuels	Photosynthesis Respiration Combustion Fossil fuels – combustions and use – including fractional distillation, cracking and polymerisation. Uses of gases (CO ₂)	Isotopes, organic chemistry.

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2.2 Teaching Climate Change in Science Key Stage 3

Purpose and key aspects of this unit

Teachers may want to use the film in short sections to support pupil investigations or to show longer sections prior to or after pupil investigations.

By completing these units pupils will have an overall learning objective of:

Evidence (including symptoms) → Science → Actions

Within this, a range of approaches and activities will be used to tackle the misconceptions which may be held by both teachers and pupils, to engage and involve pupils in their own contribution to investigating the issue and to develop the understanding of the links between personal actions and global effects.

Intended outcomes

Pupils will:

- Understand the science of global warming to help identify small changes and action to help solve the problem
 - Consider the impact of climate change on different communities and habitats
-

Evidence

The evidence includes both the scientific numerical data regarding temperature and CO₂ concentration, as illustrated in the film and symptoms of rising temperatures, rising sea-levels and effects on the lives of plants and animals. The obtaining, interpretation and questions raised by data and other observations is a theme that should run through many of the learning activities associated with 'An Inconvenient Truth' (AIT). Data and Evidence forms a key part of the KS4 programme of study (How science works) and these aspects are likely to form part of the revised KS3 programme of study (available September 2007).

The AIT film has aspects which cover all these areas of 'How science works' in the KS4 programme of study and could be used, as a whole, to illustrate the vocabulary and how the vocabulary can be misused. Misuse of the word 'theory' is an example. AIT refers to the move by some to reposition the global warming science as 'theory'. This takes advantage of the colloquial use of the word to mean little more than a guess. (In theory, a bus should be here soon). However the science use of the word 'theory' is for something that is backed up by a significant amount of evidence provided by scientifically obtained data (e.g. the 'theory' of evolution, relativity 'theory')

Key Resources

Web based resources

BBC www.bbc.co.uk/climate

Met Office www.metoffice.gov.uk/education

Royal Society of Chemistry www.rsc.org/networks/learnnet/climate.htm

Science UPD8 www.upd8.org teaching materials based on current issues

Science across the world www.scienceacross.org class linking programme with climate change resources

Curriculum links

Key Stage 3

1. States of Matter (solids, liquids and gases) and the particle theory of matter (Sc3 1a, 1b, 2a-c)
2. Combustion of fossil fuels and Production of Carbon dioxide (Sc3 1e, 1f, 2i)
3. Energy transfer by radiation (Sc4 5b, 5d, 5f)
4. Adaptation of animals and plants to their environment (Sc2 5a-e)

For **KS4 students**, viewing the film whilst trying to identify examples of data, evidence, phenomena, models and ideas would emphasise the scientific nature of the issue of global warming.

1. States of Matter

Learning objectives	Possible teaching activities	Links to An Inconvenient Truth
<p>Pupils should learn:</p> <ul style="list-style-type: none"> about materials and their properties – classifying and changing materials 	<p>Activities and Investigations based on behaviour of water in its three states (particle model prior learning and vocabulary of changes of state).</p> <p>Class investigations to answer the questions:</p> <p>Q1: What affects the rate at which ice melts? Activity could include the choice of independent variable (e.g. air temperature, water temperature if the ice is floating (or held in a strainer), number of pieces of ice (i.e. do two small ice cubes melt faster than one large ice cube?). The design of experiment would also include the choice of method of measuring the rate: periodic weighing, visual to end point, and the units (e.g. grammes/minute, volume of melt/minute)</p> <p>Q2: What does ice look like? Distribute ice blocks from freezer. Pupils examine ice through magnifying glasses. There will be bubbles of gas in the ice. Questions to answer/discuss - were there bubbles when the water was put into the freezer? What could a scientist find out from the bubbles about the place and time when the water was poured into the icemaker? (The first ice that forms is on the surface – thus any gas that comes out of solution as the lower levels cool and freeze is trapped in the body of the ice.)</p> <p>Q3. Does a `greenhouse` affect the speed at which ice melts? Place a block of ice in each of two beakers. One beaker with cling film over it. Place both beakers on black card (or ideally, metal) and position a hot lamp to shine on both so that the radiative heat applies equally to both. Does the cling film greenhouse protect the ice from melting or make it melt faster. Note, this is an adapted version of the `Greenhouse effect` demonstration in the Royal Society of Chemistry publication `Classic Demonstrations`. The published experiment uses CO₂ to create the greenhouse effect and if this could be done, then the investigation would be more analogous to the Earth.</p> <p>Q4. Is hot or cold water more dense? Slowly pour coloured very cold water into a beaker of colourless warm water – this can be done to show the difference in density and to show the effects described in AIT regarding the ocean conveyor. This can also be done with coloured `fresh` water on colourless brine.</p>	<p><u>Related scenes</u> Scene 07 Retreating Glaciers Scenes 16 and 20 Arctic and Antarctic ice melting Scene 16 Drunken trees Scene 16 and 20 The nature of the ice caps Scene 21 Rising sea-levels Scene 14 Evaporation and precipitation Scene 17 Ocean current conveyor belt Scene 8 Ice cores</p> <p><u>Activity</u> Scenes to illustrate The Scientific Process:</p> <p><u>Is the relationship between CO₂ concentration and the Earth's temperature one of cause and effect or one of coincidence?</u></p> <p>As preparation, look at a map of the world (as in Scene 2) - the previously stupid question of whether the continents fitted together. Wegener or Gore's classmate looked and saw the spatial relationship. Ask pupils what they think about the shapes of S America and Africa, or Australia and India. Then play scene 2.</p> <p>Questions for pupil investigation/learning to be answered by watching the relevant sections:</p> <ul style="list-style-type: none"> • Between which two variables is there claimed to be a relationship? • How do ice cores enable us to investigate this relationship over long periods of time? • The two graphs (CO₂ and temperature) follow the same pattern. What does this tell us and what does it not tell us? • What other knowledge and creative thought helps us make more sense of the relationship (knowing that fuel burning started to increase greatly through the industrial revolution, the use of electricity, and greater use of transport and knowing that the current rates of increase are greater than historical data). • Who has collected data such as historical temperature recordings, ice core data, numbers of extreme weather events, CO₂ concentration, phenological data. How has it all been collected? • How can links be made between data sets such as the geological historical data for CO₂ concentration and temperature for the Earth. (By plotting both against time) • How is this relationship explained by the model of the `greenhouse` gases and their effect on radiation of heat from the Earth into space.

2. Combustion of fossil fuels and Production of Carbon dioxide

Learning objectives	Possible teaching activities	Links to An Inconvenient Truth
<p>Pupils should learn:</p> <ul style="list-style-type: none"> about the possible effects of burning fossil fuels on the environment and how these effects can be minimised 	<p>Many schools have a carbon dioxide monitor used in upper school investigations of carbon dioxide and photosynthesis. Lower school identification of carbon dioxide is normally a qualitative technique of bubbling gas through limewater. If a school does have a CO₂ detector, then study of climate change/global warming will greatly increase their benefit from the equipment.</p> <p>If the school has a carbon dioxide detector as part of its data logging equipment – install it with the measurement graph projected on board. Close all the doors and windows and:</p> <ul style="list-style-type: none"> explain the units (either % or parts per million) and what that means. It is possible to compare the figures with those on the graph in AIT (probably between 3000 – 4000 parts per million) Explain that the detector is measuring a gas called carbon dioxide that is colourless and odourless. Ask for predictions and reasons for what will happen to the reading shown. If possible, allow pupils to predict by drawing on the board. Leave the monitor running. After a length of time to establish a trend, say that you will light some Bunsen burners and again ask for predictions. <p>The trend shown will be steadily, but slowly upwards with a class in a room. The questions to ask are:</p> <ul style="list-style-type: none"> What is it that is changing in the room? What other gas might be changing in concentration? (oxygen, water vapour) Why can't we see that change? Where is the gas coming from? (can introduce or remind of the word equation for respiration) What would stop the concentration of the gas increasing? – If the suggestion is to open the windows, the next question is why is the concentration lower outside? (this can lead to discussion of the balance between photosynthesis and respiration in the natural ecosystem) – and that if there were enough green plants in the classroom, then the concentration wouldn't increase Turning on the Bunsen burners will increase the rate of increase of carbon dioxide. The word equation for burning fuel can be introduced. If the classroom had had enough green plants to balance the breathing, what would now be happening? (extra CO₂ from burning fuel would exceed the capacity of the green plants to remove it by photosynthesis) <p>Traditional activities:</p> <ul style="list-style-type: none"> Breathing out through limewater and drawing gases from a burning candle through limewater to illustrate that both contain carbon dioxide. 	<p>Related scenes Scenes 5 and 6 Rising trend of CO₂ concentration Scene 22 Rising use of fossil fuel in China Scene 24 Impact of rising population on the environment (food, deforestation)</p> <p>Carbon dioxide is discussed in terms of its increasing concentration in the atmosphere and its contribution to enhanced global warming. There is not, though, an explanation of its provenance from the burning of fossil fuels to provide energy. These links are implied and taken as read. For schools, there would need to be prior learning regarding energy resources and fossil fuels.</p> <p><u>Activity</u> Scenes to illustrate The Scientific Method:</p> <p>Watch sections on Professor Revelle and the graph scenes 6 and 9. The following questions can be the focus.</p> <ul style="list-style-type: none"> What did Revelle decide to measure? Where did he do the measurements, and why? How long did he do his measurements for? Why is the graph a sawtooth shape? (stop the film at this point). This is an opportunity for pupils to think creatively to see if they can put forward ideas. Prompts such as 'What process reduces carbon dioxide concentrations? When does this happen most?' could be used. Why is the general trend of the graph going up? – Again, pupils could give their own ideas. Is CO₂ the cause of rising temperatures or is rising CO₂ caused by rising temperatures. Sceptics say we don't know – what is the explanation in AIT? <p>Watch the Defra film 'My CO₂'. What is the connection between electricity use and carbon dioxide emissions?</p>

