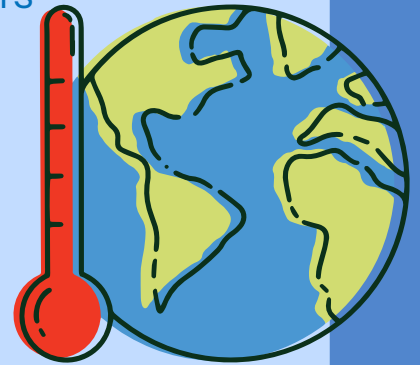


Simulating the Greenhouse Effect and the Impacts of Heatwaves on Organisms

For Students Aged 12-15

A Ready-to-Use Activity Pack for Teachers

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Content List

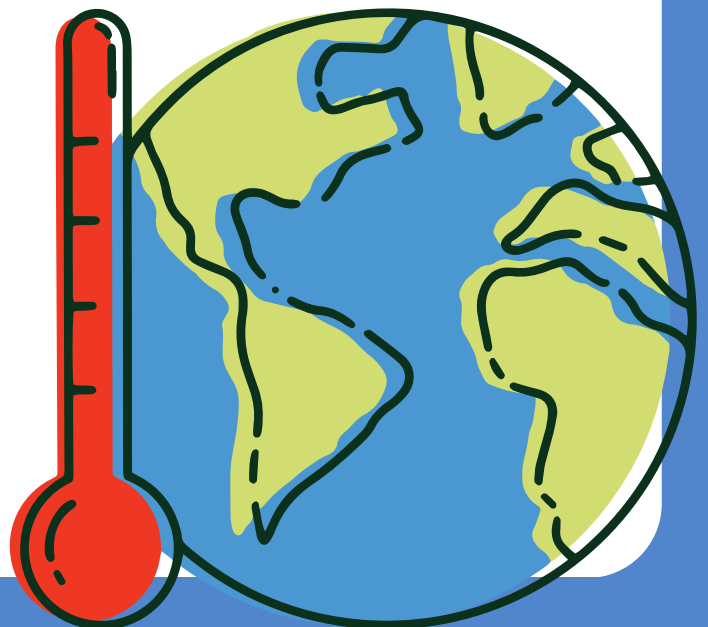
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Activity: Simulating the Greenhouse Effect

Learning Goal

Students will understand how greenhouse gases (GHGs) in the atmosphere affect how much heat stays on Earth by intercepting outgoing energy.

Materials

- Open classroom space
- Optional:
 - Yellow cards or balls = Sunlight (incoming energy)
 - Red cards or balls = Heat (outgoing energy)
 - Tape or cones to mark areas (Sun, Earth, Atmosphere)

Roles of Students

Students are divided into two main groups, with roles added as the activity progresses.

- Light/Energy Students – represent sunlight and heat
- GHG Students – represent greenhouse gases in the atmosphere

Setup

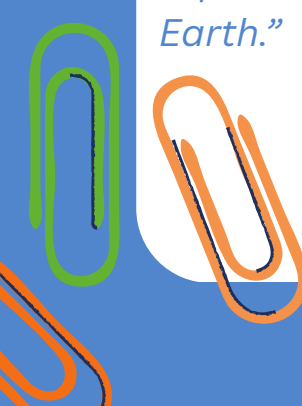
- Designate one side of the room as the Sun.
- Designate the opposite side as the Earth's surface.
- The space in between represents the Atmosphere.
- At the beginning, no GHG students stand in the atmosphere.

Step-by-Step Instructions

Step 1: Incoming Sunlight (No Greenhouse Gases)

1. Select a group of students to be Sunlight.
2. They start at the Sun side (direction).
3. On your signal, they walk straight to the Earth.

Explain: "Sunlight passes easily through the atmosphere and reaches Earth."



Step 2: Heat Leaving the Planet (No Greenhouse Gases)

1. Once sunlight reaches Earth, those students now become Heat Energy.
2. They turn around and walk back toward space (the Sun side).

Explain: "Some energy leaves Earth as heat and escapes into space."

Observation: Most heat escapes → the planet stays cooler.

Step 3: Introduce Greenhouse Gases (Low GHG Level)

1. Choose 2–3 students to be Greenhouse Gases.
2. They stand spread out in the atmosphere area.
3. Repeat Steps 1 and 2:
 - Sunlight enters normally.
 - Heat tries to leave Earth.
4. New rule:
 - If a GHG student gently tags a Heat student, the heat must:
 - Stop
 - Turn around
 - Return to surface of the Earth
5. Explain: "Greenhouse gases absorb and re-emit heat, sending some back toward Earth."

