

## Warm the Earth... Or Not Activity Guide

**Goal:** Students will understand the role of greenhouse gases in the atmosphere.

### General Description

Students play a game in which they become the Earth's greenhouse gases. They can move to capture or release radiated heat into the atmosphere. The game starts with early Earth in which there are not many greenhouse gases and the Earth is a cooler planet, it then progresses into modern time and finally into the future. As the game progresses, the greenhouse gases build up in the atmosphere and students must adopt a different strategy to keep the Earth inhabitable for humans. In the process they learn about the critical role greenhouse gases play in our atmosphere. This activity is suited for ages 10 and up.

### Materials

Mac or PC

*Warm the Earth... Or Not* Multimedia Game

Optional: NOAA Rising Greenhouse Gas Concentration Activity sheet

### Procedure

Let students play *Warm the Earth... Or Not* Multimedia Game. If you are doing this as an afterschool program for middle school and high school the accompanying NOAA handout complements the game well. Students can take turns playing the computer game, and work on the activity sheet until it is their turn to play the game.

### Discussion

If you are using the NOAA activity, there are a set of wonderful discussion questions. In addition here are some points to raise related to how greenhouse gases work:

- 1) Solar radiation passes through the atmosphere
- 2) About half of the energy of incoming sunlight reaches Earth's surface, where it is converted to heat.
- 3) Most of that energy is radiated upward as infrared emissions.
- 4) Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules
- 5) When this heat is "trapped" the Earth's surface and lower atmosphere is warmed.



### **Background Information (from Windows to the Universe)**

Energy from the Sun can enter the atmosphere, but not all of it can easily find its way out again. This is a natural process called the greenhouse effect. Without any greenhouse effect, Earth's temperature would be below freezing. However, Earth's greenhouse effect is intensifying as we add more greenhouse gases to the atmosphere. This is warming the climate of our planet.

When sunlight warms the Earth's surface, the heat is then radiated to the atmosphere. Some of this heat makes its way out of the Earth system – back to space - but along the way much of the heat is absorbed by greenhouse gases in the atmosphere. Greenhouse gases are more complex than most other gas molecules in the atmosphere, with a structure that can absorb heat. They radiate the heat back to the Earth's surface, to another greenhouse gas molecule, or out to space.

Sometimes during this Century, the amount of the greenhouse gas carbon dioxide is expected to double. Other greenhouse gases like methane and nitrous oxide are increasing as well. The amounts of greenhouse gases are increasing as fossil fuels are burned, which releases greenhouse gases. Greenhouse gases also make their way to the atmosphere from other sources. Farm animals, for example, release methane gas as they digest food. As cement is poured and hardens, it releases carbon dioxide.

As forest trees are harvested for their wood, and land is converted to farms or urban center, there are less large trees to, through photosynthesis, take carbon dioxide out of the air. Potted plants, lima bean plants, grass – all types of plants do photosynthesis, but trees, and especially large trees, are very efficient at it.

With more greenhouse gases in the atmosphere, heat on its way out of the atmosphere is more likely to be intercepted. The additional greenhouse gases absorb the heat and then radiate it away from the Earth, to another greenhouse gas molecule, or back to the planet's surface again. With more greenhouse gases, the atmosphere will radiates heat from a higher level, so less heat gets out. With more greenhouse gases, heat will get stuck in the system, warming the planet.

