

FACTFILE: GCSE BIOLOGY: UNIT 1.7



Global Warming

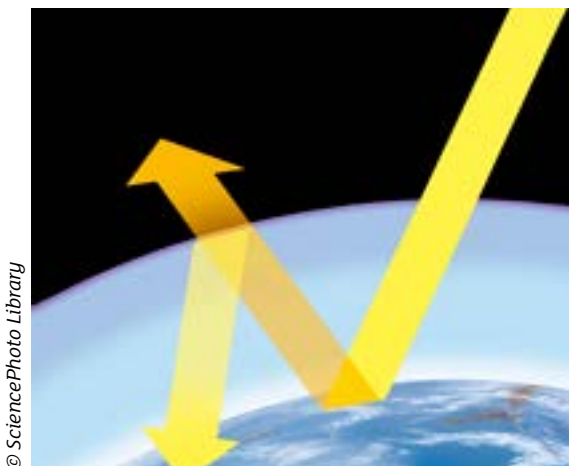
Learning outcomes

Students should be able to:

- 1.7.12 evaluate the evidence for how environmental change affect the distribution of organisms, limited to increasing levels of carbon dioxide leading to global warming and demonstrate knowledge and understanding of:
 - the causes, including combustion of fossil fuels and deforestation;
 - the problems associated with this, including: increasing temperatures; increasing frequency of extreme weather; and loss of habitats.

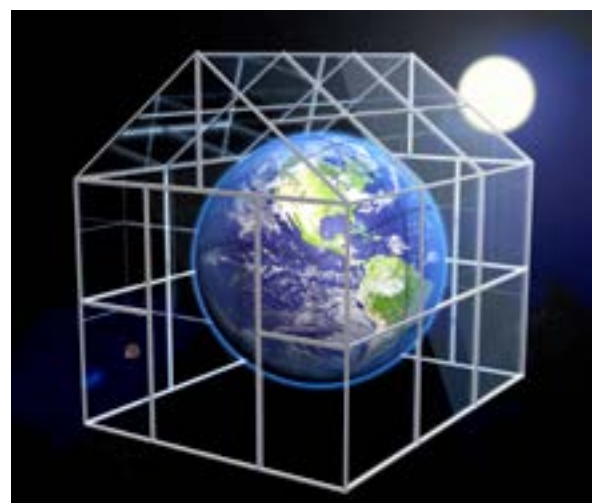
Living in a Greenhouse

The average surface temperature of Earth is about 15°C, warm enough for liquid water, making it suitable for our sort of life. This is not just because our planet is just the right distance from the sun. This comfortable temperature is also the result of having just the right kind of atmosphere.



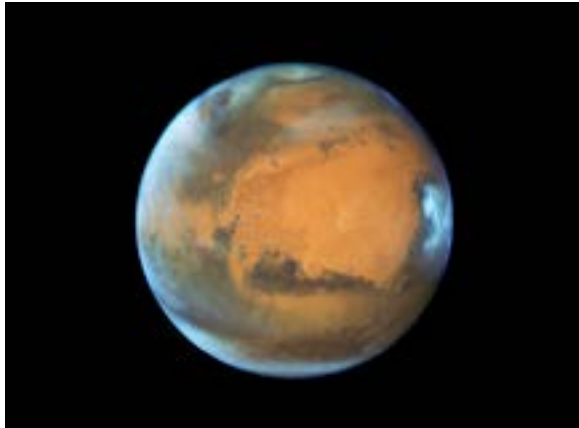
Life on Earth depends on energy that comes to us as sunlight. The diagram below shows what happens to the energy when it reaches the Earth. The light reaching Earth's atmosphere passes through the air and clouds to the surface, where it is absorbed as heat. The heat is then radiated back into the atmosphere and towards outer space. Parts of our atmosphere act as an insulating blanket, trapping about 90% of the radiated heat and keeping the global temperatures within a pleasant range for life on Earth.

The blanket here is a collection of atmospheric gases called 'greenhouse gases' and the effect of the gases is called the greenhouse effect, based on the idea that the gases trap heat like the glass walls of a greenhouse.



The greenhouse effect is important for life on Earth, any changes that strengthen or weaken the greenhouse effect can dramatically alter the conditions we live in. We can see the importance of

the greenhouse effect by looking at the two planets closest to us, Mars and Venus.



