

Climate Change

Do we have a problem?

Scientists who study the climate agree that it is getting warmer on Earth. But why is the Earth getting warmer? And how? Well, scientists have spent the past few decades trying to understand what's going on. They know that the Earth gets warmer and cooler on its own, but the world's leading climate scientists believe that things people do are helping to make the Earth warmer.

Scientists know that the air around us contains certain gases mixed into it which naturally trap heat and keep the planet comfortably warm and liveable. This is called the "greenhouse effect". Without it, the planet would be about 30°C to 40°C colder than it is now.

However scientists are concerned that human activities are adding to these greenhouse gases. Burning of fossil fuels like oil and coal causes more greenhouse gases to escape into the air. This is enhancing the natural greenhouse effect, causing the planet to warm up and climate patterns to change.

Other causes have been identified. Agriculture also contributes: livestock such as cows release greenhouse gases once they have digested their food. Rice paddies have a lot of vegetation which rots at the end of a growing season, releasing more greenhouse gases. Just ploughing land releases more gases because of bacteria naturally present in the soil.

Deforestation (cutting down trees) adds to the problem. Trees soak up carbon dioxide, one of the greenhouse gases, from the air.

Scientists can see that the average temperature has increased just as the concentration of greenhouse gases in the air has increased.



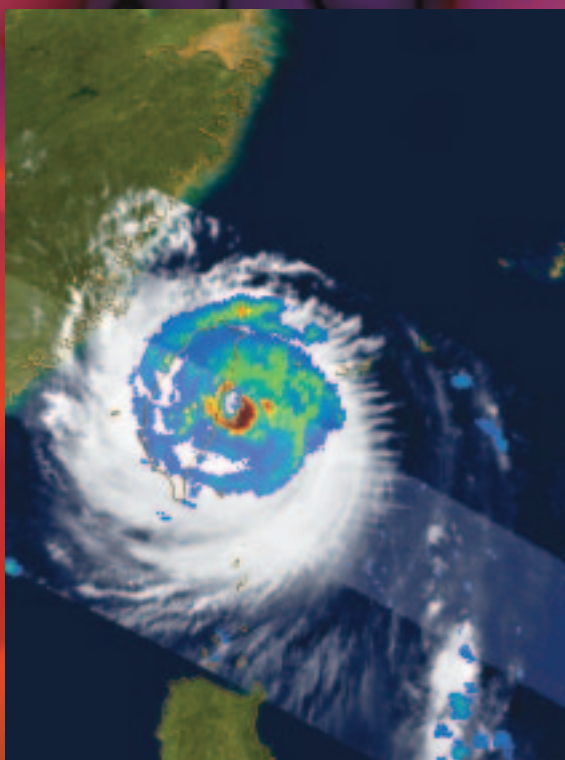
Scientists are still arguing about how fast the Earth is warming and how much it will warm. But they agree that within the next century - when you will be grandparents - the planet could be warmer by as much as 5.8°C to 11°C (according to the United Nations Intergovernmental Panel on Climate Change and Oxford University). This could cause the Earth's climate to be quite different to what it is today. For example, at the peak of the last ice age (18 000 years ago), the temperature was only about 4 °C colder than it is today. At that time, giant glaciers covered about a third of the land and oceans on Earth.

When the climate changes, there may be big changes in the things that people depend on.

The effects of global warming include:

- ☀ Rise in sea level and flooding. Global warming may make the sea level become higher. Why? Polar ice caps and glaciers (large sheets of ice, which move very, very slowly) are melting, adding more water to the ocean. Warmer temperatures also make water expand. When water expands in the ocean, it takes up more space and the level of the sea rises. Sea level may rise between several centimetres and as much as a metre during the next century. This will affect both natural systems and manmade structures along coastlines. Oceanfront property would be affected by flooding, and more vulnerable to storm waves. It could cost billions of rands to adapt to such change;
- ☀ Food and water shortages due to drought in areas such as Africa which are already dry in parts;
- ☀ Changing weather patterns, including an increase in hurricanes, cyclones, floods, heat-waves and droughts;
- ☀ Loss of biodiversity (the variety of life found on Earth) through the extinction of animals and

