Greenhouse Gases

Subject Area(s) Earth, space, measurement, and physical sciences

Associated Unit None

Associated Lesson None

Activity Title Greenhouse Gases

Header

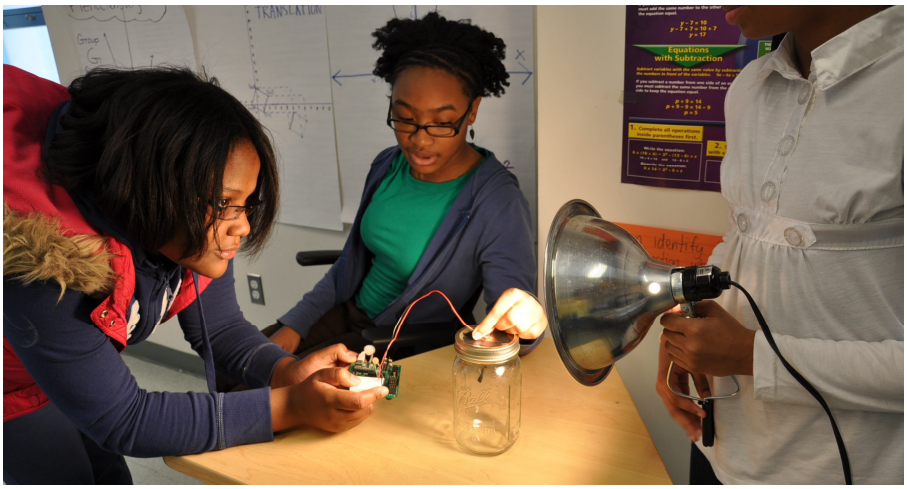

Figure 1

ADA Description: Students assembling glass jar, lamp, and temperature probe

Caption: Figure 1: Students preparing Greenhouse Gases activity

Image file name: fig1.jpg

Grade Level (6-8)

Activity Dependency none

Time Required 50 minutes

Group Size 28

Expendable Cost per Group US$0

Summary

Students will record as a class the change in readings from two temperature probes under a lamp, one inside and one outside a clear glass jar. Students plot the recorded data on two coordinate axes and identify trends for each probe. Students relate this finding as an illustration of the discussion of greenhouse gases.

Engineering Connection

Climate change is a relevant topic in every branch of engineering in today's world. Explicitly, students will use this activity to discover the analogies for global trends, which can lead to a discussion of human activity's impact on the environment. Implicitly, students use the engineering technique of scale modeling to understand larger theories and predict results.

Engineering Category (1) relates science concept to engineering

Keywords Greenhouse effect, temperature, Basic Stamp microcontroller, heat

Educational Standards

- New York State science: 4.4
- New York State math: 3.5

Pre-Requisite Knowledge

Students must be familiar with coordinate axes, and dependent and independent variables.

Learning Objectives

After this activity, students should be able to:

- Collect and record data points on a coordinate axis
- Relate the fundamental characteristics of a greenhouse gas
- Explain the function of a thermometer

Materials List

Each student needs a copy of the attached worksheet.
To share with the entire class:

- Basic Stamp 2 Microcontroller on Parallax Board of Education
- Two Parallax AD592 temperature probes
- Ring stand
- One large clear glass jar with lid
- Shop lamp with heat shield
- Computer with PBasic software
- Two 100 Ω resistors
- Two 0.22 μF capacitors
- Known thermometer that accurately measures temperature around room temperature

Introduction / Motivation

The term greenhouse effect is heard often in the news about our changing climate. Greenhouse gases, like carbon dioxide, methane, and nitrous oxide create a barrier which allows radiation from the sun to penetrate the Earth's atmosphere, but not escape. The chemical bonds in carbon dioxide molecules absorb solar energy, trapping heat within the atmosphere in the same way glass traps heat within a greenhouse. The warming of the atmosphere that results from greenhouse gases is known as the greenhouse effect. Human activities are greatly increasing the concentrations of greenhouse gases in the atmosphere. The increase in global temperature is correlated with the increasing concentration of these gases in the atmosphere.

The following activity directly measures the function of a greenhouse by recording the change in temperature of two probes under a heat lamp, one inside and one outside a glass jar. Because the air in the jar is warmed and cannot escape, the temperature in the jar rises much faster than in the ambient classroom environment. To complete the activity, students must use data logging and plotting skills to identify the warming trends in the two probes. From this vantage point, the class can participate in a larger discussion on the climate.

