

ENVIRONMENTAL CHEMISTRY AND OCEAN ACIDIFICATION

LESSON 2

WHAT IS GLOBAL WARMING?



SAILDRONE

This lesson is intended to explain and extend student's understanding of global warming.

LESSON OBJECTIVES

We are learning about the impact of human activity towards global warming.

1	2	3	4
IDENTIFY the term global warming	DESCRIBE the difference between global warming and climate change	EXPLAIN the effect greenhouse gases have on global warming using a lab example	CONNECT and apply human activity to a rise in global temperatures



US: Next Generation Science Standards

MS-ESS3 Earth and Human Activity

MS-ESS3-1 – Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy and groundwater resources are the result of past and current geoscience processes.

MS-ESS3-2 – Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

MS-ESS3-3 – Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4 – Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems.

MS-ESS3-5 – Ask questions to clarify evidence of the factors that have cause the rise in global temperature over the past century.

KS3 Science curriculum

Earth and atmosphere: the production of carbon dioxide by human activity and the impact on climate

Earth and atmosphere: the composition of the atmosphere

Working scientifically

Experimental skills and investigations: select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate

Experimental skills and investigations: use appropriate techniques, apparatus, and materials during
Experimental skills and investigations: make and record observations and measurements using a range of methods and suggest possible improvements

Analysis and evaluation: interpret observations and data, including identifying patterns and using observations to
Analysis and evaluation: present reasoned explanations, including explaining data in relation to predictions
Analysis and evaluation: identify further questions arising from their results.

KEY VOCABULARY

Climate change	A change in global or regional climate patterns due to increased levels of atmospheric carbon dioxide produced from burning fossil fuels.
Control variable	A variable which may affect the outcome of an investigation and must be kept constant.
Dependent variable	The variable which is being measured after the change in the independent variable is made.
Global warming	A gradual increase in the overall temperature of the Earth's atmosphere caused by an increase in greenhouse gases.
Greenhouse gases	Gases that contribute to global warming by preventing heat from escaping the Earth's atmosphere. These include carbon dioxide (CO ₂) and CFCs.
Independent variable	The variable for which values are changed or selected for an investigation.

WHAT IS GLOBAL WARMING?

What do these pictures have in common?



Display slide and ask students to discuss and create a definition of global warming. Share in pairs, small groups or the whole class. Display definition of global warming. What does this mean? In what ways does it effect our planet?

For extra information, see the teacher's notes.

WHAT IS GLOBAL WARMING?

Using the pictures and your background knowledge, write a definition for global warming.

Definition

Global warming is ...



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Prompt the students to think about what global warming is.
What do you think global warming is? What does this mean? In what ways does it effect our planet? How are the pictures all related?

For extra information, see the teacher's notes.

WHAT IS GLOBAL WARMING?

Using the pictures and your background knowledge, write a definition for global warming.

Definition

Global warming is the increase in the overall temperature of the Earth's atmosphere.

This is due to rising greenhouse gases levels, including carbon dioxide (CO₂).



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Display definition of global warming. What does this mean? In what ways does it effect our planet?

For extra information, see the teacher's notes.

GLOBAL WARMING: SOURCES?

Burning fossil fuels
Burning fossil fuels, such as coal, oil and natural gases release vast quantities of carbon dioxide into the atmosphere.

Deforestation
When green plants photosynthesize, they remove carbon dioxide from the atmosphere. Much of this carbon is stored in the plant. When they are removed or burnt, carbon is released back into the atmosphere as CO₂. After removal, they can no longer remove CO₂ from the atmosphere.

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Additional Information:

Globally, fossil fuel-based energy is responsible for approximately 60% of human greenhouse gas emissions.

Up to 20% of global greenhouse gas pollution comes from deforestation and forest degradation.

The third biggest contributor to human greenhouse gas emissions is through animal agriculture, which is responsible for 15% of human greenhouse gas emissions. Some of this is through CO₂ emissions, but much is through methane emissions.

Estimates from the [World Resources Institute](#), [UN Food and Agriculture Organization](#), and [Pitesky et al. 2009](#)

Deforestation:

Humans clear vast areas of vegetation around the world for farming, urban development or to sell tree products like timber and palm oil. When vegetation is removed or burnt, the stored carbon is released back into the atmosphere as CO₂, contributing to global warming.

