

# The Greenhouse Effect

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## INTRODUCTION:

In the Scientific American Article "Impact From The Deep" the author proposes a new model that seeks to explain several of the mass extinction events that have occurred during Earth's history. His model is based on cataclysmic greenhouse conditions triggered in part by changes in the oceans. In order to be able to discuss and assess this model we first need to understand some basic concepts.

In today's lab we are going to examine one of those concepts: the greenhouse effect. We will 1) build a model greenhouse; 2) study it's effects on atmospheric temperature; 3) examine some of the variables that affect the greenhouse effect.

**PURPOSE:** To answer the following questions –

1. What is the greenhouse effect? Why does it occur?
2. How does cloud cover affect the intensity of the greenhouse effect?
3. How do oceans affect the intensity of the greenhouse effect?
4. How do deserts affect the intensity of the greenhouse effect?
5. How does an increase in greenhouse gases affect the intensity of the greenhouse effect?

## Hypothesis:

1. What is the greenhouse effect? Why does it occur?

I hypothesize that the greenhouse effect is warming of the atmosphere by the trapping of radiation. I hypothesize that the gases that heat the atmosphere most are carbon dioxide, water vapor and methane. It occurs because we release the chemicals from our cars, electrical plants and much more.

2. How does cloud cover affect the intensity of the greenhouse affect?

I hypothesize that the increase of cloud cover would cool down the land beneath it because the clouds have small fragments of soot in them and water droplets form of this soot and the water actually reflects some of the sun's light, that's called global dimming that fights global warming.

3. How do oceans affect the intensity of greenhouse effect?

I hypothesize that the oceans reflect sum of the sunlight, however they do absorb some of the sunlight and warm due to the conservation of heat.

4. How do deserts affect the intensity of greenhouse gases?

I hypothesize that deserts do not effect global warming for there heat is not caused by any chemicals.

5. How does an increase in greenhouse gases affect the intensity if the greenhouse effect?

I hypothesize that an increase of greenhouse gases would increase global warming because the chemicals would become more and more dense and therefore heat up.

## **MATERIALS & EQUIPMENT:**

### **Experimental Chamber:**

- Plastic 2 l. bottle (with cap)
- Cutting blade
- Plastic dish (base)
- Thermometer
- Clear Tape
- Lamp

### **Environments**

- Sand
- Water
- White paint
- 1 Alka-Seltzer Tablet

## **PROCEDURE:**

Build your experimental chamber as follows:

1. Remove the bottle label by soaking it in warm water.
2. Cut off the end of the bottle approximately 2 inches from the bottom and discard the bottom piece.
3. Tape the thermometer on the inside of the bottle with the front of the thermometer facing out. Make sure that the thermometer bulb sits 3 inches above the bottom edge of your chamber.
4. Place the capped bottle on the plastic base.

Testing Different Scenarios:

Scenario A

1. Place the experimental chamber six inches below the lamp with the thermometer facing away from the bulb.
2. Collect temperature data every minute for the next 20 minutes.
3. Graph your data.

Now choose ONE of the following 4 scenarios to carry out -

Scenario B (effect of cloud cover):

1. Paint the upper third of your chamber with white paint.
2. Place the experimental chamber six inches below the lamp with the thermometer facing away from the bulb.
3. Collect temperature data every minute for the next 20 minutes.
4. Graph your data.

Scenario C (effect of deserts):

1. Fill the base with sand and replace the top on the base
2. Place the experimental chamber six inches below the lamp with the thermometer facing away from the bulb.
3. Collect temperature data every minute for the next 20 minutes.
4. Graph your data.

Scenario D (effect of oceans):

1. Fill the base with room temperature water and replace the top on the base.
2. Place the experimental chamber six inches below the lamp with the thermometer facing away from the bulb.
3. Collect temperature data every minute for the next 20 minutes.
4. Graph your data.

Scenario E (effect of increasing greenhouse gases)

1. Fill the base with room temperature water and replace the top on the base.
2. Break up the Alka Seltzer tablet and add it to the system through the top of the bottle, then quickly recap the bottle.
3. Place the experimental chamber six inches below the lamp with the thermometer facing away from the bulb.
4. Collect temperature data every minute for the next 20 minutes.
5. Graph your data.

Collect data for the scenarios that your team DOES NOT carry out from your other classmates.

**Data Tables:** These are my Data Tables

and observations.

### Scenario A

Minute	Temperature
Water Temperature	20
1	23
2	23
3	23
4	23
5	23
6	24
7	24
8	24
9	24
10	24
11	25
12	25
13	25
14	25
15	25
16	25
17	25
18	26
19	26
20	26

## Scenario B

Minute	Temperature
Water Temperature	20
1	21
2	21
3	22
4	22
5	22
6	22
7	22
8	23
9	23
10	24
11	24
12	24
13	24
14	24
15	24
16	25
17	25
18	25
19	25
20	25

### Scenario C

Minute	Temperature
Water Temperature	22
1	22
2	22
3	23
4	23
5	24
6	24
7	24
8	25
9	25
10	25
11	25
12	25
13	25
14	26
15	26
16	26
17	25
18	25
19	25
20	25

### Scenario D

Minute	Temperature
Room Temperature	24
1	24
2	24
3	24
4	24
5	24
6	24
7	24
8	24
9	24
10	24
11	24
12	25
13	25
14	25
15	25
16	25
17	25
18	25
19	25
20	25

## Scenario E

Minute	Temperature
Room Temperature	21
1	22
2	22
3	23
4	22
5	23
6	23
7	23
8	23
9	23
10	24
11	24
12	24
13	24
14	24
15	24
16	24
17	25
18	25
19	25
20	25

### CALCULATIONS:

Calculate the approximate rate of increase in temperature for each scenario by drawing a straight line through your data for each scenario and calculating the slope of each line.



