Classroom Demonstration "Script"

WHAT ARE THE GREENHOUSE GASES?

I. INTRODUCTION

The temperature on our planet can change for many reasons. Animals, plants, oceans, clouds, volcanoes and other natural systems affect our climate by adding or removing gases from the air. Today we will be looking at a phenomenon called the GREENHOUSE EFFECT, at the GREENHOUSE GASES which cause it, and at the potential problem of GLOBAL WARMING.

II. THE GREENHOUSE EFFECT

First, let's talk about the greenhouse effect. To understand the ANALOGY of Earth as a greenhouse, we must begin by learning what a greenhouse is and how it works.

A. HOW DOES A GREENHOUSE WORK? (experiment)
1. Visible light enters
2. Absorption by dark surfaces
3. Infrared or "IR" radiation (heat) emitted
4. Heated air trapped by glass walls

What do we use greenhouses for? *(Growing plants in places, and during seasons, that might otherwise be too cold. The warm air inside greenhouses allows plants to survive and grow.)*

(This experiment should be set up and operating a few minutes before the class comes in. Warm-up time is required. Materials: large jar with 1/2 inch of soil, 2 thermometers —one in jar, one out—light bulb equidistant between 2 thermometers. (See Figure 1 page 85, where all figures appear.)

I've had this experiment set up and running for a few minutes before you came in. This thermometer measures the temperature of the room. (Volunteer), can you read it for me? *(It is _____ degrees.)* **Is the room really that hot?** *(No, the air near the thermometers is being heated by the light bulb.)*

The other thermometer has been inside a glass jar the same distance from the light. What is the temperature of the air inside? *(The temperature inside is _____ . . . It should be significantly higher.)*

When we shine light on surfaces, they ABSORB the ENERGY we see as VISIBLE LIGHT and CONVERT it to something we can feel as HEAT ENERGY or INFRARED RADIATION. That energy heats the air around it. If the heated AIR IS TRAPPED inside something like our jar here, or a big greenhouse, the inside temperature stays warmer than outside. You've felt that same effect if you ever got into a car or bus that was parked in the sun!!

B. THE GREENHOUSE AS AN ANALOGY FOR EARTH

1. AIR: What is an atmosphere?

What does Earth have in common with a greenhouse? *(Like plants in a greenhouse, we have air all around us. It is called the ATMOSPHERE.)* **Take a deep breath. That was atmosphere. The atmosphere is a mixture of gases that begins at the surface of land, seas and at the surfaces of all objects.** (Indicate a surface. Make sure to clear up the common misconception that atmosphere is "out there somewhere.") **How high does the atmosphere go? About 99.9% of our air is in a layer that reaches to 30 miles up into the stratosphere. That sounds like a lot of gases, but let's look at the atmosphere on a different scale. If the Earth were shrunk to the size of an apple, our atmosphere would be represented by the thickness of the apple's skin!**

2. WALLS?

a. Clouds, particles
b. Gases of the atmosphere

Earth doesn't have walls around it like a greenhouse, but many components of the atmosphere affect the temperature of the planet in the same way. WATER DROPLETS in clouds and fine PARTICLES spewed by volcanos act as physical barriers (like walls) to some visible light and infrared radiation. Some of the gases in the atmosphere, the GREENHOUSE GASES, trap the escaping heat energy as well. Let us look at how those gases affect global temperatures.

C. HOW CAN GAS WORK LIKE THE SOLID WALLS OF A GREENHOUSE?

(The GREENHOUSE EFFECT)

Gases in our atmosphere exist as MOLECULES, little bundles of chemicals attached to each other by a "glue" called BONDS. The bonds in some of the atmosphere's gases ABSORB some of the infrared energy (or heat), preventing it from escaping back into space. Eventually the heat is released, but while some escapes beyond the atmosphere, some is RE-EMITTED back toward the Earth. In this way the gases act as a partial "wall" which traps not heated air, but heat ENERGY near Earth.

D. WE NEED THE GREENHOUSE EFFECT

You may have gathered from reading newspaper articles that the greenhouse effect is an environmental problem to be avoided at all costs. That's not true! If our atmosphere did not trap any heat energy, Earth would be a ball of ice. The average surface temperature would be between -27 and 0°F. We NEED the greenhouse effect to keep Earth warm enough to sustain life.

E. THE REAL PROBLEM : GLOBAL WARMING

What, then, is all the fuss about? For a long time the CONCENTRATIONS of greenhouse gases in the atmosphere remained fairly stable. In the last 200 years, however, we humans have been producing many of these gases at increasingly rapid rates. That situation is adding to the greenhouse effect and potentially bringing on the problem, GLOBAL WARMING.

If the Earth's atmosphere continues trapping increasing amounts of heat energy, the AVERAGE SURFACE TEMPERATURE is likely to rise. If that trend continues, some regions may experience more frequent droughts, while flooding may increase in others, sea level may rise and some habitats might disappear . . . all conditions that may make survival difficult for many plants and animals.

III. The GREENHOUSE GASES

Can anyone tell me the name of some of the gases that make up our atmosphere? (Nitrogen:78% / Oxygen:21% / which leaves only 1% for all the other gases. WATER VAPOR, CARBON DIOXIDE, METHANE, AND NITROUS OXIDE, the natural greenhouse gases,are part of this 1%.) (Exhibit bottle with 100 marbles.) **The marbles in here represent the gases in our atmosphere. All of the ____ ones are the nitrogen and oxygen; that leaves only this ____ one to represent all the rest.**

Remembering how relatively thin our atmosphere is, and seeing that only 1% of that is greenhouse gases, it seems hard to believe that so little gas could pose such a threat!

A. WATER VAPOR

Greenhouse gases can be produced by both NATURE and HUMAN ACTIVITIES. Those produced in nature have maintained a fairly steady balance for thousands of years. We will be focusing on the gases affected most by human activities, the ANTHROPOGENIC gases.

WATER VAPOR is the most common greenhouse gas. We have very little control over water in the atmosphere, however, so we will only mention it in passing.