Observation: Some heat escapes, some stays and Earth warms slightly.

Step 4: Increase Greenhouse Gases (High GHG Level)

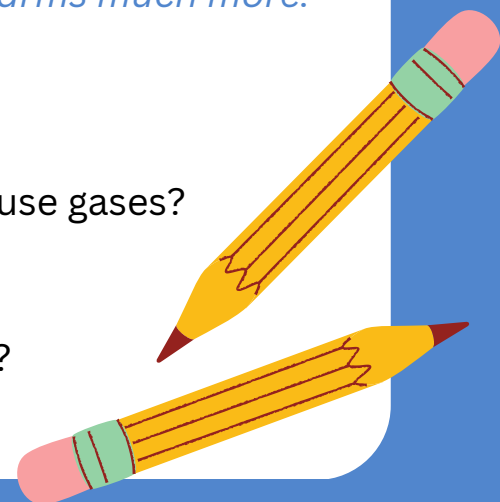
1. Add more GHG students to the atmosphere.
2. Spread them evenly across the space.
3. Repeat the energy movement again.
4. Most Heat students will now be intercepted and sent back.

Observation: Very little heat escapes and Earth warms much more.

Step 5: Reflection and Discussion

Ask students:

- What happened when we added more greenhouse gases?
- Did sunlight change, or did heat change?
- Why does Earth get warmer with more GHGs?
- What might happen if we removed some GHGs?



Key teaching moment: “Greenhouse gases don’t stop sunlight from coming in, but they slow down heat from leaving, which causes the planet to warm.”

Optional Extensions

- Assign different GHG types (CO₂, methane, water vapor)
- Time how long heat stays in the system
- Introduce the heat impact on organisms (extension activity)

Extension Activity: Impacts of Heatwaves on Organisms

Learning Goal

Students will understand that increased heat affects living organisms differently, depending on their tolerance, mobility and ability to adapt.

Extension Setup (New Roles)

Add a third category of students:

New Roles

- Humans – moderate heat tolerance
- Animals – varied heat tolerance and mobility
- Plants – low mobility, low heat tolerance

You can assign:

- 2–3 Humans
- 2–3 Animals
- 2–3 Plants

Have them stand on the Earth area.

Extension Rules (Step by Step)

Step 1: Normal Temperature (Few GHGs)

1. Run the greenhouse game with few greenhouse gases.
2. When a Heat student returns to Earth, they gently tag an organism.
3. First tag = organism is comfortable (no action needed).

Observation: Most organisms function normally.



Step 2: Rising Heat (More GHGs)

1. Add more GHG students.
2. Run the game again.
3. New rule:
 - Each time an organism is tagged by heat, they lose 1 energy point.
 - You can represent energy points with fingers

Organism Responses:

- Humans: After 2 tags (2 lost energy points) → must sit down briefly (heat stress)
- Animals: After 2 tags → must move to a “cooler area” (migration)
- Plants: After 2 tags → must sit and cannot move

Step 3: Extreme Heat

1. Add the maximum number of GHG students.
2. Run the game again.
3. New rule:
 - After 3 heat tags, organisms are “unable to function”:
 - Humans → health emergency
 - Animals → population decline or death
 - Plants → wilting or crop failure

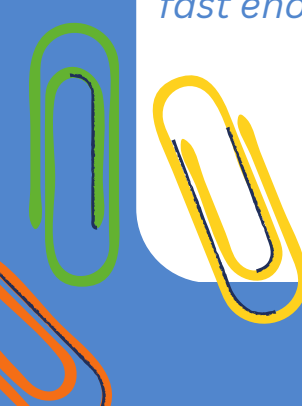
Observation: Different organisms are affected by heat at different rates.

Step 4: Reflection and Discussion

Ask students:

- Which organisms were affected first? Why?
- Which organisms could move away from heat?
- Why are plants especially vulnerable?
- How does human technology help humans cope with heat?

Key teaching moment: “All organisms depend on a stable temperature range. When heat builds up too quickly, many species cannot adapt fast enough.”



Optional Extension

- Assign adaptations:
 - Humans: air conditioning, clothing, behaviour change
 - Animals: nocturnal behaviour, migration
 - Plants: drought resistance (limited)
- Run the game again and observe how adaptations help organisms mitigate the problem.
- Find examples of species with named adaptations.

