



# Tackling climate change

An information pack for **teachers**



**ONE PLANET**  
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**Climate change\* is considered to be the most serious environmental challenge facing our planet. Our way of life, wildlife and environment\* are severely threatened.**

**There is still time to avoid the worst impacts of climate change, but we must act now and with urgency to curb the rise in average global temperatures. It is vital that a strong, new international deal on climate change is agreed to follow on from the current targets in the treaty, which come to an end in 2012.**

**Even if we are successful in limiting rises in global temperature, some climate change is now inevitable, so we must find ways to help people and nature adapt\* wherever possible.**

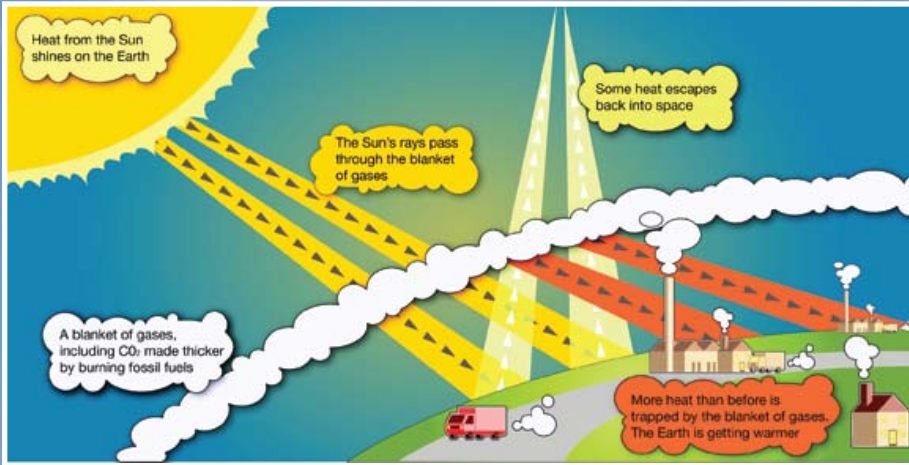
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# The greenhouse effect

The Earth's climate\* is determined by heat energy from the sun which passes through the atmosphere and warms the Earth's surface.

**As the temperature increases, the Earth sends heat energy back into the atmosphere**



Based on an illustration from *The Greenhouse Effect*, David R Wright, WWF-UK/Hodder and Stoughton, 1990.

As the temperature increases, the Earth sends heat energy back into the atmosphere. Some of this heat is absorbed and reflected back to Earth by gases in the atmosphere, such as carbon dioxide (CO<sub>2</sub>), water vapour, methane and nitrous oxide. In this way these gases, which are all naturally occurring, act as a blanket, trapping

heat that would otherwise escape into space, making the Earth a warmer place. Without it, the average global temperature would be more than 30°C colder than it is now and too cold for higher life. This natural warming is sometimes called 'the greenhouse effect' and the gases forming the Earth's 'blanket' are known as 'greenhouse gases\*'.

# What is causing climate change?

Human activities are increasing the concentration of naturally occurring greenhouse gases in the atmosphere, especially CO<sub>2</sub>, causing the world to heat up unnaturally and the weather to become more extreme. The heating process is often referred to as 'global warming\*' and the overall effect is known as 'climate change'.

CO<sub>2</sub> is the most significant of the greenhouse gases as it is currently responsible for 60% of greenhouse gas pollution\*. It is emitted when we burn fossil fuels\* such as coal, gas and oil. Globally and in the UK the two leading sources of CO<sub>2</sub> are now energy and transport. The power sector is the largest source – accounting for roughly a third of all emissions. Energy demand from UK households increased by 18% between 1990 and 2006, and our homes now contribute to 27% of our carbon footprint\*.

The transport we use, especially travel by car or plane, currently accounts for 28% of our nation's CO<sub>2</sub> emissions. Aviation is one of the UK's fastest growing sources of carbon emissions, rising annually at a rate of 3% and representing 13% of the climate change damage caused by the UK.