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	<ul style="list-style-type: none">• If CO₂ detector is available, use it in a container of green plants in a place exposed to sunlight in the daytime. Log data over 24 hours. This would help to explain the zig-zag graph shape shown on AIT. • Other uses of carbon dioxide (to illustrate that it is not a toxic pollutant)<ul style="list-style-type: none">○ fire extinguishers (why would this be?)○ fizzy drinks○ dry ice • The carbon cycle: use of and learning of diagram and explanation of why it is no longer an equilibrium.	
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3. Energy transfer by radiation

Learning objectives	Possible teaching activities	Links to An Inconvenient Truth
<p>Pupils should learn:</p> <ul style="list-style-type: none"> • About the Sun as the ultimate source of most of the Earth's energy resources • The distinction between temperature and heat • How energy is transferred 	<p>Prior learning would include photosynthesis – how sunlight energy is used by plants to convert carbon dioxide and water into food (word equation and traditional practical activity of measuring starch in leaves which have had part of the surface covered)</p> <p>If the school has an Infrared (IR) detector, a demonstration would show that `cooler' objects such as the human hand do radiate detectable levels of IR, but that these waves are easily blocked by a transparent material (such as Perspex/glass) – the analogy is that the greenhouse gases behave in a similar way, inhibiting the transmission of IR. However the Perspex is clearly transmitting visible light (as do greenhouse gases) – and also shorter wave radiation from much hotter objects (a heat emitting filament light bulb for example)</p> <p><u>Traditional Activities</u></p> <p>Formation of fossil fuels (animations, Esso video (Harry the Hydrocarbon), book diagrams, rock cycle diagrams)</p> <ul style="list-style-type: none"> • Backwards timeline – show a Bunsen burner alight. Track a carbon atom back to when it was previously carbon dioxide. Where did the energy we are now using come from? • Diagrams, videos etc on the electromagnetic spectrum. • Diagrams on the effect of colour on absorption or reflection of heat. • Royal Society of Chemistry Classic Demonstrations book – demonstration of trapping of infrared radiation by carbon dioxide. • Use of diagram to show the way the Earth radiates heat into space. 	<p><u>Related scenes</u> Scenes 3 and 4 Science of global warming (including Simpson's style cartoon) Scene 16 Animation of vicious circle of melting, floating ice - less ice/snow to reflect radiation – more liquid water surface to absorb energy which heats the ice more scene 11 Relationship of temperature with energy (including heat waves, tornadoes and hurricanes)</p> <p>The overall question is `how do the different properties of parts of the electromagnetic spectrum (EMS) affect global warming, and how does our understanding of the EMS help us to explain why the Earth is getting warmer. The sections of AIT detailed above give animations and explanations and will be more readily understood after the learning activities.</p> <p><u>Activity</u> Illustrating The Scientific Process:</p> <p>The causes, effects and future of global warming derive from a combination of scientific explanations and models. Watching the DVD, pupils could identify and summarise these in their own words:</p> <ul style="list-style-type: none"> • Energy transmission to the Earth from the Sun. • The reason that the Earth is warm enough to support life. • The reason that less heat is escaping from the Earth than previously. • The reasons that the CO₂ concentration is increasing. • Where the carbon has come from. • What processes reduce carbon dioxide and how this explains the saw tooth graph. • The means by which heat is transferred to the poles from the equator. • The reasons for more floods and droughts. • The reasons for rising sea-levels. • The reasons that reduced ice cover increases the rate of energy absorption of the Earth.

4. Animals and adaptations

Learning objectives	Possible teaching activities	Links to An Inconvenient Truth
<p>Pupils should learn:</p> <ul style="list-style-type: none"> • about how living things and the environment can be protected • the interdependence of habitats • food webs and food chains 	<ul style="list-style-type: none"> • Whilst watching the scenes detailed in the next column, pupils can classify the cases into two: animals or organisms that may benefit from global warming and those that will be threatened. • As part of learning about food webs pupils can predict and justify how a series of standard food webs may be affected by global warming. Pupils could also start with one of the scenarios and research how it might affect the food webs. For example the migratory birds missing the caterpillars will affect the survival rate of the caterpillars and, presumably, the amount of foliage they eat. The lower survival rate of the hatchlings will affect the survival rate of other insects they eat in later life and also reduce the food supply for their predators. Another question is – is the threatening of polar bears good news for sea lions? • Pupils choose animals or plants that may be affected by global warming – either directly or through changes to the habitat and the food web of which they are a part. Possible examples are: <ul style="list-style-type: none"> ○ blue whales ○ penguins ○ hedgehogs ○ marine and river life – greater flow variation, algal blooms ○ plants which are more or less adapted to hot dry/ flooded conditions ○ insects such as mosquitoes? • Research into the impact of climate change on the (micro) organisms that cause disease in humans and on the risk to humans. Examples are: <ul style="list-style-type: none"> ○ Malaria – impact on the range of area habitable by mosquitoes ○ Water borne disease: impact from water temperature, unpredictable supply, floods/heavy rain and drought. ○ Ability of humans to keep food fresh • Phenology has played a part in the identification of the impacts of global warming. There are examples and news reports of these – e.g. spring flowers appearing earlier, hedgehogs not hibernating, longer growing season for lawns. Nature Detectives has a project in which pupils can contribute to research by finding and sending in data on seasonal events and phenomena where they live. www.naturedetectives.org.uk 	<p><u>Related scenes</u></p> <p>Scene 19:</p> <ul style="list-style-type: none"> • Interruption of food chain – migratory birds and caterpillars • Pine beetles in USA • Mosquitoes surviving at higher altitudes including in cities originally built at altitudes too cold for mosquitoes • Coral reef • Other ‘problem’ species spreading (including vector for infectious diseases) • Emergence or re-emergence of pathogenic micro-organisms <p>Scene 16:</p> <ul style="list-style-type: none"> • Polar bear: animation • Drunken trees

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3.1 An Inconvenient Truth - Scene links to the geography curriculum

This grid sets out where An Inconvenient Truth can be applied to explore issues raised throughout the geography curriculum and how those can be applied to the facts surrounding climate change. The final column encourages the use of citizenship issues and techniques to be used whilst teaching aspects of this curriculum. This can enrich the geography content.

