

GREENHOUSE GASES

Driving Question

What are greenhouse gases and how do they interact with the atmosphere and cause a change in our climate

Materials and Equipment

- Heavy-duty tape
- Fast-response temperature probe
- EcoChamber with stoppers
- Size 5 or 5 1/2 solid stoppers (2)
- Dark aquarium rocks or dark sand (approximately 200 g)
- Heating lamp
- Ring stand
- Balance (1 per class)
- Canned keyboard duster (fresh)

Background

Carbon dioxide and methane are greenhouse gases – atmospheric gases that absorb reradiated energy from the earth’s surface and trap heat in the atmosphere. Solar radiation from the sun passes through the atmosphere and is partially absorbed by the earth’s surface. Some of this radiation passes through the atmosphere and into space, while greenhouse gases absorb the remainder, trapping heat in the atmosphere. This is called the greenhouse effect that can affect climate change. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations which also could disrupt food availability, reduce the access as well as food quality.

Procedure

1. Connect the fast response temperature probe sensor.
2. Open the Greenhouse Gases lab file.
3. Place 3 flat stoppers into the holes on the top of each EcoChamber. These stoppers have small holes to accommodate the temperature sensor. Plug two of these holes with the small rubber dowels.
4. Thread the temperature sensor through the hole in the last stopper on the lid of the chamber. Pull the temperature sensor through the stopper until the sensor hangs down approximately halfway in the chamber. Once the temperature sensor is in place, cover the hole with heavy-duty tape.
5. Place approximately 200 grams of aquarium rocks or enough to cover the bottom of each chamber.
6. Place the lid on the chamber, and stopper the holes on the sides of the chamber with solid stoppers (size 5 or 5 1/2 will work). If the stoppers are not solid, cover them with heavy-duty tape to ensure a good seal.
7. Position the heating lamp so that it will shine on the chamber, angled slightly downward to increase the amount of solar radiation hitting the rocks. Do not turn the light on yet.
8. Display Temperature on the y-axis of a graph with Time on the x-axis.
9. Turn on the lamp and begin recording data after 5 minutes, turn the lamp off and continue to record data for 5 minutes more. Stop recording data. Write the data in Table 1 under the column headings;

“**Initial Temp. °C**”, “**Maximum Temp. °C**”, “**Increase in Temp. °C**”, “**Final Temp. °C**”, “**Change in Temp. °C**” in the “**control row**”.

- Open the EcoChamber and allow it to cool completely. You may want to replace the rocks with room temperature rocks, but use the same mass of rocks as you did before.
- Replace the lid on the EcoChamber. Ensure that the temperature probe is hanging as it was in the first trial, and that the lamp and the chamber are positioned exactly as they were in the first trial.
- Peel back the tape on the rubber stopper on the side of the chamber and place the straw of the keyboard duster into the hole. Fill the chamber with difluoroethane by pulling the trigger on the can in a series of short bursts. Keep the can upright while dispensing.
- Begin recording data without turning on the lamp and continue to dispense the difluoroethane in short bursts. Watch the data carefully. Once the temperature inside the chamber is below the starting temperature of the control run, stop dispensing difluoroethane. Remove the straw and immediately plug the hole.
- Watch the temperature on the graph. When the temperature is 2 to 3 degrees below the starting point of the first run, stop recording data. And write the data in Table 1 under the column headings; “**Initial Temp. °C**”, “**Maximum Temp. °C**”, “**Increase in Temp. °C**”, “**Final Temp. °C**”, “**Change in Temp. °C**” in the “**Experimental (difluoroethane)**” row.

Table 1: Temperature data

| Chamber | Initial Temp. °C | Maximum Temp. °C | Increase in Temp. °C | Final Temp. °C | Change in Temp. °C |
|-------------------------------|------------------|------------------|----------------------|----------------|--------------------|
| Control (air) | | | | | |
| Experimental (difluoroethane) | | | | | |

Analysis & Questions

- How significant are the differences that you observed in heat retention and maximum temperature?
- In analyzing this data, which of the following is more valuable to compare: the overall change in temperature, the heating change in temperature, the cooling change in temperature, or the difference in maximum temperatures? Explain your reasoning.
- In what ways does this demonstration fail to predict what effect this gas would have on the atmosphere?
- In what ways will climate change effect agriculture’s ability to feed developing nations?
- How can agriculture help limit the impact of climate change worldwide?