Animal agriculture:

Deforestation to create pasture land and arable land used to grow feed crops for animals. This is responsible for 9% of human carbon dioxide emissions. Cattle produce methane (CH₄), which is a greenhouse gas about 20 times stronger than carbon dioxide. Livestock are responsible for about 37% of human-caused

methane emissions. A third greenhouse gas, nitrous oxide (N_2O) is also released, mainly from man

GLOBAL WARMING

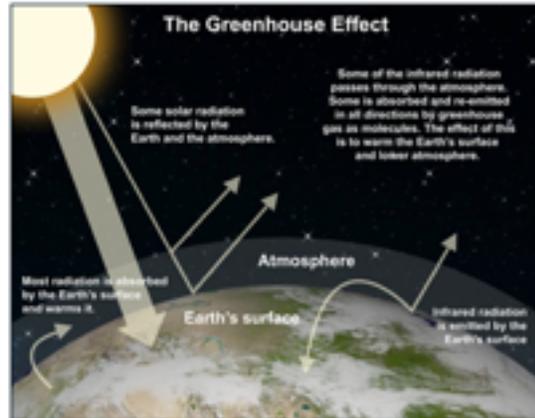
Watch the video



Watch the video from the resources.

WHAT IS THE GREENHOUSE EFFECT?

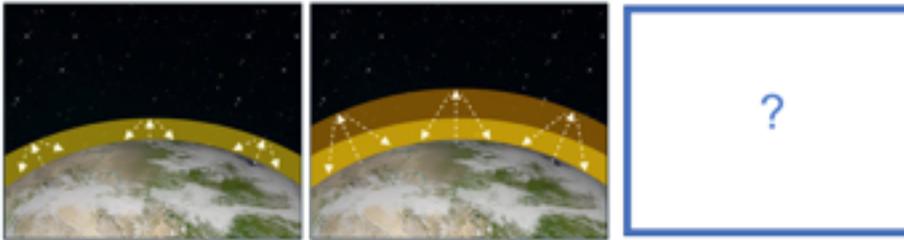
- Energy from the sun in the form of light and heat enter the Earth's atmosphere.
- Most heat energy is absorbed by the Earth's surface, which warms the planet.
- Some heat energy is reflected back, passes through the atmosphere and back into space.
- Greenhouse gases, such as carbon dioxide and methane, stop some of that extra heat energy leaving the atmosphere. These gases trap the heat and re-emitting it back towards Earth. This is the **greenhouse effect**.



Explain that, like water, the amount of carbon on Earth is finite and fixed – however, it can move from one place to another..

GREENHOUSE GASES AND GLOBAL WARMING

Imagine that greenhouse gases are like a scarf helping to keep the planet warm. As more greenhouse gases are released into the atmosphere, it is like wearing a thicker and thicker scarf until you end up too hot. The more greenhouse gases present, the more heat energy trapped in the atmosphere. Therefore, there is more warming of the Earth's surface taking place. This is **global warming**.

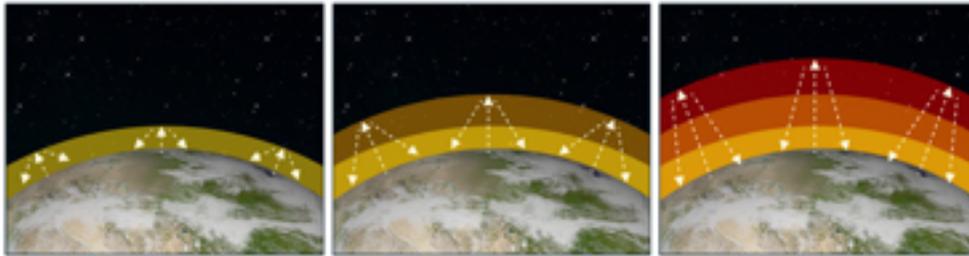


These diagrams help with the analogy of a scarf and the experiment. However, it is important that students understand that it is not actually increased layers of greenhouse gases but in fact increased concentration. This is demonstrated if just looking at the first yellow 'band' of atmospheric gases on the diagram becoming yellower in each subsequent diagram.

Prompt students to predict what the third picture might look like if we follow the trends we know about global warming.

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DEFINITION: GLOBAL WARMING AND CLIMATE CHANGE

GLOBAL WARMING

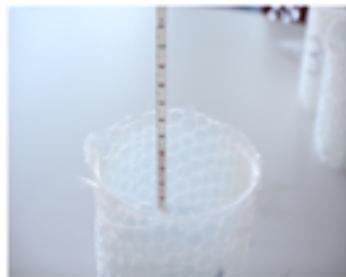
Global warming is the increase in the overall temperature of Earth's atmosphere. This temperature rise is due to rising levels of greenhouse gases, including carbon dioxide.

