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

- Temperature sensor
- EcoChamber with stoppers or large flask
- Plastic wrap
- Stoppers to seal EcoChamber or large flask
- Dark aquarium rocks or dark sand (200g)
- Heating lamp (Lamp with 100W incandescent bulb)
- 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 access, as well as food quality. To create a model of greenhouse gases we'll be using difluoroethane instead of CO_2 or methane. Difluoroethane is also carbon based but as a larger molecule is a much stronger greenhouse gas.

Procedure

1. Connect temperature sensor.

2. Open the AGR 09 Greenhouse Gases.spklab file.

    - If the file is not available create a graph display of temperature (°C) versus time (min).

3. Place the temperature sensor inside the EcoChamber or flask, the tip of the temperature sensor should be in the mid-point of the chamber.

4. Place approximately 200 grams of aquarium rocks or enough to cover the bottom of each chamber.

5. Seal the openings using rubber stoppers and plastic wrap.

6. Position the heating lamp 40-50cm away from the chamber, angled slightly downward to increase the amount of solar radiation hitting the rocks. Do not turn the light on yet.

7. Turn on the lamp and begin recording data after 5 minutes, turn the lamp off and continue to record data for 5 more minutes. After 10 minutes has elapsed, stop recording data. Use the graph analysis tools and determine the initial temp, final temp, increase in temperature (max temp minus initial), and decrease in temperature (max temp minus final temp).

8. Open the EcoChamber and allow it to cool completely to room temperature for the second run.

9. Replace the lid on the EcoChamber. Ensure that the temperature probe is placed as it was in the first trial, and that the lamp and the chamber are positioned exactly as they were in the first trial.

10. Crack the stopper or poke a small hole in the plastic wrap to insert 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 (eight 1-sec bursts). Keep the can upright while dispensing. Reseal the chamber and wait three minutes.

11. Turn on the light and begin data recording. Instead of running the light for 5 minutes, run the light until you reach the max temperature of your first run. You may need to move the ecozone closer to reduce the time of heating. Cooling an object is related to the difference from ambient conditions so you want both ecozones to experience the same drop. Then, turn off the light and continue to collect data for as long as it takes to cool the chamber to the same temperature you cooled the first run. You can turn on the previous run at any time during this run to see the comparison. Once you've reached the same cooler temperature as run 1, stop data recording.

12. Repeat the analysis described in step 7 for this run of data.

Table 1: Temperature data

Chamber	Initial Temp. (°C)	Final Temp. (°C)	Increase in Temp. (°C)	Decrease in Temp. (°C)
Control (air)				
Experimental 1 Keyboard duster (Difluoroethane)				

Analysis & Questions

1. How significant are the differences that you observed in heat retention and maximum temperature?

2. 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.

3. In what ways does this demonstration fail to predict what effect this gas would have on the atmosphere?

4. In what ways will climate change effect agriculture's ability to feed developing nations?

5. How can agriculture help limit the impact of climate change worldwide?