

Section 4


Understanding Earth and Space Systems

EXPLORATION 2

Greenhouse Effect

Investigate the effect of greenhouse gases on air temperature.

Global warming is one of our Earth's most pressing issues. It leads to a warmer planet and causes problems such as heavy precipitations, floods, rising water levels, droughts, and wildfires. The greenhouse effect is a phenomenon that is believed to be one of the major contributors to global warming. Earth's atmosphere acts like a greenhouse in the sense that it traps some of the sun's heat energy. Without this natural greenhouse effect, our Earth would be too cold for life to exist. However, problems arise when there is an excess amount of greenhouse gases, such as carbon dioxide and methane, which results in too much heat being trapped in the atmosphere. Over time, this raises the temperature to dangerous levels. So what are the greenhouse gases and how do they affect Earth's atmosphere?



Mom, why is our home getting smaller and smaller?

The illustration shows a large polar bear mother standing on a small, melting ice floe. Two small polar bear cubs are with her; one is climbing on her back and the other is sitting in front of her. The mother bear has a sad expression and a single tear on her face. The ice floe is surrounded by water, and other smaller ice pieces are visible in the background.

Rapid glacial melt is a result of global warming.

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In this experiment, you will create a model of Earth's atmosphere and examine the impact of greenhouse gases on Earth's temperature.

Level of Difficulty:

moderate

Time Needed:

1 hour

Hypothesis:

Circle the words to show your hypothesis.

Air with excessive greenhouse gases **does / does not** trap more heat and **does / does not** warm up faster than air without excessive greenhouse gases.

Materials:

- 2 thermometers
- 2 plastic bottles
- plastic wrap
- 2 elastic bands
- vinegar
- baking soda
- a tablespoon
- a funnel
- 2 lamps (ones that emit heat)

Steps:

1. Read the thermometer and record the room temperature on the next page.
2. For one bottle (Bottle A), wrap a piece of plastic wrap over the mouth of the bottle and secure with an elastic band.
3. Poke a small hole into the plastic wrap and slide a thermometer into Bottle A.
4. For the other bottle (Bottle B), place the funnel over its mouth and pour two tablespoons of baking soda into it.
5. Pour about 50 mL of vinegar into Bottle B. Then quickly wrap a piece of plastic wrap over its mouth and secure it with an elastic band.

Mixing baking soda and vinegar produces carbon dioxide.



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6. Poke a small hole into the plastic wrap and slide a thermometer into Bottle B.
7. Place a lamp about 10 cm away from each bottle and keep the bottles near the lamps for about five minutes.
8. Observe and record the temperatures.

Air Temperature Record

- Before heating: _____
- After heating:
 - Bottle A: _____
 - Bottle B: _____

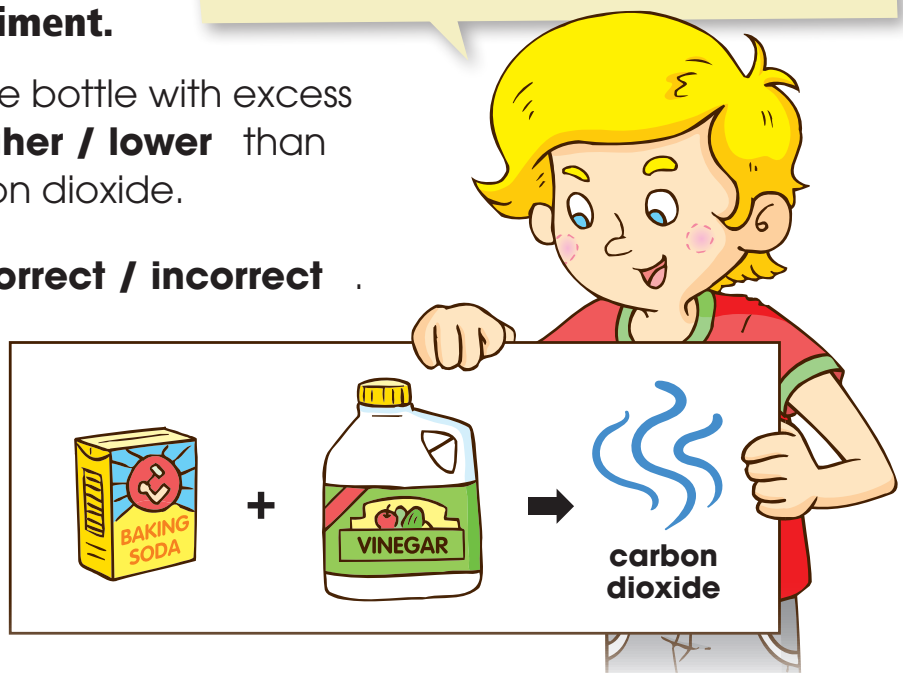
Conclusion:

Circle the correct words after conducting the experiment.

The temperature of the bottle with excess carbon dioxide is **higher / lower** than the one without carbon dioxide.

My hypothesis was **correct / incorrect** .

When baking soda and vinegar are mixed, the mixture begins to fizz. This chemical reaction creates carbon dioxide.



Greenhouse Effect

Explanation:

Bottle B contained air with an excessive amount of carbon dioxide and Bottle A contained air with only a normal trace of carbon dioxide. The recorded results should indicate that Bottle B had a higher temperature than Bottle A after both bottles were exposed to heat. This is because the excess carbon dioxide in Bottle B trapped more heat and warmed up the air faster than that in Bottle A.

The bottles are a model of Earth's atmosphere. Due to the greenhouse effect, the temperature of the air in Bottle A increased with the heat of the lamp. This demonstrates that our Earth's atmosphere traps the sun's heat energy, which is necessary for all living things. In Bottle B, however, the temperature of the air was significantly higher than that in Bottle A due to the excessive amount of carbon dioxide. This shows that too much carbon dioxide will cause an undesirable increase in temperature in our atmosphere and result in global warming and devastating climate change.

The excessive carbon dioxide in the atmosphere comes from the burning of fossil fuels, forest fires, and animal respiration. Carbon dioxide, along with other greenhouse gases such as methane and ozone, contributes to the rise in the average surface temperature of Earth.