Vocabulary / Definitions

Word	Definition
Temperature	How hot or cold something is
Heat	Energy transferred from one body to another because of a temperature difference
Greenhouse	A glass building in which plants that need protection from cold weather are grown
Gas	Fluid that has neither shape nor volume
Radiation	The transmission of energy in the form of waves or particles

Procedure

Before the Activity

- Drill a hole, approximately 0.5 cm in diameter, in the center of the lid.
- Build circuit with schematic in Figure 2 on the Board of Education prototyping breadboard, shown in Figure 3.
- Program attached PBasic code, twothermometers.bs2, to read temperature probes, and set calibration constants using known thermometer as a reference.
- Copy attached worksheet so that there is one for every student.
- Plan an area to construct the activity setup, with ring stand and lamp, in Figure 4.

Image 2 (left justified)

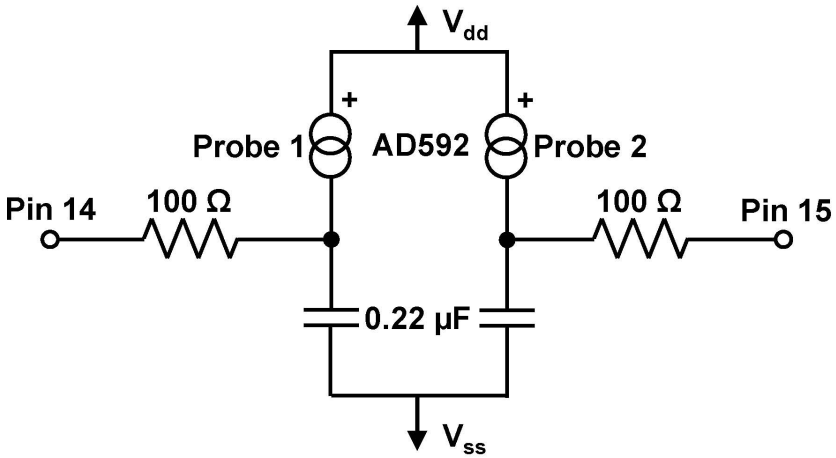

Figure 2
ADA Description: Schematic of Basic Stamp 2 circuit with two temperature probes
Caption: Figure 2: Schematic of Basic Stamp 2 circuit with two temperature probes
Image file name: fig2.jpg
Source/Rights: Copyright © Nicole Abaid, AMPS, NYU-Poly, 2010.

Image 3 (left justified)

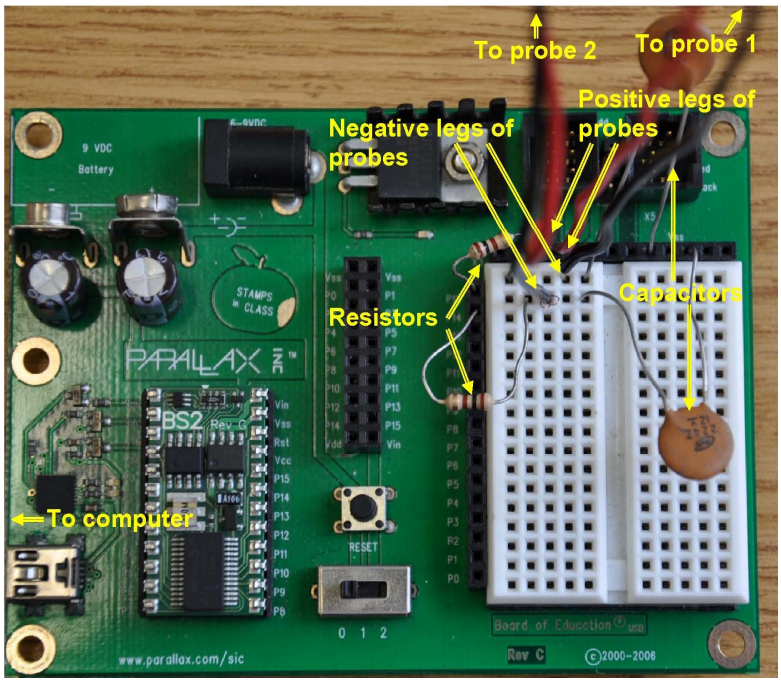

Figure 3
ADA Description: Parallax Board of Education with two temperature probe circuit
Caption: Figure 3: BS2 and circuit
Image file name: fig3.jpg
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With the Students

1. Explain to the students the basic setup of the experiment, and make hypotheses on how temperature readings between the two probes will be different.
    a. Choose a student to read temperatures to the class off the screen.
    b. Choose a student to record the announced temperatures on the board.
2. Place one temperature probe inside jar lid and screw onto jar.
3. Attach the other probe to the ring stand at approximately the same height from the table as the probe in the jar.
4. Clamp shop lamp to desk or table edge so that it shines on both probes from an equal distance and that the equipment generally follows the schematic in Figure 4, seen in Figure 5.
5. Record initial temperatures on both probes and turn on lamp.
    a. Continue taking temperature readings from both probes at 60 second intervals for a total of 6 minutes.
6. Finish data collection and turn off lamp.
7. Have students complete the worksheet by plotting data points and answering the follow-up questions to identify trend in the data.
8. Draw conclusions as a class about how and why temperatures between the probes differed.