	Scene Description	Key stages: curriculum links and learning outcomes			Citizenship links
		KS3	KS4	AS/A2	
3	Basic Science of Global Warming (1min)	<p>This scene introduces the key processes of light absorption and re-radiation of heat in a way that is appropriate for both KS3 & KS4 learners studying weather or climate change (teachers may need to provide learners with some additional detail of how light energy is actually converted into heat). In particular, the scene could support teaching of:</p> <ul style="list-style-type: none"> KS3 Unit 10: weather over Western Europe & KS3 Unit 14: can the earth cope? GCSE courses (e.g. OCR B: causes of the greenhouse effect) 		<p>Scene 3 can help to remind students about the basic mechanism of atmospheric warming as part of an AS/A2 meteorology unit. However, they will need to supplement this with additional information e.g. the idea of carbon dioxide equivalent gases [CO₂ gases include methane and water vapour].</p>	
		<p>Still images can be paused for classes to take notes at time-code 0:08:50 and 0:08:57.</p> <p>This scene may be best played alongside the first short Defra film- <i>Tomorrow's Climate Today's Challenge</i> to help pupils visualise the multiple sources of carbon emissions.</p>			
4	Global Warming Cartoon (2min)	<p>This Simpson's-style cartoon provides a humorous take on the serious business of climate change (shown here as global warming) which may help some KS3&4 learners grasp the concept for the first time. A still image can be paused for classes at time-code 0:10:35.</p>			<p>Discuss if cartoons can help to understand the science or do they distract from the message. Do they create a 'dumbing down' of the facts? - This would help understand media representations of issues.</p>
5 6	Professor Revelle (2 min) CO ₂ Measure since 1958 (2min)	<p>Scene 5 shows how evidence for rising CO₂ has been collected. Scene 6 shows the rising trend (with seasonal fluctuations) in CO₂ levels. Al Gore tells his life-story as CO₂ levels rise behind him.</p>	<p>GCSE courses tend to focus on the causes and impacts of climate change and do not require any depth of knowledge about the evidence for climate change or its sources. However, these scenes provide useful background</p>	<p>These two scenes could be integrated into a geographical skills lesson for AS students. They provide an opportunity for pupils to practice their descriptive writing.</p>	<p>Ask pupils to investigate when information about climate change became available. They may want to start an exercise asking their own families or members of the communities in which they live in when they first heard</p>

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		Pupils may ask: what were my parents and grandparents doing during this time? Did they know that this was happening? When did the UK government start to take notice?	information for students, especially those following a specification with climate change included as a sub-unit for study (e.g. AQA B).	Scene 6 describes fluctuations occurring around a mean value that is steadily increasing over time – a trend which some students may initially struggle to articulate clearly. The scene is best paused for analysis and discussion at time-code 0:15:36.	about the issues and what they actually know about them. They could create their own graph of when the public began to take interest and measure that against Government statements. Use the Met Office (www.metoffice.gov.uk) and the Defra (www.climatechallenge.gov.uk) websites for information.
7	Glaciers Recede (2min) Note: Opportunity to explore the links between glacial recession and climate change – could the melting of glaciers in some parts of the world be down to other factors? Do global trends in glacial recession provide evidence to suggest the influence of climate change?	Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially (total duration: 24-minutes) to provide pupils with an overview of the main observed and predicted impacts of climate change. This could be delivered as a stand-alone lesson or integrated into an existing QCA scheme of work such as Unit 14: Can the earth cope?	Some GCSE courses (e.g. Edexcel A) give a small amount of coverage to glacial systems and the A Level guidance notes for this scene can be adapted by teachers as appropriate.	This scene is useful for pupils studying how glacial systems operate over longer time-scales. Long-term excess of ablation over accumulation is shown to be resulting in a significant retreat of glacier snouts in a variety of contexts. Pause at 0:16:29 for pupils to sketch the retreat of the Columbia glacier. A strong synoptic link can be made here, referencing future water shortages in SE Asia as glacial melt-waters diminish (glacier AX010 in Nepal is shown here).	Either using this as a single scene or by joining the scenes together start to draw out the following questions as parts of the discussion: “What responsibility do we as a nation have to the other countries severely affected by climate change?” “What responsibility do we as individuals have to the individuals in those countries severely affected by climate change?” About the disappearance of glaciers – ask the pupils how many of them have seen or been to a glacier for themselves – draw their attention to the fact that they are not likely to have the opportunity.
		Still images can be paused for classes at time-code 0:15:54 or 0:16:06 or 0:17:33. Show the class Defra’s ‘Climate Champions’ film at www.climatechallenge.gov.uk/multimedia/film1.html (relates to the Gurschen glacier). The third short Defra film Champions’ Diaries shows the retreat of the Gurschen glacier over time. The champions stand on recently-exposed deposits that correspond with the year of their births.			
8	Ice Cores (2min)		Some GCSE courses (e.g. Edexcel A) give a small amount of coverage to glacial systems and the A Level guidance notes for this scene can be adapted by teachers as	Vital evidence is provided for past glacial movements. The precise detail that ice cores can provide is nicely illustrated by a reference to the US Clean Air Act	

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			appropriate.	at time-code 0:18:36.	
9	CO ₂ Levels Back 650,000 Years (4min)	<p>This scene outlines the crucial link between CO₂ and temperature. It could be used to support teaching of climate change directly, stressing as it does the moral and ethical dimensions of the issue (mentioned at the end of the scene).</p> <p>It could also be used as a lead-in exercise to support enquiry skills teaching. From 2008, the revised KS3 programme of study requires that pupils should be able to identify and detect bias when investigating issues. Some pupils may be aware that there has been some controversy over the linkage between temperature rises and CO₂ levels. It may be possible to discuss this issue directly, especially with gifted and talented pupils.</p> <p>Pupils can calculate their own contribution to rising CO₂ levels by visiting www.carbondetectives.org.uk or www.esd.rgs.org. A wealth of additional graphics can be accessed at www.vitalgraphics.net/documents/climate_change_update.v15.pdf.</p> <p>The third short Defra film, the <i>Carbon Cycle</i> animation may additionally help pupils understand why carbon levels can change over varying time-scales.</p>		<p>This scene could be integrated into a geographical skills lesson for AS pupils. There are plenty of opportunities for describing and comparing the two trend-lines shown. Teachers may find it useful to freeze-frame at time-code 0:21:21.</p>	<p>Ask the pupils what Gore means by 'moral and ethical', - who is responsible for those moral and ethical questions?</p> <p>Calculate their own contributions to rising CO₂ levels and then ask them to see if they can find ways to cut it. – Is it possible to set targets in their own lives?</p>
11	Rising Temperatures (2min)	Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially (total duration: 24-minutes) to provide KS3 learners with an overview of the main observed and predicted impacts of climate change.	<p>This scene supports AS/A2 and some GCSE teaching of climate modules. In particular it can nurture descriptive skills for this topic.</p> <ul style="list-style-type: none"> • Freeze-frame at time-code 0:27:12 and ask pupils to describe the pattern of temperature changes shown. • Freeze-frame at time-code 0:27:38 and ask pupils to describe and explain what the “temperature anomaly” map actually shows. 		
12	Hurricanes (4min)	<p>Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially (total duration: 24-minutes) to provide pupils with an overview of the main observed and predicted impacts of climate change.</p> <p>The scene ends with references to the 1930s that may need explaining to some learners.</p>	<p>This scene supports GCSE teaching of hurricanes (or tropical cyclones). At this level, students will be able to establish the possible link between warming waters and increasing hurricane frequency and severity (“look at that hurricane’s eye!”). Pupils should discuss whether individual events such as Hurricane Katrina provide reliable evidence of climate</p>	<p>This scene supports AS/A2 teaching of climate modules and natural hazards. It provides evidence for warmer temperatures resulting in stronger hurricanes. The human causes of increasing risk are also shown (the presence of oil rigs).</p>	<p>Ask pupils to find evidence of extreme weather conditions in their own areas, and across the UK.</p>