Another important source of CO<sub>2</sub> is deforestation. Changes in land use, such as deforestation and forest degradation\*, are now responsible for 18% of global carbon emissions, with deforestation accounting for most of these emissions. Illegal logging is one of the major causes. Deforestation releases the carbon stored in trees and also results in less CO<sub>2</sub> being removed from the atmosphere through photosynthesis\*, leading to a further increase in CO<sub>2</sub> concentrations.

As human activity increases, the concentrations of greenhouse gases – particularly CO<sub>2</sub>, but also methane and nitrous oxide – build up in the atmosphere.

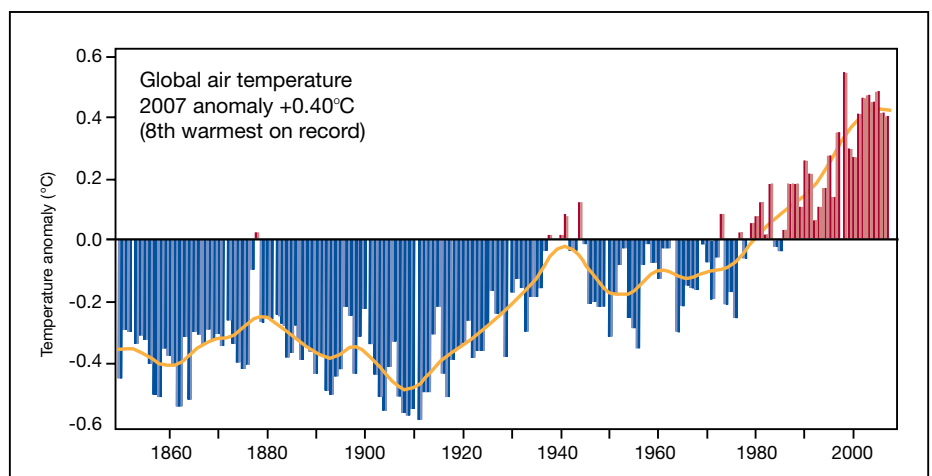
Global CO<sub>2</sub> emissions released from human activity have been increasing faster, with their growth rate increasing from 1.1% per year between 1990 and 1999, to more than 3% per year between 2000 and 2004.

The latest climate research has revealed that global warming is accelerating, at times far beyond forecasts made in 2007 by the Intergovernmental Panel on Climate Change\* (IPCC) and is now happening at an alarming rate. According to the World Meteorological Organisation the decade 1998-2007 was the warmest on record, and the top 11 warmest years have all occurred in the last 13 years. Without urgent and rapid efforts to reduce global carbon emissions, the IPCC predicts possible temperature rises of 4°C or more this century.



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**As human activity increases, the concentrations of greenhouse gases – particularly CO<sub>2</sub>, but also methane and nitrous oxide – build up in the atmosphere.**



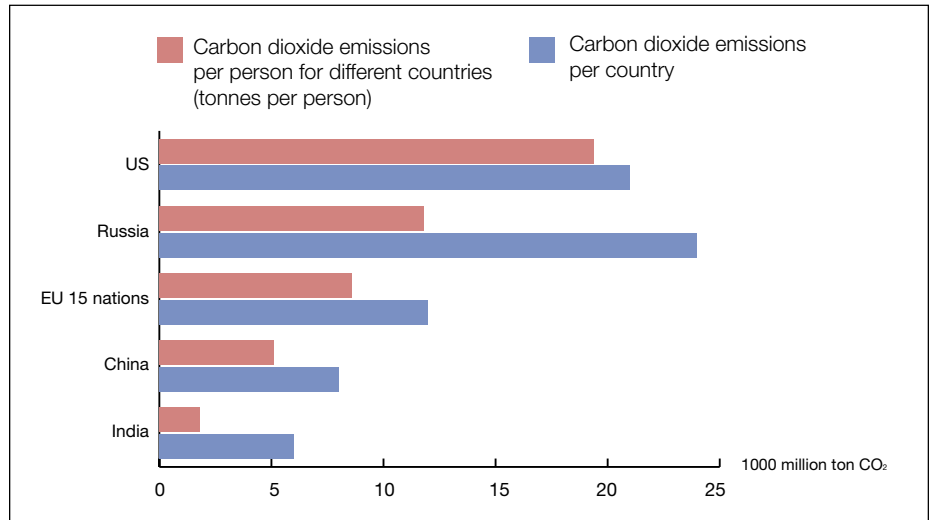
# Who is responsible for climate change?