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Not enough greenhouse effect. The planet Mars has a very thin atmosphere with not enough carbon dioxide or water vapour to produce a greenhouse effect. The surface of Mars has an average temperature of -55°C and cannot support life.



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Too much greenhouse effect. Venus has about 300 times as much carbon dioxide in its atmosphere as Earth, producing an extreme greenhouse effect and giving Venus a surface temperature of 460°C , too hot for any living thing.

What are the Greenhouse Gases?

Greenhouse gases come from a variety of sources. Most are produced naturally, but some are generated by humans. The gases are part of natural cycles that release and then absorb the gases over time keeping their levels in the atmosphere relatively stable over time.

The main greenhouse gases are:

Water vapor, the most abundant greenhouse gas. Evaporation from the oceans and transpiration from plants is the main source of water vapor in the atmosphere.

Carbon dioxide (CO_2), a small part of the atmosphere but a very important component of the greenhouse effect. Carbon dioxide is released through natural processes such as volcanic eruptions, forest fires and respiration. Human activities such as deforestation and burning fossil fuels have greatly increased atmospheric CO_2 concentrations.



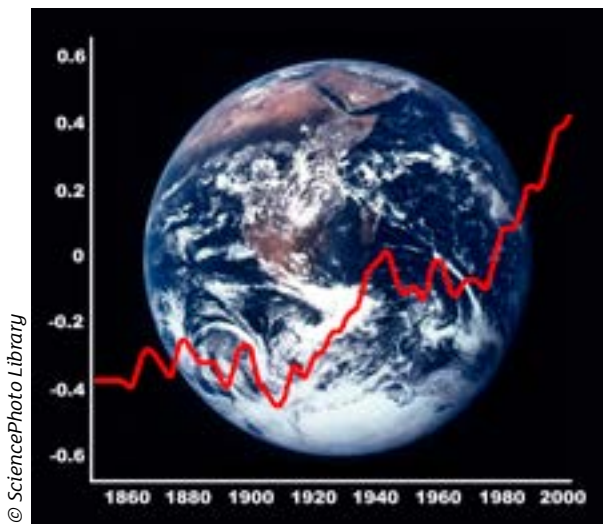
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Methane, a stronger greenhouse gas than carbon dioxide, but much less abundant in the atmosphere. It is produced both through natural sources and human activities, including the decomposition of waste and agriculture, especially rice farming and animal farming.

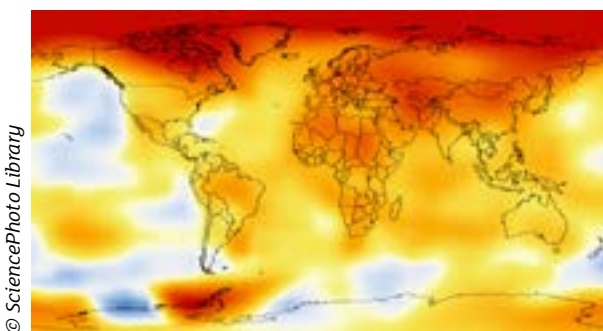
Nitrous oxide, a powerful greenhouse gas produced by burning fossil fuels and also by certain farming practices, especially the use of commercial fertilizers.

Is the Earth getting warmer?

Temperature measurement using thermometers began in the 1860's, and the graph below shows change in average global temperature since that time. Although there is variation between years there is a clear trend of warming over time. The measurements show that temperatures have increased significantly in the last 50 years. This rapid increase is called global warming.



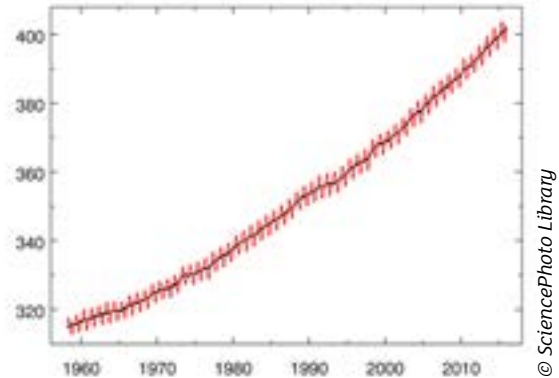
The ten warmest years since records began have all have occurred after the year 2000, with 2015 being the warmest on record. The map below shows how the warming is distributed around the world. The areas in red are places that have experienced higher than average temperatures during the last 5 years.



What is causing global warming?