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			change. Do global patterns of extreme weather events provide evidence for climate change?		
		Still images can be paused for classes at time-codes 0:29:27 or 0:30:30. Download useful hurricane images for overhead projection from www.geographyinthenews.rgs.org/news/article/?id=450 . Free resources that relate to hurricanes, weather and climate can be ordered from www.metoffice.gov.uk/education/resources/index.html .			
14	Precipitation and Evaporation (2min)	<p>Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially (total duration: 24-minutes) to provide pupils with an overview of the main observed and predicted impacts of climate change.</p> <p>It may be difficult for some pupils to fully grasp the complexities of this particular scene and teachers may need to provide some support.</p>	The A Level guidance notes for the hydrological cycle can be adopted for some GCSE courses and students, where appropriate.	<p>This scene highlights the complexity of climate change and supports AS/A2 studies in several ways:</p> <ul style="list-style-type: none"> • supports teaching of hydrological cycle (Horton overland flow resulting for extreme storm events) • nurtures critical thinking about systems: why might warmer conditions also be wetter? • allows A2 synoptic links to be drawn between changing rainfall patterns and vanishing lakes. 	<p>Gore points to areas of the world associated with problems of conflict such as Darfur.</p> <p>Raise the issue that like many conflicts one of the underlying factors to the Darfur conflict originates in a competition over resources (water, fertile land etc).</p> <p>What could be the long term consequences for peace around the globe if climate change continues and threatens natural resources?</p>
		Future scenarios for UK climate can be examined at www.ukcip.org.uk/climate_change/uk_future.asp .			
16	The Arctic (4min)	<p>Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially (total duration: 24-minutes) to provide pupils with an overview of the main observed and predicted impacts of climate change.</p> <p>The polar bear animation will most likely be a strong focal point for discussion amongst this age group, generating questions about our environmental responsibilities.</p> <p>It may be difficult for some pupils to fully grasp some of the</p>		<p>This scene supports A2 teaching of:</p> <ul style="list-style-type: none"> • periglacial landscapes and permafrost degradation (freeze-frame at 0:40:58) • wilderness environments (Alaska) • synoptic links include "Tundra Travel Days" (freeze-frame at 0:41:31) • meteorology (albedo is explained) 	<p>The impact on the lives of animals will be important to many of the pupils– use this to explore the issues of how decisions to protect and safeguard wildlife are made. Who has the power to make a difference? What are the alternatives?</p> <p>Additional information can be found at www.wwf.org.uk/news/n_0000003769.asp and www.unep-wcmc.org.</p>

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		complexities of this particular scene (permafrost and positive feedback are mentioned). Teachers may need to provide additional support.		The second half of the scene describes an interesting source of quantitative data (ice thickness readings from submarines). Positive feedback is discussed in the context of melting ice.	
17	The Ocean Conveyor (3min)			This scene supports AS/A2 teaching of climate modules. Freeze-frame at time-code 0:44:16 to support teaching of planetary air movement and ocean circulation The explanation of the ocean conveyor is useful for the teaching of system theory and synoptic geography (the significance it holds for settlement in Europe)	
19	Troubling Signs (3min)	Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially (total duration: 24-minutes) to provide pupils with an overview of the main observed and predicted impacts of climate change. This scene could also be used to support QCA scheme of work unit 23 (Section 3): What is a national park? Pupils could ask: what will happen if rare species migrate away from nature reserves as a result of climate change?	This scene supports the teaching of ecosystems and food webs at GCSE (e.g. OCR B). Students could debate what further impacts on the food web could follow on from the impacts described by Al Gore. The A Level guidance notes may be also appropriate for some GCSE courses where some knowledge of biome distribution is required.	This scene supports AS/A2 teaching of biodiversity. Knowledge and understanding of this topic can be extended by considering how the range of species could be shifting and how the distribution pattern of global biomes and soils could become modified as a result of climate change. Links can also be made with the teaching of geographies of disease for health and welfare (Edexcel B).	Refer to the points in scene 16 above. Then ask pupils to reflect on the differences it will make to their own lives to lose wildlife and also the countryside they are familiar with. Ask them to create a chart of the animals that are most threatened and possible solutions to save them.
		Resources for all key stages (including A Level) exploring these kinds of changes in more detail can be found at www.yourclimateyourlife.org.uk (available from July 2007) linking climate change to the geography curriculum.			
20	Antarctica (3min)	Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially	Some GCSE courses (e.g. Edexcel A) give a small amount of coverage	Students of A2 glaciation (e.g. OCR A) will benefit from this	The information presented in this scene creates a paradox that can

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		<p>(total duration: 24-minutes) to provide pupils with an overview of the main observed and predicted impacts of climate change.</p> <p>This scene also directly supports teaching of KS3 Unit 23 (Section 4): Why is Antarctica a fragile environment?</p>	<p>to glacial systems and A Level guidance notes for this scene can be adapted by teachers as appropriate.</p>	<p>scene, which describes how a collapse of the Antarctic ice shelf would actually lead to an advance of land-based glaciers. No longer impounded behind the ice shelf, they would surge forwards (thus there is another potential “paradox” of climate change to be explained).</p> <p>A good case study is also provided later in scene 21 of ablation mechanisms in Greenland. Freeze-frame at 0:56:04 for a diagram of moulins for students to copy.</p>	<p>confuse people about climate change – discuss if this can cause people to try to ignore what is happening.</p> <p>A general discussion on the importance of Antarctica would also benefit citizenship as long as the issues of who is responsible for actions is included.</p>
		<p>Still images can be paused for classes at time-codes 0:52:18 or 0:52:42. There are many interactive exercises for KS3 pupils at the Royal Geographical Society’s Antarctica website www.discoveringantarctica.org.uk.</p>			
21	<p>Sea Level Rise (4min)</p> <p>Note: Opportunity to explore potential size, timescales and impact of sea-level rise. What would cause the sea-level rise of 20 feet (the IPCC refers to a 7m rise) that Al Gore refers to and over what timescale could it happen? What are the rises predicted for this century? What impact are they likely to have on people and the environment?</p>	<p>Scenes 7, 11, 12, 14, 16, 19, 20 and 21 can be played sequentially (total duration: 24 minutes) to provide pupils with an overview of the main observed and predicted impacts of climate change.</p>	<p>This scene supports teaching of settlement changes and migration at GCSE and AS level. Impacts are shown in a variety of settings and students can write an account of how such changes will modify settlement patterns and trigger refugee movements. However, teacher guidance will be needed - especially at GCSE – in relation to the time-scale these impacts will be experienced over. Changes will not be instantaneous, as the images might suggest. Students should think about how long it will take for sea level rises to be experienced and whether any fatalities are actually likely to occur.</p> <p>Several GCSE courses also require that students can write about the impact of global warming on one region/country e.g. coastal flooding in Bangladesh as a result of the rise in sea-level affecting low lying areas (60m people are at risk).</p>		<p>The images from this section include the everyday impact on ordinary people’s lives.</p> <p>Raise a discussion about global responsibility towards individuals. Pose the question: ‘Is the priority to slow climate change or to create international systems to help those most affected by it?’</p>
		<p>Download useful images for overhead projection from http://maps.grida.no/go/graphic/causes_of_sea_level_rise_from_climate_change.</p>			

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22	China (2min)		<p>Scenes 22-24 can be shown as a part of a population and resources unit:</p> <ul style="list-style-type: none"> • Scene 22 asks if population pressure can be alleviated through technological solutions (echoing the Boserup thesis). • In scene 23, a striking image of the border between Haiti and Dominican Republic (freeze-frame at 1:02:07) highlights differences between nations in terms of resource governance. • Scene 24 describes the dual role that technology plays in creating new problems while also solving them • Scene 24 suggests that the Boserup thesis (“necessity is the mother of invention”) could be flawed if, like the frog, we do not recognise necessity. 	
23	Population Explosion (2min)			
24	Old habits and new technology (2min)	<p>Scene 24 asks: who is to blame? Where does the responsibility lie for tackling the environmental problems shown in this scene? The sequence featuring an animated frog is a helpful image to get pupils thinking about how risk can be identified. This scene could be helpful for both KS3 & KS4 in a variety of contexts.</p> <p>Some GCSE courses (e.g. Edexcel B) require that students recognise ways in which attitudes of individuals and organisations influence the measures they might take (not everyone believes action is necessary). This scene ends in a way which might help learners understand why some countries have been slow to respond to the threat of climate change.</p> <p>The second Defra short film <i>My CO₂</i> could be shown alongside these scenes. The film looks at the consumption of electricity.</p>		<p>Ask pupils to identify who they think should be taking the lead to tackle climate change. What are the different options available for change?</p>
		<p>Still images can be paused for classes to discuss at time-code 1:04:49 and 1:05:12. Pupils can calculate their own contribution to rising CO₂ levels at www.carbondetectives.org.uk or www.esd.rgs.org.</p>		
26	Is There a Controversy? (2min)	<p>Scenes 18, 26 & 27 can be shown sequentially as part of a lesson dealing with the uncertainties that surround climate change.</p>	<p>This scene could be employed as part of a geographical skills lesson that looks at how data is presented and manipulated. The idea of a paradigm in science (or social science) could be introduced by teachers. Parallels can be drawn with the uncertainties surrounding plate tectonic theory.</p>	<p>Using the quote “Repositioning Global warming as a theory rather than fact” Discuss: why people would seek to do this; what have been the consequences of this practice; what role do specialists play in this?</p> <p>In March 2007 ‘The Great Global Warming Swindle’ was shown on Channel 4. The impact of the programme provides a good opportunity to explore alternative</p>
27	Science Fraud (2min)	<p>These key scenes deal with the controversy surrounding reporting of the facts about climate change. Although this may be a difficult theme for some KS3 pupils, the revised KS3 programme of study requires that pupils are able to recognise bias in data analysis and these scenes provide excellent support by comparing scientific and media reporting. The same themes are equally important for GCSE students also.</p>		

