

## Whole World in our Hands: Experiential Activities

# Greenhouse Gases & Climate Change

### Theme:

Climate change and renewable energy.

### Prerequisite:

Students should have some knowledge about what the “greenhouse effect” is, and its role in the earth’s climate. Note that this activity is designed specifically for science-oriented classes and required laboratory equipment.

### Curriculum Entry Points:

Grade 10 science, Grade 11 chemistry, Grade 12 chemistry, Grade 12 Physics, Grade 12 World Issues



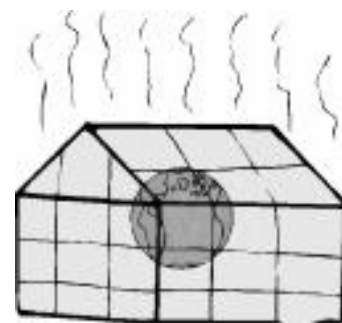
[www.enhvacare.ca.uk](http://www.enhvacare.ca.uk)

### Overview:

Greenhouse gases are thus named because of their capacity to trap heat within the atmosphere. The experiment will allow students to investigate the different sources of GHGs as well as the impact that they may have on climate change. Students will build a visual representation of the greenhouse effect. The experiment illustrates the heat-absorption of atmospheric carbon dioxide. Discussions are to be oriented not only around the science but the real life encounters with the greenhouse effect and climate change.

### Objective:

Students will create and observe a simulation of the greenhouse effect. Thus, they can experience first hand the role that atmospheric gases play in warming the earth.



### Main Concepts and Vocabulary:

**CONTROL:** The unchanged subject which will be compared to the variable (in this case, the uncovered bottle is the control)

**FOSSIL FUELS:** Natural resources such as coal, oil and natural gas that are composed of hydrocarbons and are generally non-renewable. The combustion of such fuels is often used to produce electricity.

**GREENHOUSE GASES (GHGs):** Gases such as carbon dioxide, methane, and nitrous oxides that contribute to global warming by creating an atmospheric layer that only allows certain wavelengths of light to pass.

**MODEL:** A visual representation of the greenhouse effect on the atmosphere.

**POLICY:** Rules and regulations established by governments.

# Classroom Activity:

## *Measuring Heat Absorption of a Greenhouse Gas*

### Time Required:

Two 60 minute periods

### Materials:

- 5 x 250 ml flasks
- 2 no hole stopper or equivalent
- 5 one hole stoppers or equivalent
- Acetic Acid 5% (white Vinegar) 30ml
- Sodium Bicarbonate ( baking soda) 5ml
- Pressurized Methane Gas CH<sub>4</sub>
- Kettle
- Large pan or bucket of water
- Activity worksheets



### Specialized Supplies Required:

- Nitrous Oxide NO<sub>2</sub>
- Short glass tube connected to 30 cm of flexible tubing, such as airline tubing (to run from one of the flasks to the pan of water)
- 5 thermometers (preferably lab thermometers)
- 5 lamps with 100 Watt halogen light bulbs ( preferably UV output)

### Background:

Carbon dioxide is identified as a “greenhouse gas” because of its ability to “trap” heat within the earth’s atmosphere. This experiment is designed to compare the ability of a sample of GHGs to absorb thermal energy compared to a sample of ordinary air. The most common greenhouse gases are, in order, water [H<sub>2</sub>O], carbon dioxide [CO<sub>2</sub>], methane [CH<sub>4</sub>], nitrous oxide [N<sub>2</sub>O], and chlorofluorocarbons [CFCs]. Carbon dioxide is the most prevalent greenhouse gas in the atmosphere. It is also the GHG that scientists are most concerned about because it is the easiest one to control directly, as it is produced by the burning of fossil fuels.

### Opening Questions:

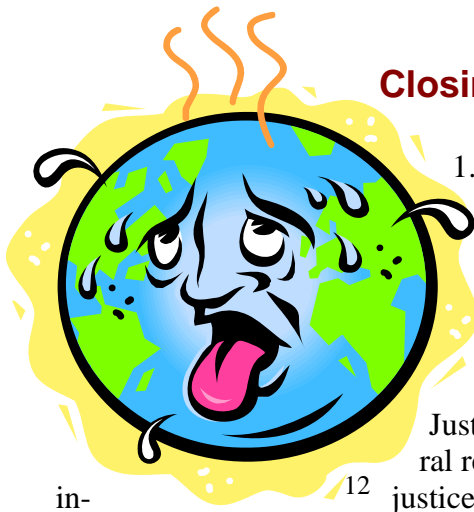
1. Ask the students to come into groups and give a description of what is the natural greenhouse effect as opposed to the increased greenhouse effect.
2. Briefly review the concept of the “greenhouse effect” with the class (see background supplement handouts). What would the world be without the greenhouse effect? What phenomena are caused by the greenhouse effect?
3. Ask the class how a gas might cause an increase in temperatures.
  - a) How could we find out if CO<sub>2</sub> in the atmosphere actually causes an increase in temperatures on Earth?
  - b) Have the class discuss how they might build a model in the classroom that replicates this phenomenon.

# Activity Instruction Sheet

The following experiment can be done by groups of students or in a single demonstration. In regards to the products being used, such as methane (natural gas), nitrous oxide and carbon dioxide, please consult with the science department for the handling precautions.