Final teaching moment: “Climate change is not just about temperature—it’s about how heat affects living systems, food, health and survival.”



Worksheet: Simulating the Greenhouse Effect and the Impacts of Heatwaves on Organisms

Name: _____

Date: _____

Class: _____

Part 1: Before the Activity (Prediction)

1. What do you think greenhouse gases do in Earth's atmosphere?

- Let more sunlight in
- Trap heat
- Block all energy
- I am not sure

2. Prediction:

What do you think will happen to Earth's temperature if we add more greenhouse gases?

Part 2: Observations During the Activity

Round 1: No Greenhouse Gases

3. What happened to the sunlight entering the atmosphere?

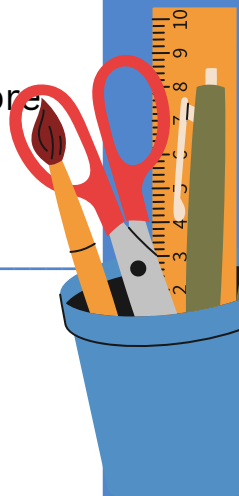
- Most reached Earth
- Most was blocked

4. What happened to the heat leaving Earth?

- Most escaped into space
- Most stayed near Earth

5. Earth's temperature would most likely be:

- Cooler
- Warmer



Round 2: Some Greenhouse Gases

6. What happened when heat met a greenhouse gas student?

7. Compared to Round 1, more heat:

- Escaped
- Stayed near Earth

Round 3: Many Greenhouse Gases

8. When more greenhouse gases were added, what changed?

(Check all that apply)

- More heat was sent back to Earth
- Less heat escaped to space
- Sunlight was blocked

9. Earth's temperature would now be:

- Much cooler
- Slightly warmer
- Much warmer

Part 3: Understanding the Science

10. Which type of energy passes easily through the atmosphere?

- Heat
- Sunlight

11. Which type of energy is trapped by greenhouse gases?

- Heat
- Sunlight

12. Complete the sentence:

Greenhouse gases cause Earth to warm because they ...



Part 4: Reflection Questions (Short Answer)

13. Did greenhouse gases stop sunlight from entering Earth's atmosphere? Why or why not?

14. How did adding more greenhouse gases change the system?

15. Name one greenhouse gas found in Earth's atmosphere: _____

Part 5: Real-World Connection

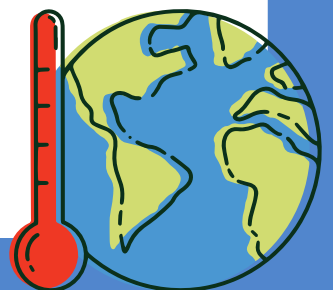
16. Human activities such as burning fossil fuels increase greenhouse gases. Based on this activity, what effect does that have on Earth's climate?

17. If Earth had no greenhouse gases at all, what do you think would happen to life on Earth?

Part 6: Heat and Living Organisms

18. Which organism was least able to escape heat?

- Humans
- Animals
- Plants



19. Why are plants more vulnerable to rising temperatures?

20. How did animals respond differently from plants?

21. How extreme heat affects humans in real life?

- Heat stroke
- Water shortages
- Crop failure
- All of the above

Part 7: Drawing

22. Make a drawing representing how greenhouse gases affect life on Earth.



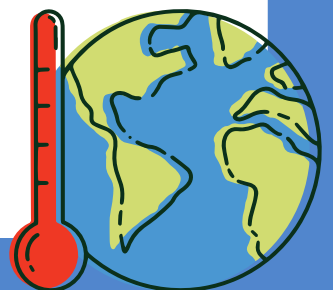
Part 8: “What Can We Do?”


Example ideas to connect climate change to everyday life.

- saving energy at home and school
- using public transport, biking, or walking
- reducing waste and recycling
- protecting forests and green spaces
- saving water (shorter showers, turning off the tap)
- eating more local and seasonal food
- reducing food waste
- reusing items (bags, bottles, school supplies)
- planting trees or plants and caring for school gardens
- talking about climate change with family and friends

21. Take Action!

Choose 1–2 of these ideas—or come up with your own—and implement them for 1–2 months. Keep track of what you do and report your experience here. Every small step counts toward a healthier planet!





Background Information: Simulating the Greenhouse Effect and the Impacts of Heatwaves on Organisms

Climate Change and the Greenhouse Effect

Climate change is one of the biggest challenges of the 21st century. Scientists around the world study how Earth's climate is changing and why. The Intergovernmental Panel on Climate Change (IPCC) has shown that there is strong evidence that recent climate change is mainly caused by human activities. These activities increased especially after the Industrial Revolution, around the year 1750.