Image 4 (left justified)

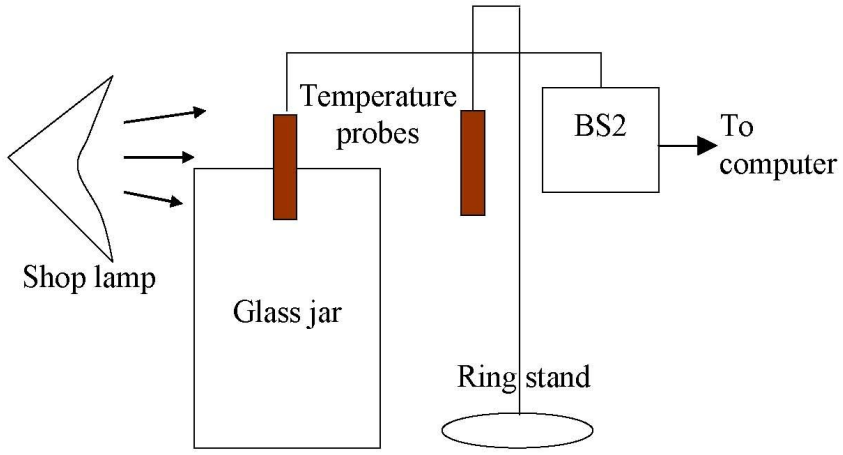

Figure 4
ADA Description: Schematic of activity equipment setup
Caption: Figure 4: Schematic of equipment setup
Image file name: fig4.jpg

Image 5 (left justified)

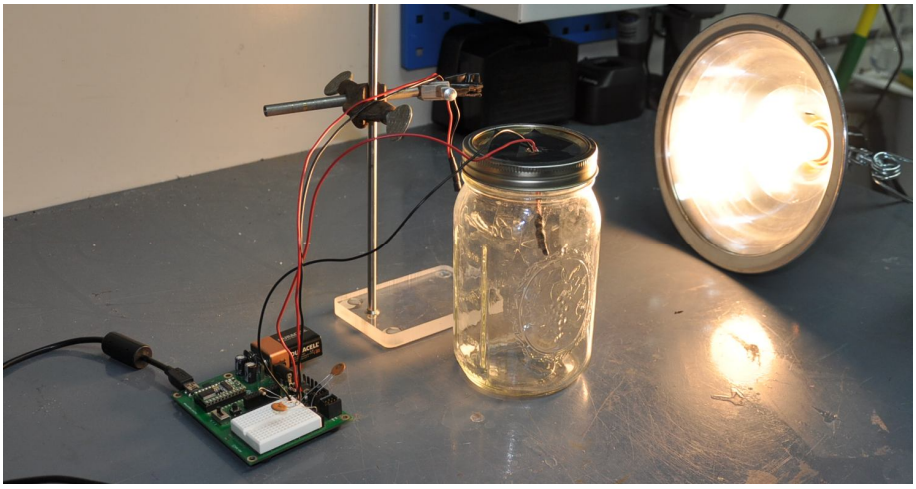

Figure 5
ADA Description: Activity setup, with glass jar, ring stand, temperature probes, and Board of Education
Caption: Figure 5: Activity equipment setup
Image file name: fig5.jpg

Attachments

Greenhouse_Gas_worksheet.doc

Twothermometers.bs2

Safety Issues

- Shop lamps have metal shields to direct light. The shield gets very hot after the lamp has been on. The experiment should be set up in a place that the students will be able to avoid touching the shield.
- Caution should be taken handling the glass jar.

Troubleshooting Tips

The temperature probes can drift during use. It is important to align calibration constants so that both probes read the same temperature at the beginning of the experiment, which can be validated by a known mercury or alcohol thermometer. After calibration, experiment should be performed shortly.

Investigating Questions

Assessment

Pre-Activity Assessment

What is global warming: Ask students to describe what the term "global warming" means. Discuss causes for this condition, including the accumulation of greenhouse gases in the atmosphere. One can also use the planet Venus as an example.

Activity Embedded Assessment
Prediction: After discussing the experiment, have students predict which thermometer will record a higher temperature over time.

Post-Activity Assessment
Worksheet: See attached document.

Activity Extensions

Activity Scaling

- For lower grades, the activity can be done solely as a demonstration, with data logging and plotting done on the board.
- For upper grades, students can work with the Basic Stamp 2, including building the circuit used in the experiment and programming the microcontroller.

Additional Multimedia Support

References Basic Stamp 2 Syntax and Reference Manual version 2.2
www.parallax.com

Other

Redirect URL http://gk12.poly.edu/amps-cbri/

Owner AMPS GK-12 Program, Polytechnic Institute of New York University

Contributors Nicole Abaid

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