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Pokémon TRADING CARD GAME

PURPOSE

To observe temperature differences in a greenhouse model

BACKGROUND

The warming of the Earth's atmosphere is called the greenhouse effect. The Earth's climate is warming in response to atmospheric accumulation of heat-trapping gases, such as carbon dioxide (CO2). CO2 is responsible for about half of the warming of the climate. The other major gases that are responsible for the greenhouse effect are nitrogen oxide (N4O), methane (CH4) and chlorofluorocarbons (CFCs). CO2 is produced from power plants and burning fossil fuels. Nitrogen oxide is produced by automobile exhaust. Rotting garbage, decaying plants and animals, rice fields and humans and animals passing gas produce methane gas. CFCs are found in refrigerators, air conditioners, foamed plastics and other man-made products.

Over the past few centuries, people have been burning larger amounts of fuel, such as wood, coal, oil, natural gas and gasoline. The result, some experts believe, will be the Earth heating up and undergoing global warming. Some scientists believe that different factors, such as increased cloud cover, could counteract the warming. Cloud cover reflects sunlight before it ever reaches the Earth, thus reducing the amount of sunlight that reaches the Earth's surface. Some scientists fear that the rise in temperature will disrupt weather patterns causing the polar icecaps to melt and release more water into the ocean. This increase in the water level might cause the ocean's saline concentration to weaken, threatening marine species and flooding coastal areas.

The build up of CO2 in the atmosphere is also caused by deforestation. Cutting down forests reduces the number of trees available to absorb CO2.

However, some scientists are considering whether the warming exists at all. And, if it does, whether it is caused, wholly or in part, by a periodic but small increase in the Sun's energy output. An increase of just 0.2 percent in the solar output could have the same effect as doubling the carbon dioxide in the Earth's atmosphere.

In this lesson, students will construct two greenhouses and observe temperature differences between them. They will compare a greenhouse modeled after Earth to one modeled after a planet that does not have an atmosphere capable of trapping greenhouse gases.

MATERIALS

Collect empty, rinsed 2-liter plastic bottles. You'll need enough for two per group.
Divide the class into groups of four to five students.
Collect enough materials to model the steps for the class.

For each group:

- two empty plastic 2-liter soda bottles
- yarn
- potting soil
- water
- sunny area or a sunlamp
- spoon
- funnel
- tape
- permanent marker
- two thermometers
- student sheet

PROCEDURE

1. Explain to the class that CO2 is the greenhouse gas believed to be responsible for about half of the warming of our climate. If we put too much CO2 in the atmosphere it could cause the Earth to overheat.
2. Global warming could cause many problems. Help the class identify problems related to global warming, and list them on the board.
3. Explain to the groups that they will make a model greenhouse to represent the Earth. Read and model the steps below while the groups follow your directions.
   a. Take the top off a plastic, 2-liter bottle and place the funnel in the top.
   b. Place spoonfuls of topsoil in the funnel until the bottom of the bottle has several inches of dirt.
   c. Pour 2 to 3 teaspoons of water in the funnel—just enough to moisten the soil.
   d. Tie the yarn to the thermometer. Students will pull the yarn to retrieve the thermometer for readings.
   e. Hand out the Student Sheets and tell students to record the thermometer reading under the column for "Earth Greenhouse."
   f. Remove the funnel from the bottle and insert the thermometer. Slowly lower the thermometer until it is directly above the soil. Leave slack at the other end of the yard to tape it to the outside of the bottle.
   g. Replace and tighten the top. See diagram 1.

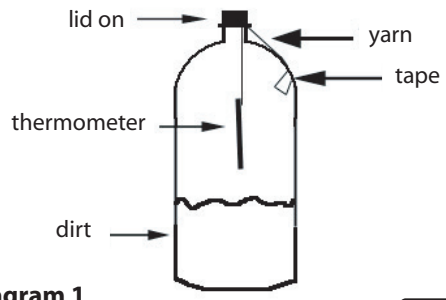

Diagram 1

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4. Explain that the groups will make a bottle that represents a planet that does not have the heat-trapping greenhouse gases. Read and model the steps below while the groups follow your directions.

   a. Repeat steps "a" through "d" in the Procedure section.

   b. Record on the Student Sheet the thermometer reading under the column for "Other Planet."

   c. Do not replace the top. See diagram 2.

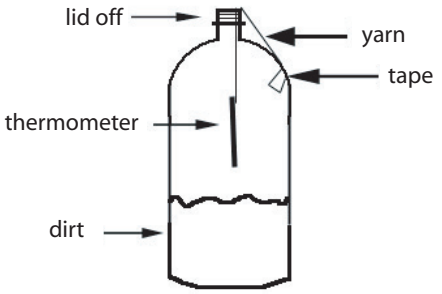

Diagram 2

5. Using the permanent marker, write your group number on each bottle.
6. Place your bottles in a well-lit window where both can receive direct sunlight or place them under a sunlamp.
7. Check your thermometer reading every 30 minutes for 2 hours. Record your readings on your chart.

CONCLUSION

1. Ask the groups the following questions.

- Did you record the same temperature on both thermometers? Students should have recorded higher temperature readings on the closed bottles that simulate the Earth.
- Can you explain why these two temperature records are not the same? Students should relate the fact that the bottle with the top off allows the heated gases to escape; therefore, the temperature will be cooler than the bottle with the top. The air over the thermometer in the open bottle is constantly changing, and as it gets warm, it is replaced by cooler air. The air in the bottle with the top cannot circulate to the outside; this air stays in the sunlight and gets warmer and warmer.

2. Explain that similar trapping of heat happens in the Earth's atmosphere. Sunlight passes through the atmosphere and warms the Earth's surface. The greenhouse gases trap the heat radiating from the surface. Without an atmosphere, the Earth's temperature would average about -17 C (0 F). This warming due to heat-trapping gases is called the "Greenhouse Effect." Both the atmosphere and the bottle allow light to enter, but then trap the energy when it is converted to heat.
3. Ask the students if they have ever sat inside a car parked in the sunlight with the windows closed. The sunlight and heat get trapped in the car. This is an example of the greenhouse effect. However, it is dangerous to stay in a parked car on a hot day because the temperature inside the car can reach over 49 C (120 F) in a matter of minutes.

EXTENSIONS

1. Do more research about global warming. Create signs or banners showing some things we can do to help prevent global warming. Examples may include to stop destroying the forests and plant more trees, conserve energy, car pool, turn off lights, turn down the thermostat, switch from gas cars to electric, and so on.

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Temperature Chart

Observations	Earth Greenhouse	Other Planet
Time Temperature		
Time Temperature		
Time Temperature		
Time Temperature		