P2: Many scientists blame global warming for changing weather patterns, including an increase in hurricanes such as this one in the Pacific Ocean, as seen from space in October. Image: NASA



plants which need specific conditions to survive. Many habitats and ecosystems depend on a delicate balance of rainfall, temperature and soil type. A rapid change in climate could upset this balance and seriously endanger many living things;

Most past climate changes occurred slowly, allowing plants and animals to adapt to the new environment or move somewhere else. However, if future climate changes occur as rapidly as some scientists predict, plants and animals may not be able to react quickly enough to survive. The ocean's ecosystems also could be affected for the same reasons;

- ☀ Contamination of fresh water by sea water. Coastal flooding could cause saltwater to flow into areas where salt is harmful, threatening plants and animals;
- ☀ Effects on human health: The spread of infectious diseases such as malaria may increase; as will heat stress and other heat-related health problems.

What will happen if global warming continues?

Scientists can't say exactly what global warming will bring – but they can suggest trends which will occur. Some changes brought about by global warming might be good. If you live in a very cool climate – such as in the high Northern Hemisphere – warmer temperatures might be welcome because you can grow more food and live more comfortably. But it is also true that changes in some places will not be very good at all, especially for the natural plants and animals.

In places – such as much of the Southern Hemisphere where parts of continents are already dry and prone to drought – warming and drying predicted in these regions could be catastrophic.

Because it takes such a long time for heat which is trapped in the atmosphere to redistribute (the ocean helps to do this), there is a "lag" in the way global warming changes the climate. For instance, greenhouse gases released in this decade will only play out in the climate in 30 to 40 years from now. The changes we are already seeing are because of emissions from three to four decades ago.

Scientists say we are already committed to "dangerous" amounts of global warming.

What is being done about global warming?

Scientists agree that the burning of fossil fuels is causing global warming. Since these fuels are burned for energy, and everyone uses energy, everyone can help stop global warming just by using less energy.

An international agreement between countries, called the Kyoto Protocol, tries to limit the greenhouse gas emissions for developed countries, some of which are the worst polluters. This agreement also keeps check on the levels of gases being released globally. South Africa signed this agreement along with about 120 other countries. But the big problem with Kyoto is that some countries will not sign. The United States – which produces 20% of all the greenhouse gases (South Africa only produces 1.23%) – does not want to join the Kyoto agreement.

What can I do about global warming?

You don't have to wait until you are grown to do something about global warming. Think about the things you do each day that use energy. The lights in your house, the washing machine and TV all use electricity. Every time you ride in a car, it uses petrol.

There are some very simple things that everyone can do to help stop global warming:

- ❁ Turn off the lights when you leave a room. Use fluorescent bulbs.
- ❁ Turn off your computer or the TV when you're not using it. Unplug chargers when not in use.
- ❁ When boiling the kettle, only fill it with as much water as you need. Do not fill it up if you only need one cup of boiled water.
- ❁ Wait until you have a lot of clothes to wash before using the washing machine. Don't use the machine for one item just because it's your favourite shirt.
- ❁ Take shorter showers. Heating water uses energy.
- ❁ Close the curtains on a hot day if the sun is shining in.
- ❁ Dress more warmly when it's cold, instead of turning on a heater.
- ❁ Walk short distances instead of asking for a ride in a car.
- ❁ Buy food and vegetables that are grown in your community. Some items bought in a shop are transported from other parts of the world, which uses lots of energy.
- ❁ Plant a tree.
- ❁ Read and learn more about global warming so you can talk to people about it.
- ❁ Buy cool stuff. Some products – like certain cars and stereos – are made specially to save energy. Buy recyclable products instead of non-recyclable ones. Look for the recycle mark – three arrows that make a circle – on the package. Recyclable products are usually made out of things that have already been used. It usually takes less energy to make recycled products than to make new ones.

What does this mean?