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				<p>views on climate change, the role of the media and reaction of the wider scientific community. Visit www.greatglobalwarmingswindle.co.uk.</p> <p>Alternative theories on the causes of climate change, such as those set out in the CH4 documentary, are not accepted by the vast majority of the scientific community. An analysis of these alternative theories is included on the Royal Society website:; visit www.royalsoc.ac.uk/page.asp?id=6229&gclid=CNH6k_OPzIsCFQ3olAodd1UHAw.</p>
		<p>Clarification of the situation for teachers who want to know more about these issues can be sought from the Hadley Centre at www.metoffice.gov.uk/research/hadleycentre/index.html. They also gives access to key recent official documents relating to climate change (<i>IPCC report (2007)</i>, <i>Stern Review (2006)</i>)</p>		
28	Balancing the Economy and Environment (2min)	<p>This scene introduces the basic challenge of sustainable economic development. With an amusing delivery that will engage younger pupils, Al Gore shows that it is a “false choice.” Pupils could be asked to provide examples of compromise solutions they have heard of that might “save the planet” while also remaining profitable (e.g. biofuels, local produce, renewable energy sources, etc.)</p> <p>GCSE courses require that students recognise that damage to the physical environment may be a side-effect of the creation of wealth and job opportunities. Some boards (e.g. AQA B) may ask them to develop an understanding of stewardship of the environment, which can be seen in this context as an attempt to overcome a “false choice”. GCSE students should remain aware that even if they choose to believe that climate change is not really happening, they still need to consider how our planet’s resources can be used more equitably (exploitation versus conservation and stewardship).</p>		<p>Explore issues surrounding sustainable economies – how does that relate to their own lives.</p> <p>Ask pupils to discuss what is meant by consumption – what is their own personal consumption. Do they live in a sustainable way? Who is most responsible for creating sustainable communities?</p>
30	The Solutions are in Our Hands (2min)	<p>These scenes deal with ethical and moral geographies, important for the delivery of citizenship through geography at all key stages. They can trigger a discussion of how we can best manage the environment in a</p>	<p>These scenes could be used as part of a plenary session for A2 students who have a synoptic</p>	<p>Whilst addressing the ethical and moral issues – ask the question ‘Are we living in and supporting</p>

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31	<p>Are We Capable of Doing Great Things? (2min)</p>	<p>more sustainable way.</p> <ul style="list-style-type: none"> At KS3, these scenes support Unit 16 (Section 3): What is development? Here, pupils explore the idea of sustainable development and recognise its implications for people, places and environments and for their own lives. At GCSE, some boards require students to look at strategies to address the effects of global warming. (e.g. OCR A looks at the challenges of global interdependence and responsibility, including sustainable development and Local Agenda 21). <p>Teachers may need to prepare an explanation of ozone depletion for pupils (the role that CFCs played in the destruction of stratospheric ozone and the impact this had on ultra-violet penetration – and our global success in tackling this).</p>	<p>paper or decision-making exercise to sit. Themes include:</p> <ul style="list-style-type: none"> the idea of stabilization wedges (scene 30), where a variety of solutions are shown to bridge the gap between high-level and low-level emissions the memorable quote that “political will is a renewable resource” which highlights the possibility of improved environmental governance references to the Kyoto Protocol recognition that there are different scales of environmental management that exist (state and federal in the US) <p>lessons learned in tackling ozone depletion (a “success story”)</p>	<p>fair treatment in our local, regional and global communities?’ Discuss what is meant by: “political will is a renewable resource” - How can that be applied, local, regionally, nationally and globally?</p>
		<p>Useful websites that deal with solutions include www.teachernet.gov.uk/sustainableschools/yearofaction (what your school can do), the film’s official website www.climatecrisis.net or coinet.org.uk.</p>		
32	<p>Our Only Home & Action Points (in credits) (6min)</p>	<p>The final scene broadcasts a number of suggestions for action, starting at time-code 1-25-56 and ending at 1:29:20. For pupils at all key stages, it can be used as a starter for discussion of the critical question: what can I do?</p> <p>At KS3 we might expect pupils to describe a list of actions. By A Level, we would want them to recognise strengths and weaknesses of the proposed solutions. For instance, biofuels are a controversial method for overall reduction of CO₂ emissions.</p> <p>An excellent summary of the film produced by Australian Teachers of Media is available at www.aninconvenienttruth.com.au/truth/guide.htm. Also helpful is the Sustainable Schools Carbon Detectives’ Kit (register from April 2007) www.carbondetectives.org.uk.</p>		<p>This is an opportunity to start discussing solutions to the issues raised – are there solutions that individuals can take part in?</p>

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3.2 Teaching Climate Change in Geography Key Stage 3

Purpose and key aspects of this unit

This is primarily a geography sub-unit of work. The purpose of it is to explore how climate change will impact upon a range of different issues and environments. In addition, it will foster an understanding of (i) the interconnectedness of different environments and societies and (ii) the concept of interdependence.

In recent years, climate change has become the leading environmental concern for both the public and for policy-makers. However, the nature of most of the issues that are described as impacts of climate change – be it collapsing ice sheets, hurricanes or disappearing coral reefs – may leave some pupils wondering “what’s this got to do with me?”

This sub-unit – which can either be appended to existing QCA schemes of work or can form the nucleus for a new KS3 unit for teaching in schools from September 2008 - looks at how some of the impacts described in “An Inconvenient Truth” have very serious implications for every town and school in the UK.

Intended outcomes

By the end of this unit pupils will:

- understand the importance of climate change
- have described its main current and predicted impacts
- be able to identify areas of the world and parts of the environment that are especially at risk from climate change and sea-level rise
- be able to identify some of the impacts that these changes will have on people living in the UK
- understand the disadvantages of not acting quickly to slow down the rate of climate change as much as possible
- have developed their own opinions about what the UK can do to help slow the rate of climate change - and be able to offer some positive suggestions for action

Key Resources

Web based resources

Royal Geographical Society (& Defra) climate change website

www.yourclimateyourlife.org.uk

Royal Geographical Society (& BAS) Antarctica website

www.discoveringantarctica.org.uk

US and UK An Inconvenient Truth (AIT) websites

www.climatecrisis.net and www.aninconvenienttruth.co.uk

Australian AIT website www.aninconvenienttruth.com.au/truth/guide.htm.

Printed resources

The book of the film is called “An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It” (Rodale Press 2006) ISBN-10: 1594865671

Curriculum links

This unit provides opportunities for pupils to:

- ask geographical questions and to identify issues (1a)
- collect, record and present evidence (1c)
- use atlases and globes to locate places (2c)

Pupils will be taught:

- eight key areas of impact of climate change
- where changes are taking place and the issues that arise from these changes
- to explain how the UK and other places are interdependent