Industrialised countries have the responsibility to begin the process of CO<sub>2</sub> emission reductions because:

- their emissions per person are many times higher than those of developing countries;
- they have the finance and the technologies to kick-start energy-saving and clean energy industries\*, and
- they are historically the largest CO<sub>2</sub> emitters, and currently among the largest emitters.

The G8 countries (Canada, France, Germany, Italy, Japan, Russia the United Kingdom and the United States) are responsible for 62% of the CO<sub>2</sub> accumulated in the Earth's atmosphere.

Countries that are now industrialising rapidly, like China and Brazil, are rapidly increasing their carbon emissions. According to the Netherlands Environmental Assessment Agency, which tracks global annual carbon



emissions, in 2007 the country of China overtook the US as the country that emits most carbon, but the emissions of carbon per person were still more than three times higher for an American than for a Chinese citizen, (see bar chart).

Source:  
Netherlands  
Environment  
Assessment Agency,  
2008



# What are the impacts of climate change?

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

## Sea level rise

Sea levels are predicted to rise due to thermal expansion of the sea, and melting of ice sheets, glaciers and snow. New studies predict that by the end of the century the rise will be more than double the maximum estimate of 0.59m predicted by the IPCC in 2007. Sea level rise of more than 1.2m would put vast coastal areas at risk in Europe and around the world.

Coastal zones are among the world's most densely populated areas. Entire nations on low-lying islands in the Pacific and Indian Oceans could be submerged.

## Melting glaciers

Glaciers are melting on all continents. One example of the potentially devastating impacts of climate change is the rapid melting of glaciers in the Himalayas – the huge mountain chain that runs through the middle of Asia. More than a billion people rely on these glaciers to provide water for drinking, sanitation, agriculture and power generation from hydroelectric plants.

The rapid melting of Himalayan glaciers is set to increase the volume of water in rivers, causing widespread flooding. Then, in a few decades the water level in rivers is predicted to seriously decline, leading to massive problems for people and environments in western China, Nepal and northern India, as less fresh water means less agriculture, less food and less income. These regions are also where some of the world's most spectacular biodiversity\* can be found. For example, many of the world's tigers and rhinos depend on this water supply to survive.

## Weather

It is not just warmer weather that is causing concern. Climate change has an impact on climate patterns more broadly and is likely to cause more weather extremes, such as heavy rainfall, prolonged drought, storms and super-hurricanes.

The latest research predicts an increase in the number and intensity of violent cyclones over the British Isles and the North Sea, leading to higher wind speeds and greater damage from storms. In 2005, a single storm substantially damaged the annual forest harvest in Sweden and Latvia. Rainfall is projected to increase in most of Europe, resulting in higher flood risk and economic costs. In contrast, the Mediterranean region is expected to experience more frequent long-term drought.

**Arctic ice is like a mirror, reflecting the sun's heat back into space. As that ice goes, Arctic waters absorb more heat, adding to global warming**



Amazon: © Nigel DICKINSON / WWF-Canon Hermit crab: © Martin HARVEY / WWF-Canon Endangered flowered leek © Hartmut JUNGIUS / WWF-Canon

### Natural carbon sinks

Over the past 15 years, about half the CO<sub>2</sub> emissions arising from human activity have been absorbed by land and ocean. Now these natural 'sinks' are losing their ability to absorb CO<sub>2</sub> faster than expected. This means that more of the CO<sub>2</sub> emitted from human activities will stay in the atmosphere and contribute to global warming.