The main human activities that affect the climate are burning fossil fuels such as coal, oil, and natural gas, cutting down forests, and some farming practices. These activities increase the amount of greenhouse gases in the atmosphere. One of the most important greenhouse gases is carbon dioxide (CO₂). When the concentration of these gases rises, the Earth becomes warmer. This process is called global warming.

Weather and Climate

Weather is what we experience every day. It describes short-term conditions in the atmosphere, such as temperature, rain, wind, or snow. Climate, on the other hand, describes weather patterns over a long period of time, usually many years. Climate helps us understand what the weather is usually like in a certain place or region.

Energy from the Sun and Earth's Climate System

The Sun is the main source of energy for Earth. Areas near the equator receive more sunlight and are warmer, while areas near the poles receive less sunlight and are colder. Air in the atmosphere and water in the oceans move heat around the planet. This helps balance temperatures and makes life possible in many different regions. If parts of this climate system change, the whole system can become unstable. This can lead to unusual or extreme weather events. These long-term changes are called climate change.



The Greenhouse Effect

Earth is surrounded by a thin layer of gases called the atmosphere. Most of it is made of nitrogen and oxygen, but it also contains small amounts of greenhouse gases such as water vapour, carbon dioxide, methane, ozone, and nitrous oxide.

These gases trap some of the heat from the Sun and keep the planet warm. This natural process is called the greenhouse effect. Without it, the average temperature on Earth would be about $-18\text{ }^{\circ}\text{C}$, and life would not be possible. With the greenhouse effect, the average temperature is about $15\text{ }^{\circ}\text{C}$. However, too many greenhouse gases strengthen this effect and cause the planet to warm too much.

Heatwaves and Their Consequences

One important result of climate change is the increase in heatwaves. Heatwaves are long periods of extremely high temperatures. They are becoming more frequent, more intense, and lasting longer.

Impacts of Heatwaves on Humans, Animals, and Plants

Heatwaves can have serious effects on living beings. Humans may suffer from dehydration, heat exhaustion, and heatstroke, especially elderly people, young children, and people with health problems. Very high temperatures can also make it difficult to work, learn, and sleep, and they can increase the risk of fires and power shortages.

Animals are also affected by heatwaves. Many animals struggle to find enough water and food during very hot periods. Fish can die in warm rivers and lakes because warm water contains less oxygen. Wild animals may be forced to move to cooler areas, while pets and farm animals can suffer from stress and illness due to heat.

Plants need water to grow, but heatwaves often come with droughts. High temperatures can dry out the soil, slow plant growth, and reduce crop yields. Some plants may wilt or die, which can lead to food shortages and damage natural ecosystems.

Why Climate Change Matters

Climate change affects ecosystems, sea levels, food production, and human health. It can increase poverty and inequality, but it also gives us a chance to change how we live. By using renewable energy, saving resources, and protecting nature, we can reduce greenhouse gas emissions and build a more sustainable future. Understanding climate change helps us make responsible choices for ourselves and for future generations.

What Can We Do?

Example ideas to connect climate change to everyday life.

- saving energy at home and school
- using public transport, biking, or walking
- reducing waste and recycling
- protecting forests and green spaces
- saving water (shorter showers, turning off the tap)
- eating more local and seasonal food
- reducing food waste
- reusing items (bags, bottles, school supplies)
- planting trees or plants and caring for school gardens
- talking about climate change with family and friends





Quiz: Simulating the Greenhouse Effect and the Impacts of Heatwaves on Organisms

Answer the questions and test your knowledge.

Part 1: Climate Change and the Greenhouse Effect

1. What is climate change mainly caused by today?

Choose one answer.

- a) Changes in the Moon
- b) Human activities such as burning fossil fuels
- c) Earth's distance from the Sun
- d) Ocean tides

2. Which of the following is an example of a fossil fuel?

More than one answer is possible.

- a) Wind
- b) Solar energy
- c) Coal
- d) Water
- e) Petroleum
- f) Natural gas

3. What is the greenhouse effect?

Choose one answer.

- a) A process that cools the Earth
- b) A process that traps heat in the atmosphere
- c) A type of weather forecast
- d) A layer of clouds around Earth

4. What would the average temperature on Earth be without the greenhouse effect?

Choose one answer.