3. Geography

1. What are the main impacts of climate change? (approx. 40 minutes)

Learning objectives	Possible teaching activities	Learning outcomes	Points to note
<p>Pupils should learn:</p> <ul style="list-style-type: none"> why climate change is important on a global scale and what its main impacts are (and could be) 	<p>A brief starter activity would be to ask pupils where they think the greatest impacts of climate change will be experienced: Arctic, Amazon, Asia or Africa? Which of the “4As” will it be? Many will choose the Arctic, as they will believe that the most ice will be melted there. They should then be reminded that geographers need to think about people as well as places. Given that Asia is where most people live, it is the continent where most people will be effected.</p> <p>Once they recognise that we need to think about both physical and human impacts, the main part of the lesson can proceed, consisting of a 24-minute sequence of climate change impacts taken from “An Inconvenient Truth” (following a brief introductory statement about who Al Gore is, and why his film is important).</p> <p>Photocopy the supplied grid for pupils to write down the main problems that climate change is bringing and note the names of any places that are or will be particularly badly effected.</p> <p>This activity could be spread over two lessons if teachers want to pause playback of the film more frequently in order to clarify points or allow greater time for pupils to write notes.</p>	<p>Pupils:</p> <ul style="list-style-type: none"> learn about what impact climate change is already thought to have had on glaciers, temperatures, hurricanes, precipitation, Arctic circle, biodiversity, Antarctica and sea-level rise identify how these changes may accelerate further in the future appreciate the importance of climate change in shaping the world they will be living in as adults 	<p><u>Related scenes</u></p> <p>Scene 07 <i>Glaciers recede</i> Scene 11 <i>Rising temperatures</i> Scene 12 <i>Hurricanes</i> Scene 14 <i>Precipitation and evaporation</i> Scene 16 <i>The Arctic</i> Scene 19 <i>Troubling signs</i> Scene 20 <i>Antarctica</i> Scene 21 <i>Sea-level rise</i></p> <p><u>Background information</u></p> <p>Prior learning is expected of what the greenhouse effect is (either from science or geography).</p> <p>Prior learning is expected of the main sources of CO2 that are causing the atmospheric blanket to thicken (thus “making everyone’s bed too warm!”)</p> <p>If reminders are needed, still images of the greenhouse effect in action can be projected if the film is paused at code 0:08:50 and again at 0:08:57.</p>

3. Geography

2. What will the impact of climate change be on *our place*? (approx. 40 minutes)

Learning objectives	Possible teaching activities	Learning outcomes	Points to note
<p>Pupils should learn:</p> <ul style="list-style-type: none"> to assess the possible consequences of climate change for their local community and physical environment 	<p>Divide the class into groups and ask each to choose one of the main areas of impact looked at in the last lesson. Firstly, they should remind themselves what they learned previously. They should then think how their chosen climate change issue could have impacts on their own local community and / or the physical environment around their school.</p> <p>The impacts could be physical but they might also explore the concepts of interconnectedness and interdependency. What products may no longer be sold in local shops due to changes occurring in the regions where these products were made / grown? How might the holiday destinations of local people, family and friends change? Might more refugees need to come and live here if their own countries become uninhabitable? In what ways might climate change cause other types of connections with the wider world to start to change in our own neighbourhoods?</p> <p>Each group should be given an OS map of the area around the school to help them identify areas or activities they think could be particularly at risk. In the second half of the lesson, they could produce a PowerPoint presentation of their findings. Or a spokesperson for each group could make a presentation to the whole class.</p>	<p>Pupils will:</p> <ul style="list-style-type: none"> consider how specific impacts of climate change may have an impact on key aspects of life in their local neighbourhood, threatening sustainable development 	<p><u>Resources</u></p> <p>OS maps of the area around the school can be consulted – what is at risk?</p> <p>The Environment Agency website will show if there is already a flood risk that could be exacerbated by sea-level rise (enter your postcode where indicated):</p> <p>www.environment-agency.gov.uk/subjects/flood/</p> <p><u>Background information</u></p> <p>Pupils should apply knowledge of their local neighbourhood, its people, economy and environment.</p>

3. Geography

What are the main impacts of climate change?

Activity grid

The impact of Climate Change on:	Recent changes (outline the key ideas and try to add some facts and figures to support each idea)	Names of the places that are most badly affected
Glaciers all over the world		
World air temperatures		
Hurricanes and storms		
Rainfall, evaporation and drought		

3. Geography

The Arctic circle, both land and ice		
Biodiversity and where things live		
Antarctica		
Sea-level rise and inhabited areas		

Citizenship

4.1 Climate change debate topics

Debate topics in the film that can be used to start classroom or group discussion with Key Stages 3, 4 and A Level.

Introduction

Discussion and debate about climate change fit into a number of the areas of the citizenship curriculum:

- The work of community-based, national, international and voluntary groups
- the importance of resolving conflict fairly
- the significance of the media in society
- the world as a global community, and the political, economic, environmental and social implications of this, and the role of the European Union, the Commonwealth and the United Nations.

Also because of the controversy around the subject and the way in which it has emerged it is an ideal subject to draw out investigation and discussion skills.

All of the 'An Inconvenient Truth' film can be used to spark discussion and debate with pupils, however as there is not usually the time to look at the whole film the following topics can be used to draw out some of the key themes. These topics have also been selected as they are useful for discussion led with out specialist knowledge. Show the scenes and then raise the questions.

Topic 1: What are the issues – where has this all come from?

(Scenes 3, 4, 5 and 6)

Introducing the subject of climate change, this selection provides the basic information for understanding what it is about.

Raise the questions:

- What did you know about this before?
- Why do you think this matters?
- Have these scenes helped you understand what the issues are?
- How do you think this relates to your life?
- Do you have a part to play in the rise of CO₂ levels?

Use the RGS site or the Sustainable Schools Carbon Detectives' Kit to measure pupil and school contributions to carbon: www.esd.rgs.org and www.carbondetectives.org.uk.

Topic 2: The role of the Media and the science community – have they helped or hindered the public understanding?

(Scenes 18, 25, 26, and 27)

These scenes ask pupils to consider the role that the media and the science community have played in presenting these issues to the public and its understanding of what is happening.

Raise the questions:

- What lessons can be learnt by the way that tobacco has been presented?
- Does the media have a responsibility to only present the facts about climate change – or should it also comment on the arguments? – What are the implications for the role the media has played in this?
- Do scientists have a responsibility to make their findings accessible to the general public? Or is that the role of government?
- What are the implications for the statement 'Reposition global warming as theory rather than fact'?

Topic 3: The role of the politicians

(Scenes 13, 18, 23, 24 and 27 – choose those that you feel are most appropriate)

These scenes show some of the ways in which (American) politicians have responded to the issue of climate change.

Raise the questions:

- Consider the reasons why politicians may have wanted to ignore climate change?
- What decisions might politicians have to make in response to climate change?
- Should politicians take the lead on climate change – is it an issue that can be legislated about?
- Are politicians responsible to their own electorate or the international community? –What are the consequences of those responsibilities?
- What pressures can be put on politicians to respond to climate change?
- Find out about the Kyoto Protocol – what has the UK promised, are we on target?

Useful websites:

http://unfccc.int/essential_background/convention/items/2627.php

http://unfccc.int/kyoto_protocol/items/2830.php

www.bbc.co.uk/climate/policies/kyoto.shtml

Topic 5: Al Gore's lifetime and personal narrative

(Scenes 2,3,5,11,15 and 29 – choose only a selection of these)

The film uses Al Gore's own life as a way of holding the science and factual information together. It also provides a way to explore the changes that have happened in one lifetime. These scenes can be used to help pupils understand the speed the changes have occurred but also assess the values of using the human experience in this way.

Raise the questions:

- Why does Al Gore use his own life as a narrative to hold this documentary together? Is it because he is famous in the USA?
- Does having a politician rather than a scientist or journalist present this material mean anything?
- Are there any benefits to having the science explained over one person's life time?
- Do his efforts to get people to learn about climate change tell us anything about the issues?
- Would it be possible to map the changes to the climate to our own lives – starting with what we know about it and when we found out?

Topic 6: The industrialisation of the developing world

(Scenes 22, 23 and 24)

These scenes explore the industrialisation of the developing world which is now growing as a contributor to carbon emissions. Pupils need to explore the impact of this industrialisation and the reasons why they are doing this?

Raise the questions:

- The industrialisation of the developed world (UK, Europe, USA) led to the rise in carbon emissions do we now have a right to stop developing countries from doing the same thing? Do they have a right to try and advance technologically just as the developed world did?
- In what ways can the developing world be assisted by the developed world to not make the same mistakes – whilst still moving forward?
- What are the pressures placed on the developing world to not control its carbon emissions?
- Whose responsibility is it to galvanise the international community to co-operate and share technologies?

Topic 7: Realistic solutions

(Scenes 28, 30, 31)

These scenes explore the ways in which climate change can be related to our own lives and how changes can be made.