### Health

There are likely to be wide-ranging and damaging impacts on human health, with significant loss of life caused by heatwaves and the spread of diseases such as malaria.

Extreme weather events such as the hot summer of 2003, which caused 35,000 deaths across Europe from heat stress and poor air quality, will happen more frequently. In the Mediterranean region, similar periods of extremely high temperatures are projected to be at least three times as frequent by the end of the century.

### Food and fisheries

Rising temperatures have already led to a major reduction in wheat, maize and barley crops, resulting in losses of 40 million tonnes of grain a year.

If warming continues, south Asia and southern Africa are predicted to suffer significant reductions in the yields of several crops that are important for their large populations.



### Species\*

Some plants and animals will be able to adapt to a warmer world, but for many, the change will be too rapid and they will die. Some species will simply have no suitable habitats\* to which they can move because we have destroyed so many wild places. In 2007, the IPCC predicted that up to 30% of higher plant and animal species would be at high risk of extinction\* with a warming of just 1.5-2.5°C above present temperatures. The greatest risks of species extinction from global warming may be in the tropics, where biodiversity is greatest. Climate conditions that are currently only found in polar regions are likely to disappear. This means that Arctic communities\* of plants and animals are likely to be disrupted and that some species endemic\* to polar regions, such as the polar bear, are more likely to become extinct.

### Forests

The world's forests, like the oceans, are massively important carbon sinks that absorb CO<sub>2</sub>. They also tend to be the areas on land with the richest diversity of plant and animal species. As temperatures rise, some of the world's most important tropical rainforests\*, including large areas of the Amazon,

could dry out and become savannahs\* rather than forests. This means that they will start emitting, rather than absorbing CO<sub>2</sub>, making climate change even worse.

### Warming oceans

When the atmosphere warms up, so do the world's oceans, causing many dramatic changes. Warming seas are having a terrible effect on the world's coral reefs. These reefs are effectively the rainforests of the seas, with a staggering array of fish and other marine animals living in and around them. Around half a billion people, a twelfth of the entire population of the world, rely on fish from coral reefs as their main source of protein. Corals are living organisms that are extremely sensitive to changes in temperature. For example, it is estimated that if the global rise in temperature is not stopped just 5% of Australia's Great Barrier Reef, the world's largest coral reef, will remain by 2050.

## The global warming of less than 1°C that the world has experienced to date may have already triggered the first tipping point of the Earth's climate system – the disappearance of summer Arctic ice



© Wim VAN PASSEL / WWF-Canon

### The Arctic\*

Human-induced changes to the Arctic climate are among the most significant on Earth. The global warming of less than 1°C that the world has experienced to date may have already triggered the first tipping point of the Earth's climate system – the disappearance of summer Arctic ice.

The latest science shows that the Arctic Ocean is losing sea ice 30 years or more ahead of projections made by the IPCC's 2007 report. In September 2007, the sea ice shrank to 39% below its 1979-2000 average, the lowest since satellite monitoring began in 1979 and also the lowest for the entire 20th century, based on monitoring from ships and aircraft. The whole of the Arctic Ocean could very soon be ice-free during summer – a state not seen on the planet for more than a million years. This is forecast to happen between 2013 and 2040.

Polar bears are already being affected and are very unlikely to survive as a species if summer ice disappears. Impacts are being felt by indigenous people\* of the Arctic whose traditional livelihoods depend on healthy ecosystems\*.

The loss of Arctic ice will have further worldwide consequences. It will produce feedbacks\* that are expected to increase global warming and could result in rapid and abrupt climate change rather than the gradual changes that have been forecast so far.