CLIMATE CHANGE

Climate change is a broader term that includes any changes in the climate, such as changing rain and snow patterns, increasing storms and droughts, as well as increasing global temperatures.

GLOBAL WARMING LAB

- You will be carrying out an investigation to demonstrate how greenhouse gases lead to global warming.
- You will use a container with hot water inside to represent the Earth and bubble wrap to represent greenhouse gases.



The investigation that the students carry out will mimic having additional greenhouse gases in the atmosphere (additional layers of scarves to use the analogy from the previous slide) by adding additional layers of bubble wrap to help insulate a container filled with hot water. On Earth, less heat is able to escape the atmosphere as greenhouse gas levels increase. This leads to global warming. In the investigation, students will be measuring how quickly the water cools. Because not all the heat is being contained by the bubble wrap, and more heat is not being added, the water will eventually cool. It is important that students see the connection between the water cooling more slowly and the global temperature increasing.

VARIABLES

INDEPENDENT
VARIABLE

Number of layers of bubble wrap

DEPENDENT
VARIABLE

Temperature of the water

CONTROL
VARIABLE

Starting temperature of water
Container
Length of time between measurements
Amount of water

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PROJECT



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GLOBAL WARMING LAB

Equipment	Method
3 equally-sized containers 6 sheets of bubble wrap Hot water Thermometer Timer/stopwatch	<ul style="list-style-type: none"> ➤ Set up three equally-sized containers. ➤ Cover Container #1 in one layer of bubble wrap, Container #2 in three layers of bubble wrap and Container #3 in six layers of bubble wrap ➤ Pour equal amounts of hot water into each container (take care when using hot water) ➤ Record the initial temperature of each container. ➤ Take temperature measurements every three minutes and record in data table.



Health and Safety:

Before carrying out any experiment refer to CLEAPSS or Flinn Scientific for risk assessment information.

Teacher should encourage students to consider safety expectations before lab begins. Students should be directed and reminded of safety expectations before starting their experiment. It is important they recognize the need to work carefully with hot water to prevent spills and burns.

GLOBAL WARMING LAB

Time	Temperature of Water (°C)		
	Container # 1 1 layer of bubble wrap	Container #2 3 layers of bubble wrap	Container #3 6 layers of bubble wrap
0 minutes			
3 minutes			
6 minutes			
9 minutes			
12 minutes			
15 minutes			
18 minutes			



Table for students to use as needed

Health and Safety:

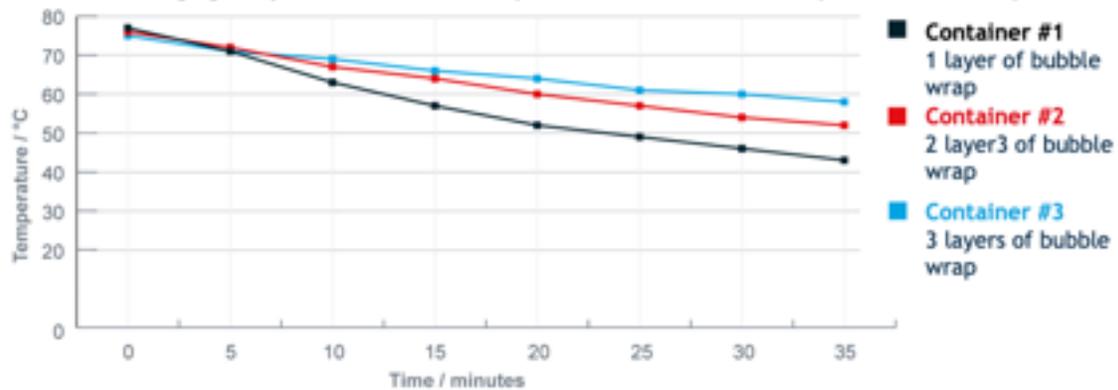
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Extension: Time permitted, have students graph their data using graph paper and pencils. Students can identify anomalous (outlying) results, draw lines of best fit and explain trends in more detail.

GLOBAL WARMING LAB

The Changing Temperatures of Water: Dependent on the Number of Layers of Bubble Wrap



This graph is an example of the results the students might expect to see.