Raise the questions:

- What options does the film present us with to consider?
- Can the actions of the individual make a difference?
- Should we influence policy makers to try and change what is happening? – How?
- Earlier in the film Al Gore quotes Winston Churchill, “The Era of Procrastination of half measures of soothing and baffling expedients, of delays, is coming to a close. In its place we are entering a period of consequences” – discuss what you think this means and why it might apply to climate change?
- Al Gore uses the quote “It is difficult to get a man to understand something when his salary depends on him not understanding it”, by Upton Sinclair. What do you think he meant by this. Can this be applied to our own lives? How do we overcome this type of argument?
- Find out about the arguments concerning recycling versus consumption.
- Do you know your own carbon footprint and how to change things? Use the following resources to find out more:

www.esd.rgs.org

www.carbondetectives.org.uk

www.teachernet.gov.uk/_doc/10752/Sustainable%20Schools%20Assemblies.pdf

Citizenship

4.2 Planning a whole day event on climate change

Introduction

Below is a suggested outline for a whole day exploring climate change. This can be organised solely as a citizenship day but would work most effectively if it includes the contributions of the science and geography departments. Suggested lessons for those two subjects are available in this guidance - remember in this instance it is the information and experience that pupils take away from the science and geography sessions that is important not the extent to which they expand their understanding of the individual subjects.

For the discussion groups the questions presented in the citizenship topics should be used to initiate the debate.

If the opportunity of having a cross-curricular day is not possible then replace the morning session three with either a guest speaker, extra group discussion or new group discussion based on the short films produced by Defra.

In particular a day such as this would apply to Key Stage 3 QCA scheme of work Unit 21 – People and the environment:

“Pupils are encouraged to consider the positive and negative effects of scientific and technological developments on the environment. They take account of other views and understand why opinions differ. They evaluate the strength of the evidence they have collected. They select and use a wide range of reference sources. They communicate clearly the results of their research and explain its significance. They begin to appreciate the power and the limitations of scientific methodology. The specific science content will, however, depend on the issues that pupils investigate.”

Learning aims:

- To introduce the topic as a subject worthy of a whole day
- To draw together the different specialist subjects into one day to present a coherent overview.
- To provide an intensive environment for pupils to address and discuss many of the different issues in one day.
- To encourage pupils to consider the issues and how they effect their own lives
- To provide an opportunity to discuss the issues with their peers
- To encourage pupils to explore the opportunities within their own lives for making changes and suggesting solutions
- To encourage pupils to understand the relationship between evidence and affect
- To engage pupils with the impact of climate change locally and globally
- To encourage pupils to use tools to record information and use skills of testing, debate, measuring evidence and using maps.

Planning your whole school day – an example

Session one

Show first half of An Inconvenient Truth – stopping at the end of scene 19.

Session two

Break into groups to discuss issues:

Topic 1: What are the issues – where has this all come from?

Topic 5: Al Gore's lifetime and personal narrative

Topic 4: Nature the threat to animals and the habitat

Section three

Option one: science experiments

Option two: geography lesson

Examples of both are included in this guidance

If this is not a cross curricular day use more of the topics for discussion.

Lunch

Climate change fair

The showing of the Defra films

Afternoon sessions

Session four

The second half of the film starting from scene 20

Session five

Break into groups to discuss:

Topic 2: The role of the Media and the science community – have they helped or hindered the public understanding?

Topic 3: The role of the politicians

Topic 6: The industrialisation of the Developing World

Session six

Option one: Working in groups and using one of the following resources to help pupils investigate solutions to tackle climate change that they can actually do.

www.carbondetectives.org.uk

www.teachernet.gov.uk/doc/10752/Sustainable%20Schools%20Assemblies.pdf

Option two: Invite in a guest speaker to go over the issues raised across the day and to discuss solutions.

Use - Topic 7: Realistic solutions

Follow up

The day should be finished by the solutions being written onto boards that can be displayed around the school.

Extension work could then be to take some points to be discussed by the school council and or to set up working groups to monitor the schools behaviour as a contributor to climate change and explore ways of challenging it.

Suggested organisations for the climate change fair and as guest speakers:

Friends of the Earth

RSPB

DEA (Development Education Authority)

4. Citizenship

Local green action groups
WWF

Support activities for throughout the day

Activity one

Pin up two maps, one of the UK one of the world.

Next to the maps will be stickers of three different colours indicating:

- Low
- Moderate
- Serious

As the day go on pupils can write about issues on the stickers and place them on the maps where they think it is relevant e.g. sea-level rises, hurricanes, electricity use.

Activity two

Throughout the day pupils should be encouraged to find out their own contribution to CO₂ levels by going to: www.carbondetectives.org.uk or www.esd.rgs.org.

Activity three – see next page.

4. Citizenship

Activity three

In small groups ask the pupils to complete the table below.

Term	Meaning/description	Importance to Climate Change
Permafrost		
Hurricane		
Global warming		
CO ₂		
Glaciers		
Rising sea-levels		
Fossil fuels		
Ocean currents		
Carbon emissions		
Kyoto Protocol		
Biofuels		
Ozone layer		
Antarctica		
Precipitation		
Animal habitat		
Personal consumption		
Food miles		
Reusable resources		
Evidence collection		

5. FAQs

Q: Is there any doubt as to whether global warming is occurring?

A: No. The temperatures of many places on Earth have been measured for many years and the data shows a clear pattern of rising temperatures. Even those whose views on the causes of climate change differ from the scientific consensus are unlikely to deny average global temperatures are rising.

Q Is there any doubt that increasing levels of man-made CO₂ and other greenhouse gases are the main contributor to global warming?

A: There is a strong scientific consensus that man-made emissions of CO₂ are the main driver behind rising global temperatures as reflected in the recent report by the Intergovernmental Panel on Climate Change (IPCC) www.ipcc.ch. There are a small number of scientists who have alternative theories but they are a tiny minority in the scientific community.

Q: Does the hole in the ozone layer cause global warming?

A: No. There is understandable confusion because of the relationship between the hole in the ozone layer and the risk of sunburn and melanoma. Temperature (an important variable in global warming) and sunburn are easily merged into one issue. However, CFCs – the main cause of the ozone depletion do act as greenhouse gases. So a link is that the same air pollutant that causes the hole in the ozone layer also contribute (in a relatively minor way) to global warming.

Q: Is current global warming merely a part of long term temperature variations?

A: Partly, but the degree and rate at which both CO₂ concentrations are increasing and the temperature are increasing exceed the natural variations which the Earth has experienced during geological history.

Q: Does a record hot day count as evidence for global warming?

A: On its own, no. However the frequency of record temperatures is increasing and this is evidence of a long term pattern or trend.

Q: Does global warming mean less rain?

A: No. This is an understandable confusion because higher temperatures and dryer conditions are associated with summer. However global warming means there will be more evaporation from surface waters and therefore more rainfall. However, the pattern of rainfall is likely to be much more erratic leading to more droughts and more floods.

Q: What does it mean to say that CO₂ acts as a greenhouse gas?

A: The Earth's atmosphere of gases, such as carbon dioxide and water vapour are vital to life both in terms of its chemical composition (oxygen etc) and its 'greenhouse' role in maintaining habitable temperatures. The problem is that increasing concentration of CO₂ is enhancing the greenhouse effect so that even less heat energy can radiate into space from the Earth. The molecules of certain gases, including CO₂ have a greater ability to absorb infrared radiation (the way the Earth transfers heat energy away from itself) and so the increasing CO₂ concentration leads to increasing temperature.

Q: Is it true that electric vehicles do not contribute to the greenhouse effect?

A: Not necessarily. If the vehicle charges its battery from a source of electricity that depends on the burning of fossil fuels, then the greenhouse gas emissions are displaced from the vehicle to the power station. The manufacture of any type of

5. FAQs

vehicle requires the use of energy so the total carbon footprint is dependent not only on the operation but the materials etc from which it is made.

Q: Does hydrogen as a fuel contribute to the greenhouse effect?

If hydrogen is made industrially from methane, then carbon dioxide is a by-product of the process. If not all this CO₂ is used for other purposes, then there is a contribution to the greenhouse effect.

Hydrogen itself also contributes to the greenhouse effect in an indirect way as it reacts in the atmosphere to increase methane and ozone, both of which are greenhouse gases. However, this contribution should be compared with the greater impact presented by fossil fuels, which release CO₂.

Q: Is the white 'smoke' seen coming out of cooling towers or the smoke from power station chimneys carbon dioxide?

A: No. Cooling towers emit water vapour and the smoke from chimneys is other particulate matter. Carbon dioxide is colourless.

Q: Why can heat get in through the atmosphere, but not out through it?