- a) 15 °C
- b) 0 °C
- c) -18 °C
- d) 30 °C

5. What is a heatwave?

Choose one answer.

- a) A single hot afternoon
- b) A short rainstorm
- c) A long period of very high temperatures
- d) A cold winter event



Part 2: Heatwaves and Their Impacts

6. How do climate change and global warming affect heatwaves?

Choose one answer.

- a) Heatwaves are less frequent and less intense.
- b) Heatwaves are less frequent but more intense.
- c) Heatwaves are more frequent but less intense.
- d) Heatwaves are more frequent and more intense.

7. How do heatwaves affect cities in Europe?

Choose one answer.

- a) All European cities experience heatwaves in the same way.
- b) Heatwaves affect cities differently depending on geography and urban design.

8. Which of the following factors help cities become more resilient to heatwaves?

More than one answer is possible.

- a) Adding more green spaces and water areas.
- b) Using passive cooling strategies in buildings.
- c) Reducing energy use in buildings.
- d) None of the above.

9. Which solutions can help cool cities during heatwaves?

More than one answer is possible.

- a) Water sprinklers in public spaces and fans.
- b) Urban forests and green corridors for better air flow.
- c) More ice for cold drinks.
- d) None of the above.

10. Which statements about heatwaves and heat-related illnesses are correct?


More than one answer is possible.

- a) Wearing dark clothes helps us feel cooler.
- b) It is best to open windows at midday.
- c) Heat exhaustion can cause tiredness and weakness.
- d) Some medicines increase the risk of heatstroke.
- e) Very high temperatures can be dangerous or fatal.

11. Who are the most vulnerable groups during heatwaves?

More than one answer is possible.

- a) People with heart diseases.
- b) Athletes.
- c) Elderly people.
- d) Children.
- e) Nobody is affected by heatwaves.



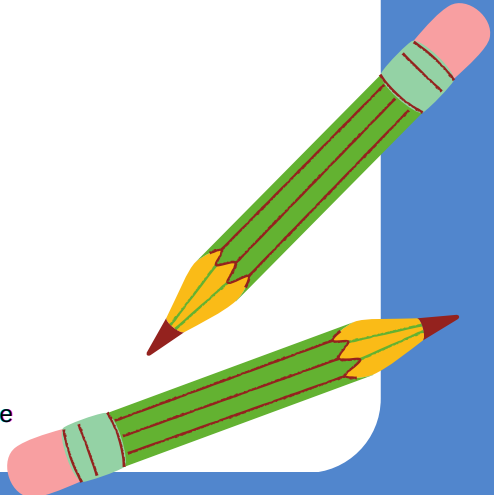
12. Which actions are correct during a heatwave?

More than one answer is possible.

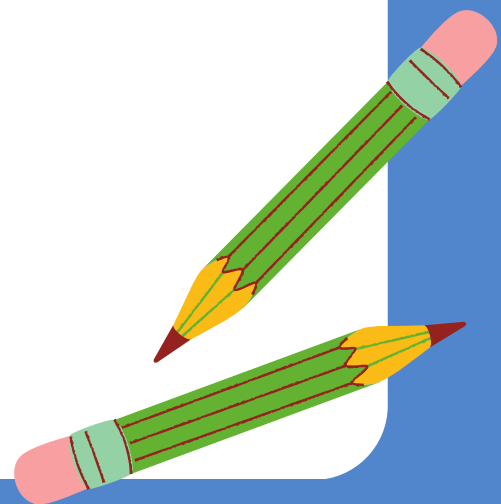
- a) Drinking water only when thirsty.
- b) Keeping all outdoor plans unchanged.
- c) Protecting yourself from the sun when outside.
- d) Taking extra care of elderly people and children.
- e) Following heat warnings and safety advice.

Correct Answers:

1 b, 2 c, e, f, 3 b, 4 c, 5 c, 6 d, 7 b, 8 a, b, c, 9 a, b, 10 c, d, e, 11 a, c, d, 12 c, d, e



Notes

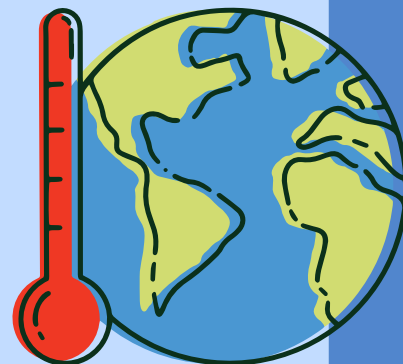




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