Maps showing the decline of sea ice can be found at: <http://maps.grida.no/go/graphic/arctic-sea-ice-minimum-extent-in-september-1982-and-2008>

### Loss of Arctic sea ice affects the rest of the world through:

- increased warming across the globe. Arctic ice acts like a mirror, reflecting the sun's heat back into space. As that ice disappears, Arctic waters absorb more heat, adding to global warming;
- rising sea levels as Arctic ice melts, and
- changes in ocean circulation.

Change is impacting on the Arctic atmosphere, snow, permafrost\*, species, food webs, ecosystems and human societies, as well as the oceans and sea ice.

Temperatures at the top of the permafrost layer have increased by up to 3°C since the 1980s in the Arctic. As permafrost melts more rapidly, a lot of methane will be released into the atmosphere. Methane is a greenhouse

gas up to 20 times more potent than CO<sub>2</sub>, so permafrost melting would create further global warming.

### Countries affected

Climate change will affect all countries, although in different ways. Those in the Middle East, Africa, India and some other countries could face drought, and millions of people could have more problems with their water supplies. Other regions, including North America and parts of Asia, are predicted to receive more rain than they do now.

The world's poorest countries are likely to suffer the most and are less able to adapt because:

- they are located where the climate is most variable, and so are particularly vulnerable;
- they lack the resources and capacity needed to respond quickly to climate change; and
- most of the world's 2.7 billion poor depend on natural resources for survival and economic development, and those resources have already been substantially degraded.



# What has been done to tackle climate change?

At the United Nations climate summit in Kyoto in 1997, legally binding targets were agreed in order to achieve a reduction in industrialised countries' emissions of the six main greenhouse gases by just over 5% by 2012, compared with 1990 levels.

It took over four years for the world's leading industrial nations to agree on rules that would allow the Kyoto Protocol's recommendations to be put into practice.

The Kyoto Treaty\* came into force on 16 February 2005, after Russia ratified. This meant that a large enough number of nations had ratified the Protocol for it to become international law. US is now the only industrialised major emitter not to have signed up. Since his election in November 2008, President Barack Obama has promised leadership in climate change and targets aimed at reducing US greenhouse gas emissions to 1990 levels by 2020.

## How can we tackle climate change?

The latest reported evidence indicates that climate change is happening faster and sooner and is having greater impacts than predicted, even just a year ago. This means that to meet global energy demand, which is growing and projected to more than double by 2050, we need:

- **Urgency.** Decisive action to tackle climate change is even more urgent than believed previously. Delays will mean the changes we need to make to our economy and lifestyles will be more difficult and more expensive.

- **A global effort.** Every country has a role to play to meet the challenges from climate change arising in its territory. Developed countries will need to take additional responsibility and make the greatest cuts in emissions. Eventually, developing countries will need to join in the effort to reduce total global emissions.

- **Leadership by governments.** Governments need to agree emission reduction targets. They must work together on effective strategies and to influence and coordinate the investment of funds needed to tackle climate change.

Cuts in global greenhouse gas emissions of at least 80% are needed by 2050 to keep the average rise in global temperature below 2°C and so avoid the worst impacts of climate change. However, even with these cuts, damages will be significant and much more substantial adaptation efforts than those currently planned will be needed to help cope with much of the damage.

To secure this, a strong and fair UN agreement, the 'global deal', must be reached at the Copenhagen climate summit in December 2009 and then ratified so that it comes into force by the end of 2012, when the commitments under the current international agreement come to an end.

The scale of this task is daunting, and achieving such reductions will require radical changes in the way the world sources and uses energy.

However, several studies, including a 2007 WWF report, show that it is still possible to avoid the worst impacts of climate change by using clean energy solutions (to cut some 65% of global emissions) and stopping tropical deforestation (avoiding some 20% of emissions).