Questions to prompt students analysis of data:

- Which container's temperature was reduced the most in 12 minutes. Why do you think this is?
- What was the difference between container 1 and 3 after 6 mins? After 18 mins?
- Do you think that the temperature in the containers would continue to drop? For how long? What is the lowest temperature each container will reach? – *Discuss the fact that the temperature in the containers will not drop below the ambient temperature (room temperature).*

WRITING CONCLUSIONS

STEP 1: WHAT IS THE PATTERN?

- Look at your table and describe any patterns:**
- Are there any unusual results?
 - How clear is the pattern?

STEP 2: WHAT DOES THIS SHOW?

- Use sentence starters like:**
- My experiment shows that...
 - In general this shows...
 - I conclude that...

STEP 3: WHAT DOES THIS MEAN?

- Explain your conclusion:**
- What scientific concepts explain your conclusion?
 - If you were to complete this experiment again, what would you change or improve?



EXAMPLE CONCLUSION

STEP 1

Respiration is a chemical process in which all living things use oxygen (O_2) and glucose to produce carbon dioxide (CO_2), water and energy.

STEP 2

Green plants absorb light energy and carbon dioxide (CO_2) to make food (glucose) and release oxygen (O_2) in a process called photosynthesis.

STEP 3

The layers of bubble wrap are insulating the water, which slows the drop in water temperature. This is similar to global warming. In global warming, the carbon dioxide acts as an insulator, trapping heat in the Earth's atmosphere.



Example of the student's conclusion. Remind the student's that their conclusion should reflect their lab and what they have learned. Urge them write the information in their own words.

Extension: Have the students reference specific data points from their lab in their conclusion. In addition, have students include predictions about trends if the lab were to continue and predictions for the future affects of global warming.

ATMOSPHERIC CARBON DIOXIDE - GOOD OR BAD?

**TOO MUCH
CO₂**

With large amounts of greenhouse gases in our atmosphere, our climate will continue to get hotter and hotter. Venus, which has huge amounts of greenhouse gases in its atmosphere, is regularly 400° C.

TOO HOT !

**TOO LITTLE
CO₂**

If there were no greenhouse gases in our atmosphere, the planet wouldn't be able to store the heat from the sun. Without greenhouse gases, the Earth would be -18° C!

TOO COLD

Greenhouse gases have an important role to play in stopping the planet becoming too hot or too cold. As greenhouse gas emissions increase, temperatures will increase. This will apply new and increases pressures on ecosystems, habitats and organisms.



Have the student discuss the title, 'Atmospheric Carbon Dioxide – Good or Bad?' before reviewing the facts and information on the slide.

MISCONCEPTIONS? THE FUTURE? WHAT DO YOU THINK?



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Use this cartoon to promote discussion over the impact of global warming, globally and for the UK.

One of the common misconceptions about global warming is that all areas of the globe will get warmer. Global warming is based on changes to the average global temperature. While there are no certainties over the effects of global warming, some of the main predictions for the UK include:

1. More flooding and at unusual times of the year (the UK may have wetter winters and dryer summers).
2. Average UK temperatures may increase. However, some scientists suggest that global warming could lead to abrupt changes in the Gulf Stream, which currently keeps the UK 5°C warmer than it would be otherwise. If the Gulf Stream changes, this could lead to a decrease in temperature.
3. Rising sea levels, mainly due to expansion of water due to ocean warming.
4. Changes in habitats and knock-on effects for UK animal and plant populations.
5. Increases in heat related deaths.
6. Increases in invasive species.

GLOBAL WARMING EFFECTS: THE SCIENTIFIC PREDICTIONS

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- Average UK temperatures may increase. However, some scientists suggest that global warming could lead to abrupt changes in the Gulf Stream, which currently keeps the UK 5°C warmer than it would be otherwise. If the Gulf Stream changes, this could lead to a decrease in temperature.
- Possible increases in heat related deaths.
- Due to ocean warming, sea levels will rise from water expansion.
- Changes in habitats and knock-on effects for UK animal and plant populations.
- Increases in invasive species.

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Alex – more research into teacher notes

SELF ASSESSMENT

✓	I can identify the term global warming.
✓	I can describe the difference between global warming and climate change.
✓	I can explain the effect greenhouse gases have on global warming using a lab example.
✓	I can connect and apply human activity to a rise in global temperatures.



Students can self-assess according to your school's assessment system.

US: Next Generation Science Standards

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NEXT LESSON - WHAT IS pH?

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