ATMOSPHERE: The atmosphere covers the Earth. It is a thin layer of mixed gases which make up the air we breathe. This thin layer also helps the Earth from becoming too hot or too cold, much like clothing does for us.

WEATHER: The condition of the atmosphere in a given place at a given time. The weather can change a lot within a very short time. For example, it may rain for an hour and then become sunny and clear. Weather includes daily changes in precipitation, barometric pressure, temperature, and wind conditions in a given location. What is your weather like today?

CLIMATE: Describes the total of all weather conditions and patterns of a place/country over a long period of time (at least 20 years). Climate tells us what it's usually like in the place where you live. Gauteng has a mild climate, the Karoo has a dry climate and Durban a humid climate. How would you describe the climate where you live?

GREENHOUSE EFFECT: Certain gases which occur naturally in the atmosphere trap heat and keep the planet comfortably warm and liveable. This is called the "greenhouse effect". The gases responsible for this are "greenhouse gases": mostly carbon dioxide, nitrous oxide, and methane. Without these gases, heat would escape back into space and Earth would be about 30°C to 40°C colder than it is now.

Have you ever seen a greenhouse? They are used to grow plants, especially in winter. Greenhouses work by trapping heat from the sun. The transparent panels of the greenhouse let in light but keep heat from escaping. This causes the greenhouse to heat up, much like the inside of a car parked in sunlight, and keeps the plants warm enough to live in the winter.

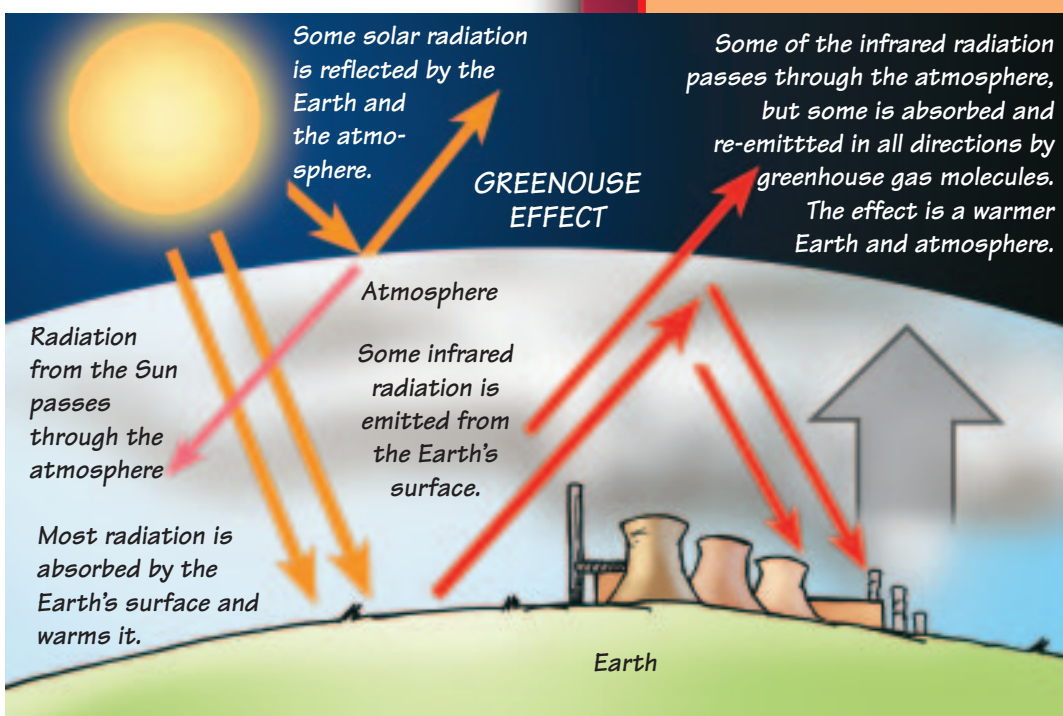
Greenhouse gases in the atmosphere behave much like the glass panes in a greenhouse. Sunlight enters the Earth's atmosphere, passing through the blanket of greenhouse gases. As it reaches the Earth's surface, land, water, and biosphere (the place where plants and animals, including humans, live) absorb the sunlight's energy. Once absorbed, this energy is sent back into the atmosphere. Some of the energy passes back into space, but much of it remains trapped in the atmosphere by the greenhouse gases, causing our world to heat up.