## WWF aims to secure a complete rethink of aviation policy.



The technologies and sustainable energy resources known or available today are sufficient to meet the challenge of the emissions cuts needed. There is still enough time to build up and deploy these solutions, but only if the necessary decisions are made in the next five years.

Finding ways to adapt to climate change will be one of the key components of the global deal.

### Solutions – cutting global emissions

1. Energy efficiency is a priority, especially in developed countries.
2. Stopping and reversing loss and degradation of forests, particularly in the tropics, is crucial.
3. The rapid development and use of renewable energy\* sources, such as wind, hydro, solar and bio-energy (from sustainable sources), is vital.
4. Energy from intermittent sources, such as wind and solar, will need to be stored and transformed into fuels that can be transported and can meet the needs of industry. New fuels, such as hydrogen, that meet these requirements will need major new infrastructure for their production and distribution.
5. Using natural gas as a fuel offers the opportunity to save on significant carbon emissions in the short term, while low-carbon energy sources are being developed.
6. It is essential that any new fossil fuel plants are equipped with carbon capture and storage technology (see below) from the outset, and that all existing power stations have are fitted with this technology fitted.

### Solutions – cutting UK emissions

A recent WWF and RSPB study showed that it is possible for the UK to make cuts of at least 80% in carbon emissions by 2050 from 1990 levels, by domestic efforts alone and without the use of nuclear energy.

The estimated cost of meeting the 80% target ranges between 2% and 3% of Gross Domestic Product (GDP) in 2050. Energy efficiency could markedly reduce these costs to approximately 1.5% to 2% of GDP. Meeting the 80% target would cost between one half and one tenth as much as the costs that would be faced if we do nothing, based on recent estimates of damage costs from climate change.

The UK's Climate Change Act became law in November 2008. The Act includes the new and increased UK target of an 80% reduction in CO<sub>2</sub> and other greenhouse gas emissions by 2050. Reductions in emissions from aviation and shipping are included in this target. The Climate Change Act is the world's first legally binding target for a nation to cut its greenhouse gas emissions.

WWF believes that in order to meet the 80% target the UK will need to take the following measures:

#### The power sector

Secure a rapid reduction in carbon emissions from the power sector such that by 2035 it is carbon free.

#### Stop the use of unabated coal

Coal is the most polluting of all fossil fuels, so the current proposals for new coal-fired power stations in the UK would gravely undermine progress towards targets to reduce carbon emissions.

The power sector and the UK government hope to ensure that new stations are 'capture ready' so that carbon capture and storage equipment could be fitted

at a later date, once the technology is proven. Carbon capture and storage is a process for trapping CO<sub>2</sub> and transporting it to underground geological sinks for storage. However, this technology has not yet been demonstrated on a large scale power plant anywhere in the world. New coal plants are currently only proposed to be 'capture ready' and the intention is to fit this technology at a later date, once its feasibility has been proven. WWF believes that building 'capture ready' stations is an unacceptable risk until there is a guarantee that the technology is feasible and economical.

Instead, WWF is calling for a limit to be placed on emissions from power stations – a so-called 'emissions performance standard'.

### Reduce energy demand and increase energy efficiency

The government has promised a 'step change' in energy efficiency, but WWF believes that urgent and much more ambitious action is needed to ensure that households and appliances become much more efficient than at present.

### Increase renewable energy production

The UK has a vast potential in renewable energy resources – one of the largest in the northern hemisphere for wave and tidal power. But these resources are still largely untapped in the UK. In fact the UK is third from the bottom of the EU renewable energy league table.

The EU has a target to achieve 20% of its final energy demand from renewables by 2020. This target has been broken down so that each EU country gets has its own target. For example the UK's new legally binding target is to achieve 15% of final energy demand from renewables by 2020. WWF believes it is essential that the UK meets its fair share of the EU renewable target.

### Reduce emissions from aviation and transport

If recent rates of growth continue, aviation emissions will account for half the UK's carbon emissions by 2050 and threaten to take up the whole of the UK's fair share of global carbon emissions within a few decades.