A: The Sun's energy reaches the Earth in the form of visible light and other short wavelength electro magnetic radiation. This can penetrate the atmosphere and warm the surface of the Earth. The Earth re-radiates longer wavelength infra red radiation which is more easily absorbed by the greenhouse gases in the atmosphere.

Q: Is the ice in the Arctic and Antarctic growing?

A: No – there may be some seasonal changes but the overall trend is for melting. Arctic ice is shrinking significantly (by 20% in area and 40% in thickness since around the mid 1970s - http://nsidc.org/sotc/sea_ice.html), but Antarctic ice is actually increasing. Antarctic sea ice is showing no significant change, whereas Antarctic land ice is actually growing owing to increased precipitation (the latter caused by global warming - www.antarctica.ac.uk/Key_Topics/Climate_Change/ccps.html).

Q: What will cause sea- levels to rise?

A: The main cause of rise in sea-levels is thermal expansion of water. This applies now and in the future. At the moment, the main contributor to sea-level from melting of land based ice is from glaciers, but in the future, if Greenland and Antarctica melt, they will be larger contributors to sea-level rise than glaciers.

For geographers looking at the UK, the tectonic bounce is also a factor. The NW of the UK is getting higher while the SE is sinking partly due to the retreat of glaciers at the end of the last ice-age, though this is a slow process.

Q: How does recycling reduce global warming?

A: Many products need a lot of energy to produce them from raw materials. In particular, glass and aluminium need high temperatures and aluminium requires electricity. Recycling reduces the need to use burn fuel or use electricity and so reduces greenhouse gas emissions.

Q: How does conserving water reduce global warming?

A: It takes a lot of energy to move water from where it is found to where we need it. Pumps use a lot of energy and, in addition, energy is used to make the chemicals needed to make water drinkable. Reducing the amount we use therefore reduces the energy needed to treat and transport it.

5. FAQs

Q: Do we need China and India to act combat climate change?

A: Some people argue that we need rapidly developing economies such as India and China to reduce CO₂ emissions if we are going to reduce the impact of climate change. However, individuals in North America and Europe are still greater contributors to global warming than individuals in China and India. As such, it can be argued that as our relative prosperity is based on an industrial system that has mainly caused the current situation, we have a moral responsibility to lead in tackling the problem. AIT illustrates the significant potential effects of relatively small measures.

Q: Is it too late to repair the damage?

A: No. The technology and approaches are available to slow down and then reverse the trends.

Q: Can global warming be a good thing?

A: A list of temporary benefits and longer term problems could be produced to illustrate the overwhelming balance against global warming having benefits. For example, there is evidence to suggest that in the short term some areas will produce higher crop yields. However, in the long term evidence suggests that overall crop yields on a global scale will be reduced.

Q: Does carbon offsetting remove the risk of global warming?

A: Measures such as tree planting or manufacture of wind turbines and solar cells to offset the amount of carbon dioxide produced by air travel or other human activity contributes to the reduction of carbon dioxide. However, CO₂ emission cuts would make the biggest difference to removing the risk of global warming. Additionally, in the short-term Carbon Sequestration may help, further details are available at www.tyndall.ac.uk/publications/fact_sheets/t2_21.shtml.

Q: How can we tell if a product has produced a lot or a little greenhouse gas before we buy it?

A: With difficulty – factors such as transport miles, whether forest clearance has played a part, packaging and the input of heat and other energy into the manufacture are all part of the picture. Locally-sourced products with less packaging are likely to have fewer ‘food miles’.

Further information about misconceptions can be found at:

www.climatechallenge.gov.uk/understand/myths.html#one

www.metoffice.gov.uk/corporate/pressoffice/myths/index.html

6. Further Resources

Sustainable Schools: www.teachernet.gov.uk/sustainableschools/yearofaction

The climate change film pack for secondary schools forms one of a number of materials produced as part of the Year of Action on Sustainable Schools. Visit the Year of Action page to download or order additional resources.

Assembly plans are available to download based on the 8 doorways of the Sustainable Schools National Framework. The series provides suggestions for headteachers and school leaders on how to profile sustainability within school assemblies. Assembly 9 is 'Climate Chaos' and could form part a 'Climate Change day'.

Carbon detectives' kit: www.carbondetectives.org.uk

An online interactive site for Key Stage 2 and 3 pupils to help them investigate the sustainability performance of their own school and develop practical suggestions for staff and governors on moving forward.

Climate Challenge www.climatechallenge.gov.uk

Initiative led by Defra in partnership with the Energy Savings Trust, the Carbon Trust, the Department for Business, Enterprise and Regulatory Reform (DBERR) (formerly DTI), the Environment Agency, the UK Climate Impacts Programme and the Department for Transport.

Met Office : www.metoffice.gov.uk

Links to FAQs, myths, data and explanations around climate change. The site also includes links to use of models for predictions.

A range of free resources on weather and climate are available for schools at www.metoffice.gov.uk/education/resources/index.html. These include 'Life in a Changing Climate' - an interactive multimedia learning resource for GCSE and AS/A2-level studies of climate change and its impacts. From mid-May 2007, free climate change posters for science and geography will also be available.

Hadley Centre: www.metoffice.gov.uk/research/hadleycentre/index.html

UK AIT website: www.aninconvenienttruth.co.uk

US AIT website: www.climatecrisis.net

Australian AIT: www.aninconvenienttruth.com.au/truth/guide.htm

Association for Science Education Science - UPD8: www.upd8.org

A free web-based resource providing materials (downloadable teaching notes and pupil materials) for lessons based on current issues. The searchable list includes activities linked to many areas of the KS3 and KS4 science curriculum.

Association for Science Education - Science Across the World:

www.scienceacross.org

A free web-based resource providing the opportunity for pupils in one country to collaborate on a science investigation with pupils in another country. There are downloadable teacher and student materials available in several languages. The topics provided for the projects include:

- Renewable energy
- Drinking water

6. Further Resources

- Climate change (Making the News)
- Global warming

The climate change project enables pupils to upload project work to the website for viewing and reviewing by other pupils whilst the other projects involve the sharing of results from investigations.

BBC Climate Change www.bbc.co.uk/climate

Wide range of information and topics: evidence, impacts, phenology etc.

Climate Outreach and Info Network: <http://coinet.org.uk/>

Wide range of information including discussion boards and response to 'The Great Global Warming Swindle'

Geographical Association: www.geography.org.uk/resources/themes

Further ideas about how An Inconvenient Truth can be used in geography lessons.

Green Facts: www.greenfacts.org/en/climate-change-ar4/index.htm

Questions and answers with a range of detail and depth.

Nature Detectives (Woodland Trust): www.naturedetectives.org.uk

Opportunity for pupils to contribute to national phenology project – identifying the impacts of global warming on seasonal patterns of animal and plant life.

Practical Action (formerly Intermediate Technology Development Group):

www.climatechoices.org.uk

Education site aimed at upper KS2 – some materials suitable for lower KS3. Information and perspectives from a range of countries.

Royal Geographical Society (& BAS) Antarctica website:

www.discoveringantarctica.org.uk

Royal Geographical Society (& Defra) climate change website:

www.yourclimateyourlife.org.uk

A website linking climate change to the geography curriculum.

The Royal Society: "Climate Change Controversies - A Simple Guide":

www.royalsoc.ac.uk/page.asp?id=6229&qclid=CNH6k_OPzIsCFQ3olAodd1UHAW.

A useful site exploring alternative views on climate change.

Royal Society of Chemistry: www.chemsoc.org

Climate change and sustainable energy

www.rsc.org/Chemsoc/ImportanceOfChemicalSciences/ClimateChange.asp

Climate Change resources www.chemsoc.org/networks/learnnet/climate.htm

Science Learning Centres: www.sciencelearningcentres.org.uk

Teachers can find professional development opportunities on climate change at the Regional and National Science Learning Centres. A range of teaching and learning resources for all ages and key stages are also available. Visit the website for the latest news, courses and opportunities.

UK Climate Impacts Programme: www.ukcip.org.uk/climate_change

Some data, predictions and information – links to IPCC information

6. Further Resources

United Nations Environment Programme: Vital Climate Graphics:

www.vitalgraphics.net/climate2.cfm

Graphs, charts, diagrams on climate change.

West Midlands Regional Broadband Consortium: www.wmnet.org.uk

Links to Climate Change in the Curriculum project with information and opportunities to contribute to the project.

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