On Earth, human activities are changing the natural greenhouse effect. Since the start of industrial revolution, there has been a huge increase in the burning of fossil fuels like coal and oil for energy for homes, industries and transportation of people and goods. This has increased the concentration of greenhouse gases in the atmosphere. The graph

below shows the change in the level of CO₂ over time.



To a lesser extent, deforestation and the clearing of land for agriculture, industry, and other human activities has disturbed the natural processes which absorb CO₂ from the atmosphere. This means that CO₂ is being removed at a slower pace than before.

The Intergovernmental Panel on Climate Change, a group of 1,300 scientific experts from countries all over the world gathered by the United Nations, concluded that: "Human influence on the climate system is clear, and recent emissions of greenhouse gases are the highest in history."

The report they produced stated that there's a better than 95% probability that human activity and human-produced greenhouse gases have caused much of the observed increase in Earth's temperatures, especially over the past 50 years.

What might be the effects of global warming?

The climate system is very complicated, this makes it difficult to predict exactly the consequences of global warming. However, we have already been able to observe some effects of climate change on the environment.

Melting of polar ice and sea level rise

The poles are especially sensitive to warming and areas such as Greenland, the Arctic and Antarctica have seen a loss of ice cover. This has caused a loss of habitat for species such as polar bears that live on the ice. The melting glaciers are also causing more water to enter the oceans. At the same time the oceans are heating up causing their water to expand. This has resulted in a rise in sea levels that

has lead to more coastal flooding and threatens to completely cover many coastal cities and low lying countries in the next few decades.



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More extreme weather

As the planet continues to warm, the extra heat is causing large scale changes to the weather. Hotter summers mean that heat waves and droughts are more common. Changes in rainfall also mean that some areas will receive more rain, increasing the risk of flooding.

Warmer sea temperatures have also led to hurricanes and tropical storms being more frequent and more powerful. The frequency of the strongest hurricanes (Category 4 and 5) has increased since the 1980's.



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Sea level rise will also make storms more destructive as it will allow them to affect places further inland.

Changing distribution of plants and animals

As the climate changes the habitats of plants and animals will also change. For some species this may mean that they are able to spread further. For example mosquitos prefer warm, wet environments and warmer temperatures will allow them to move to new habitats. This may cause an increase in diseases carried by mosquitoes such as malaria.

However in many cases such as arctic or alpine habitats, the species may not be able to find suitable habitats to move to and may die out and become extinct.

Changes in growing conditions are also likely to affect food plants. Areas used for farming now may become unsuitable as the temperature or rainfall changes. New areas would need to be cultivated or more effort would have to be made to keep the current areas fertile.

How can we respond?

Global temperatures are predicted to continue increasing through this century. For humanity there are three ways of responding to global warming and the climate change it is producing:

1. **Do nothing and live with the consequences.** There is a very small probability that human activity is not causing global warming and the climate may cool down due to natural processes.
2. **Adapt to the changing climate.** Instead of trying to influence the climate we can attempt to deal with the effects of climate change like droughts and sea level rise as they happen with engineering or economic solutions.
3. **Try to reduce the impact of climate change.** Attempt to deal with the cause of the problem by getting governments to make policies that actively reduce the concentration of greenhouse gases in the atmosphere.

All of these responses may have negative consequences that we cannot yet predict so there is still much debate about which is the best course of action.

Glossary

Greenhouse effect: The trapping of solar energy in a planet's atmosphere by certain gases.

Greenhouse gases: Gases that are good at absorbing and then emitting heat energy into the atmosphere. The main greenhouse gases are water vapour, carbon dioxide and methane.

Global warming: The trend of rapidly increasing global temperatures in the last 50 years.

Fossil Fuels: Natural fuels that were formed millions of years ago from the remains of living things. Coal, oil and natural gas are all fossil fuels.

Climate Change: The change in the distribution of long term weather patterns around the Earth or in a region of the Earth.

Learning activities

1. The climate and global temperatures have changed throughout the history of the Earth before humans appeared. Investigate what are some of the natural processes that have caused climate change in the past.
2. What are the main human sources of greenhouse gases? Draw a graph to show the relative amounts each source produces.
3. What can be done to reduce the emission of greenhouse gases at a national level and at the level of individuals?
4. Choose a particular species of plant or animal. Investigate how climate change might affect your chosen species.
5. Why might some governments and countries be reluctant to try and reduce their emissions of greenhouse gases?
6. Research some of the criticisms of the idea that human activity is causing global warming. How could you respond to these criticisms?