The greenhouse effect is important. Without the greenhouse effect, the Earth would not be warm enough for humans to live. But if the

greenhouse effect becomes stronger, it could make the Earth warmer than usual. As we have seen, even a little extra warming may cause problems for humans, plants, and animals.

GLOBAL WARMING:

An average increase in the Earth's temperature, which in turn causes changes in climate. A warmer Earth may lead to changes in rainfall patterns, a rise in sea level, and a wide range of impacts on plants, wildlife and humans.



CAREERS

What is a climatologist?

Climatologists study long-term trends in the climate, which can affect energy usage, food production, survival of endangered species, and even human health and life expectancy.

What does a climatologist do?

Climatology is one of the more adventurous environmental sciences. A climatologist might drill holes in polar ice, travel down the depths of the ocean, or journey to the tops of mountains to get data. You might be working with other scientists to capture marine animals and fit them with sensors; sampling plankton, fish, and insects; or maintaining sensor buoys out in the middle of the oceans. You might also write computer programs to model changes in climate or develop new ways of taking the Earth's temperature.

What to study if you want to become a climatologist

Important school subjects: All of the physical and biological sciences.

At university: Studying physics, meteorology, biology, zoology, botany, palaeontology, geology, entomology, microbiology, oceanography, astronomy, maths, computer science, and, of course, climatology will give you solid grounding for doing climatological research.

Heatwaves, drought and fires go hand-in-hand. Images of these huge fires in northern Australia were captured by a NASA satellite in October.



What is the difference between “global warming” and “climate change?”

“Global warming” refers to the increase of the amount of heat trapped in the Earth’s system, due to a build-up of greenhouse gases in the atmosphere. “Climate change” is a broader term that refers to long-term changes in climate, including average temperature and precipitation.

How do scientists know about climate change?

Scientists have to think like detectives. They look for clues to help them understand how the world works. Then they investigate these clues to find evidence – real facts that can give them a better idea of what is going on.

Here are some of the ways that scientists gather evidence about climate, both past and present:

Weather Stations

Weather stations help us find out the temperature on the surface of the Earth; they can tell us how fast the wind is moving and how much rain falls on the ground during a storm.

Weather Balloons

Almost everyone likes balloons - including scientists! Weather balloons are released to float high up into the atmosphere. They carry special instruments that send all kinds of information about the weather back to people on the ground.

Ocean Buoys

A buoy is an object that floats on water, and is often used to warn boats away from dangerous places in the ocean or on a river. But some buoys have special instruments on them. These buoys can tell us the temperature and other things about the conditions of the atmosphere.

Weather Satellites

Satellites that travel around the Earth send back information to scientists on the ground. Some of the information they give us is about the weather and the Earth’s temperature.

Ice Cores

Some scientists who want to find out more about climate study ice from glaciers for clues. They cut pieces of ice and look for air bubbles that were trapped in the ice hundreds or even thousands of years ago. The air bubbles help them discover what the composition of the atmosphere used to be like on Earth.

Sediment Analyses

Sediment is the earth and rock that has built up in layers over time. Scientists are learning a great deal about past climate from studying these layers. Sediment layering provides information about where glaciers have been in the past. Ocean sediments provide a map of how ocean currents have flowed in the past. Fossilised pollen found in sediment layers tells us about where different plants have grown in the past.

Tree Rings

You can tell how old a tree is by counting its rings because it grows a new ring every year. Scientists study the sizes of tree rings. The different sizes of the rings tell us about changes in temperature and precipitation (rain or snow or any other moisture that falls to the Earth).

What are scientists still unsure about?

How do clouds respond to changes in temperature and precipitation? How do oceans transport heat? How do climate and intense weather events like hurricanes affect each other? As scientists try to answer these and other questions, they will discover many more clues about how the Earth’s climate system works.