

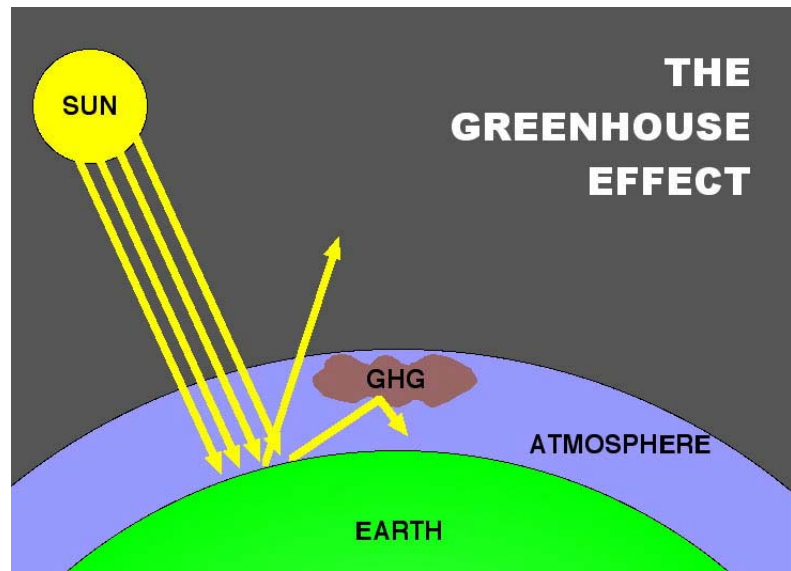
Climate Change 3 — The Greenhouse Effect

Most of us are familiar with greenhouses. They have walls and roofs made of glass. Sunlight comes through the glass and warms the interior of the room. But the glass keeps the heat from radiating back out. The result is that on a sunny day, the greenhouse is many degrees warmer than the outside temperature. This is the greenhouse effect. Something similar is responsible for global climate change.

Glass is not the only substance that can have a greenhouse effect. Some gasses, called greenhouse gasses (GHGs), also have that effect. Some common GHGs include carbon dioxide (CO_2), water vapor, methane, and nitrous oxide (N_2O). These gasses are mixed into the atmosphere, sometimes because of natural causes, sometimes because we emitted them as pollution.

Sunlight penetrates the atmosphere, striking the earth and warming it. Some of the heat is reflected or re-radiated by the earth back towards space. Before it can get there, however, it is blocked by GHGs in the atmosphere, just as glass in a greenhouse blocks heat from escaping. The result is that the earth warms, just like the interior of a greenhouse. The additional warmth is small, but it leads to climate change.

The main trigger is carbon dioxide (CO_2). We emit staggering amounts of it into the atmosphere when we burn hydrocarbons. It causes the climate to warm slightly. As we all know, increasing temperature causes water to evaporate more quickly. The small increase in temperature causes a small increase of water vapor in the air. Unfortunately, water vapor is a powerful GHG. More water vapor in the air increases the greenhouse effect, which warms the earth even more, which causes more water to evaporate into the air, which increases the greenhouse effect, etc. This kind of situation, where each change acts to accelerate more change, is called *positive feedback*. Thus, our CO_2 emissions become the trigger that over time causes a significant increase in atmospheric water vapor, resulting in climate change.ⁱ



ⁱ My presentation of the greenhouse effect is greatly simplified. For a thorough, scientifically sophisticated discussion, see Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather, 2007: Historical Overview of Climate Change. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Retrieved online at <http://www.picc.ch>. Wikipedia also has articles on both the greenhouse effect and on global warming that can serve as resources for those who don't want to tackle the IPCC report.