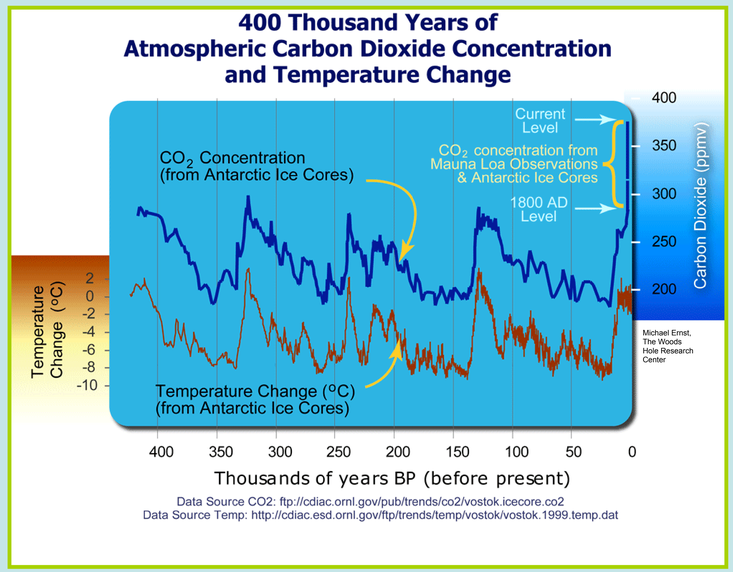
What is the Greenhouse Effect?

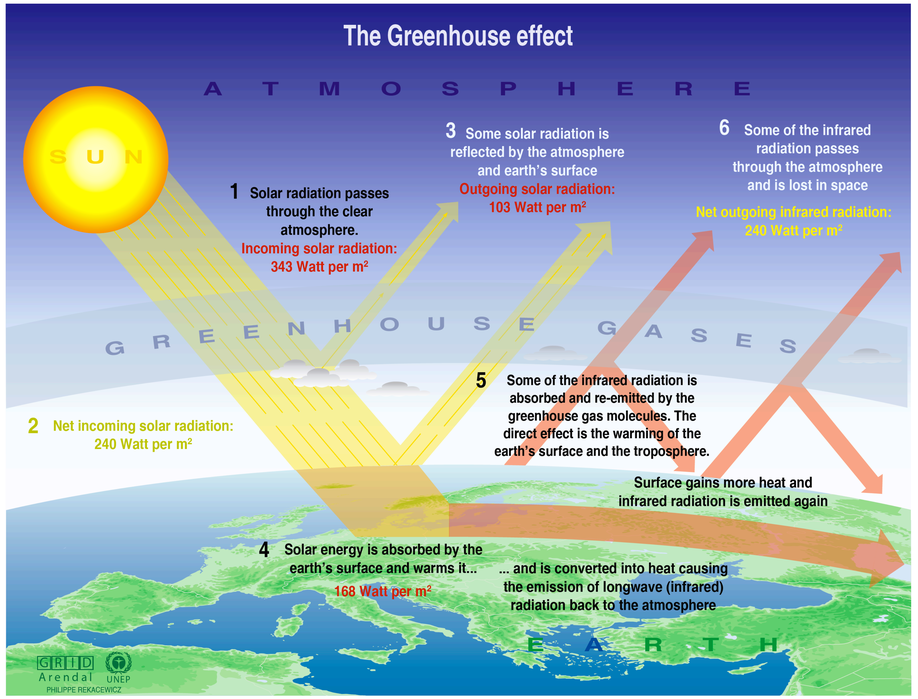
In an ordinary greenhouse, sunlight passes through the glass walls and warms up the inside. This heat then gets trapped within the walls. **The greenhouse effect** in the atmosphere works a little bit like an ordinary greenhouse. *Greenhouse gases* trap the heat brought by light passing through the atmosphere of the Earth. The major heat-trapping gases include water vapor, carbon dioxide, and methane. Earth would be a chilly place without the greenhouse effect - the average temperature would be 57ºF colder!

Too much greenhouse effect also has consequences: Venus has an atmosphere of 96% carbon dioxide, and a surface temperature of 860ºF! Only 0.04% of Earth's atmosphere is carbon dioxide. On Earth, most carbon is stored in sedimentary rocks, whereas on Venus, most carbon is in the atmosphere.



The Earth has warmed an average of 1.1ºF (0.6 ºC) since the beginning of the Industrial Revolution in 1880. Although this may seem like a small increase in temperature, it is a dramatic change relative to the last several hundred years or more. It is widely thought that the increase in temperature is largely caused by the human-induced increase of greenhouse gas concentrations in the atmosphere.

The data in this graph show that temperatures have risen and fallen with CO_2 concentrations over the last 400,000 years. More recent data have shown the same relationship extends 650, 000 years or more. Gas bubbles from ice cores show that there is now 36% more carbon dioxide in the atmosphere that at any time in at least the last 650,000 years.

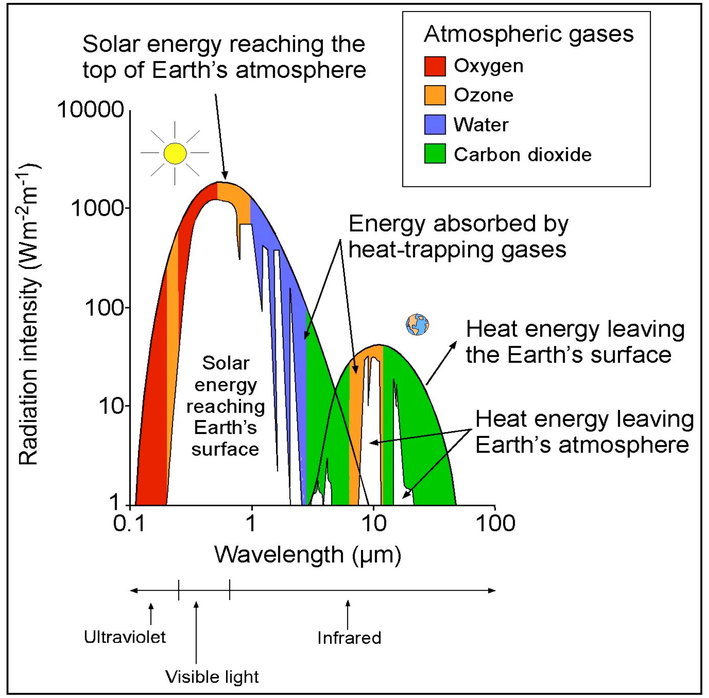


Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996. Graphic design by *Philippe Rekacewicz, UNEP/GRID-Arendal*

How do heat-trapping gases work?

The energy from the sun that reaches Earth's surface is mostly "shortwave" radiation - mostly visible light. This energy passes freely through the atmosphere and is absorbed by Earth's surface. The surface warms from the energy input, and some of its heat projects back to the atmosphere as infrared radiation. The greenhouse gases in the atmosphere absorb 95% of the energy in infrared radiation, allowing only 5% to pass into space. When greenhouse gases absorb energy, heat is released in all directions, including back towards Earth. As the concentration of greenhouse gases increases, this "insulating blanket" thickens, further warming the Earth.

The graph on the right shows the amount of solar energy that reaches the Earth's atmosphere (left curve), and the infrared energy projected from the Earth's surface (right curve). Absorption values for some of the atmospheric heat-trapping gases are given by color; white peaks represent the energy that fully passes through the atmosphere.



Created by Jill Taylor and Carol Goranson for the Boston Area Climate Experiment. This poster was designed during the class "Climate Change: Mechanisms and Biological Impacts," at the University of Massachusetts Boston, Fall 2006.