## **Data Analysis:**

### **What I Measured and Why:**

In this lab I measured the increase in temperature in different situations to see their affect. I learned that the differences are very noticeable and depending on the substance in the bottle. These measurements allowed me to better understand the affect on the areas heat depending on the substances that are on the ground or in the sky and that's why I measured it because I wanted to better understand the greenhouse effect. This all relates to life however I did it on a much smaller scale, for instance if there was a cloud over an area the area under the cloud would be cooler because the water molecules reflect some of the sunlight. I also learned that if there was no cloud but a large ice sheet it would reflect a lot more than a cloud would because the water molecules in a cloud are more spread out than they are in an ice sheet.

**How My Data Helped Me Better Understand The Greenhouse Effect:** My data shows that the temperature of the air depends on the substances below. I was surprised with the outcome of temperature for all of the experiments I thought that the temperature would be much higher, because I overestimated the heat of the lamp. In order to better understand my data I made graphs of increase of temperature per minute (see graphs A-E in the Calculation section). In graph E the temperature fluctuated a lot maybe because the Alka-Seltzer tablet may have given of different amounts of bubbles at different points in time. This is what I observed my observations. When I added the Alka-Seltzer tablet through the top of the bottle they fizzed and giving of many bubbles. I think that the Alka-Seltzer tablet

contained something that converted the water into a gas, this gas rise in a form of a bubble and the bubble popped letting the gas rise the top of the bottle. When this happens the water level lower do to loss of H<sub>2</sub>O molecules and when it is converted to a gas it expands compressing it. And the gas at one point was compressed enough that the bottle began to float so we opened the cap to release some of the pressure.

**Possible Sources of Error:** The main source of error is that Michelle opened the cap in experiment E because the pressure was to high and the bottle was beginning to move to the top of the water, releasing this pressure may or may not have made a dramatic difference in my results but if it did I would say that opening the cap would give you lower results. Other sources of error may include: outside sunlight and accidentally bumping the bottle.

### **QUESTIONS TO CONSIDER:**

1. Compare the graphed information from the different bottles. Which warmed up most rapidly? Most slowly?

According to my graph **Scenario A** was the most rapid increase of temperature. According to my graph **Scenario D** had the lowest increase in temperature.

2. How might you explain the differences?

In **Scenario A** I think that there was nothing to absorb some of the heat like sand or water and the light just reflected back and forth from the top of the cup to the bottom of the cup. I think **Scenario D** was the lowest temperature because the water may have absorbed some of the heat and it may have reflected it into different directions because the surface of the water was not exactly flat.

3. Relate the factors affecting the model greenhouses to the factors affecting the "global greenhouse." Which factors are the same? Which are different?

The similarities of the global greenhouse affect and the model greenhouse affect are that the lamps light acts like the heat of chemicals like Co<sub>2</sub> and we set different environments to see what the out comes are like over and desert or ocean. The differences are that some of the radiation does escape through the atmosphere and in ours it was impossible.

**WEB LINKS:**

<http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/>

<http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html>

**Conclusion:** I learned that the atmosphere traps all gases that can warm our climate. I learned that this is a good experiment to do to understand the greenhouse affect. I was surprised with some of the results in the experiments and that the temperatures were lower than my expectations. I would like to learn more about how the sun heats us and compression of atoms and what compression causes them to do and why. I was also interested in what happens to light when it bounces and why. I think this lab was very effective, I found the subject very interesting and I would like to do a similar subject for the next chosen lab. My hypothesis was correct.

Here are my answers to the purpose questions.

1.What is the greenhouse effect? Why does it occur?

The greenhouse effect is warming of the atmosphere by the trapped radiation The gases that heat the atmosphere most are carbon dioxide, water vapor and methane. It occurs because we release the chemicals from our cars, electrical plants and much more, the gases get trapped and create a rise in temperature.

2. How does cloud cover affect the intensity of the greenhouse affect?

An increase of cloud cover would cool down the land beneath it because the clouds have small fragments of soot in them, and water droplets form on this soot and the water actually reflects some of the suns light, that's called global dimming that fights global warming.

3. How do oceans affect the intensity of greenhouse effect?

The oceans reflect some of the sunlight but absorb some too giving the oceans a higher temperature melting the ice caps.

4. How do deserts affect the intensity of greenhouse gases?

Deserts do not affect the intensity of greenhouse gases but they do increase the temperature of the climate around them for greenhouse gases and this heat are different.

5. How does an increase in greenhouse gases affect the intensity of the greenhouse effect?

An increase of greenhouse gases would increase global warming there would be more chemicals which cause an increase in global warming.