1. Make sure that a well ventilated area is available during the filling of the recipients.
2. Set-up and preparation of the samples:
  - A) Prepare 5 stoppers with thermometers
  - B) Fill a 250 ml flask with water to the rim, then stopper the flask with a #6 no-hole stopper.
  - C) Place the flask, upside down, into a pan or bucket of water and then remove the stopper. The flask should remain filled with water as it sits upside down in the pan.
  - D) Add 100 ml of water to a second flask.
  - E) Insert a short glass tube into a #6 one-hole rubber stopper. Then attach a piece of airline tubing to the glass tube. The airline tubing should be about 30 cm in length.
  - F) Feed the free end of the airline tubing under the water in the pan and into the inverted flask.
  - G) Mix Sodium Bicarbonate into the flask containing 100 ml of cold (4°C) water, add Vinegar and then quickly place the stopper securely on the flask with the tube assembly.
3. The carbon dioxide from the chemical reaction will begin to displace the water in the inverted flask in the pan. After the water has been evacuated from the flask in the pan, place the #6 no-hole stopper in the flask and remove the flask from the pan of water.
4. Insert a laboratory thermometer into each of two #6 one hole stoppers. Dip the thermometers in glycerin before attempting this procedure. Measure one of the thermometer stoppers into an empty flask. This will be the sample of air.
5. Remove the stopper from the flask of carbon dioxide gas and quickly replace it with a thermometer stopper. (Note: carbon dioxide gas is more dense than air and should remain in the flask after it is opened.)
6. Measuring temperature:
  - A) Place each flask 5 cm from a 100 watt light bulb.
  - B) Record the beginning temperature in each flask of gas.
  - C) Turn on the light and record the temperature in each flask in degrees Celsius.
7. Have all students begin at the same time and record their data at precise one-minute intervals for 25 minutes or until temperatures begin to level off.
8. Construct a line graph of the collected data, using separate colored pens for each flask.
9. Discuss differences between this greenhouse analogy and what actually happens in Earth's atmosphere.

## Closing Questions and Environmental Justice



1. What are some local consequences that have been felt from climate change?
2. Who is responsible, where are the consequences being felt the most? Is there a way that this can change?
3. How might climate change affect people living in different places in the world?

Share with students the definition of environmental justice: “Environmental Justice is a term in the social sciences used to describe injustices in the way natural resources are used.” Ask students to share some examples of environmental justice. If there is no response ask them to consider the effect of climate change on the Inuit in Canada’s north. Have they contributed to the greenhouse gases responsible for climate change? Are their lifestyles and culture affected in the same way as that of someone living in New Brunswick? Does this situation seem fair? Other examples of environmental justice include the case of the Ogoni people in Nigeria fighting Shell oil, or the effects of deforestation by mining companies in Latin America. In all cases the people and communities suffering the most from the destruction and exploitation of natural resources are not those demanding, using or purchasing the resource. The benefits are to those far away, usually in over-developed countries, while people living in the majority world are left to deal with the environmental and social destruction these projects create.

### Community Activity

**Using the attached sheets (School Energy Efficiency Survey) conduct a survey of your School’s energy needs. After the survey, develop a list of recommendations for the principal or student’s council. The class can then present these findings to the appropriate group or individual and increase the schools energy efficiency; reducing greenhouse gases and helping to fight climate change!**

#### **For More Information...**

Catton, William. 1980. *Overshoot: the Ecological Basis of Revolutionary Change*. Urbana: University of Illinois Press.

Dauncey, Guy and Patrick Mazza. 2001, *Stormy Weather: 101 Solutions to Global Climate Change*, New Society Publishers, Galiona Island.

[http://www.choike.org/nuevo\\_eng/informes/268.html](http://www.choike.org/nuevo_eng/informes/268.html)

[http://en.wikipedia.org/wiki/Global\\_warming](http://en.wikipedia.org/wiki/Global_warming)

## SCHOOL ENERGY EFFICIENCY SURVEY

Name of school:

What grades are taught here and how many students are enrolled in this school?

In what year was your school built?

What fuel is used to heat your school? (Oil, natural gas, solar, electricity, heat pump, other?)

What fuel is used to heat the water for the taps and showers?

How is heat distributed around the school? (Forced air, radiators, in-floor, etc.)

How much heating fuel did the school use last year? (Either in the past 12 months, in the previous fiscal year, or in some other 12-month period in the recent past for which records are available.) \_\_\_\_\_ (liters) Cost \$\_\_\_\_\_

How much electricity did the school use in the same 12-month period as in (7)?

\_\_\_\_\_ kilowatt-hours, cost \$\_\_\_\_\_

What kind of insulation is in the walls, ceiling, and basement of the school?

Is there a cooling system in the school (air conditioning?). Y N

Are there things the management, teachers, and/or students at the school have done in the past to make the school more energy efficient? If so, what are they?

Has this school had a professional energy audit in the past 10 years? Y N  
In what year was the audit performed?

What are three things that your class could do to make the school more energy efficient?

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

What are things the school could do to conserve energy?

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**Thank you for taking the time to examine the school's energy use.**

**Submit a summary of your class' findings to the school principal to help him or her take into account available energy efficiency options.**