WWF aims to secure a complete rethink of aviation policy. A major WWF campaign – the One in Five campaign – which encourages businesses to cut down on flying by making greater use of alternatives such as videoconferencing.

### Emissions Trading Scheme

Major changes in investment, especially in energy sources and energy efficiency are needed. Putting a price on carbon (called 'cap and trade') should provide incentives to move away from carbon intensive investments such as coal-fired power stations, to low carbon alternatives, such as renewable energy sources.

Europe has an Emissions Trading Scheme, which began in 2005 and sets a cap on emissions from more than 11,000 individual installations in the power sector and industries that emit a large amount of CO<sub>2</sub> (such as cement, steel, pulp and paper).

However, it is clear that in the short term the price of carbon (which is driven by how tight the emissions cap is) will not be at all sufficient to drive the investment we need in low- carbon alternatives, particularly in the power sector. This is why WWF continues to lobby for direct regulation of this sector.

### Use sustainable development\* principles

The government should use sustainable development principles when choosing measures to tackle climate change – for example, it should avoid unsustainable sources of biofuels\*.

## Glossary

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

**Arctic** – the area lying above 65.5 degrees North latitude that includes the Arctic Ocean, and areas of North America, Russia, Greenland and northern Europe.

**Biofuel** – a fuel produced from dry organic matter or combustible oils produced by plants. Examples of biofuel include alcohol (from fermented sugar).

**Biodiversity** – the variety of life on Earth, reflected in the multitude of ecosystems and species, their processes and the way they interact, and the genetic variation within and among species.

**Carbon footprint** – A measure of the amount of carbon dioxide generated to support a person, organisation or nation over a given time.

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

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

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

**Community (of plants or animals)** – an association of plants or animals of various species found growing together in different areas with similar site characteristics.

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

**Endemic** – only found in to a particular locality, area or region.

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

**Extinction** – the process by which organisms die out.

**Feedback** – a feedback mechanism is something affected by climate change, which itself makes climate change happen more or less quickly.

For example, heating the Earth could make the ice caps melt, which could mean that less of the Sun's light is reflected back into space, which could in turn cause the Earth's temperature to rise even faster. This is a POSITIVE feedback.

Some feedback mechanisms could slow climate change. These are NEGATIVE feedbacks. Feedbacks make prediction of climate change harder and mean that scientists need to run many more models to get a feel for what is likely to happen.

**Forest degradation** – reduction in forest quality caused by human activities.

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

**Global warming** – a gradual rise in the average surface temperature of the Earth.

**Greenhouse gases** – gases that contribute to the greenhouse effect: the accumulation of carbon dioxide, water vapour and other gases in the upper atmosphere insulates the Earth, which in turn prevents heat loss and increases atmospheric temperature.

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

**Indigenous people** – people from any ethnic group who inhabit a geographic region with which they have the earliest historical connection.

**Intergovernmental Panel on Climate Change** – an organisation established in 1988 by the World Meteorological Organisation and the United Nations Environment Programme to provide information on climate change. It consists of over 2,000 climate scientists from over 150 countries.

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

**Permafrost** – permanently frozen ground; generally refers to a layer at some depth below the soil surface.

**Photosynthesis** – process of using the energy in sunlight to convert water and carbon dioxide into carbohydrates and oxygen.

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

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

**Savannah** – a rolling grassland scattered with shrubs and isolated trees, which can be found between a tropical rainforest and desert biome. Not enough rain falls on a savannah to support forests. Savannahs are also known as tropical grasslands. They are found in a wide band on either side of the equator on the edges of tropical rainforests.

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

**Sustainable development** – development that can be continued on an on-going basis without depletion or damage. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.

**Tropical rainforest** – a rainforest found near the equator, typically characterized by high rainfall, poor soil, and a high diversity of plant and animal species.



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

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

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