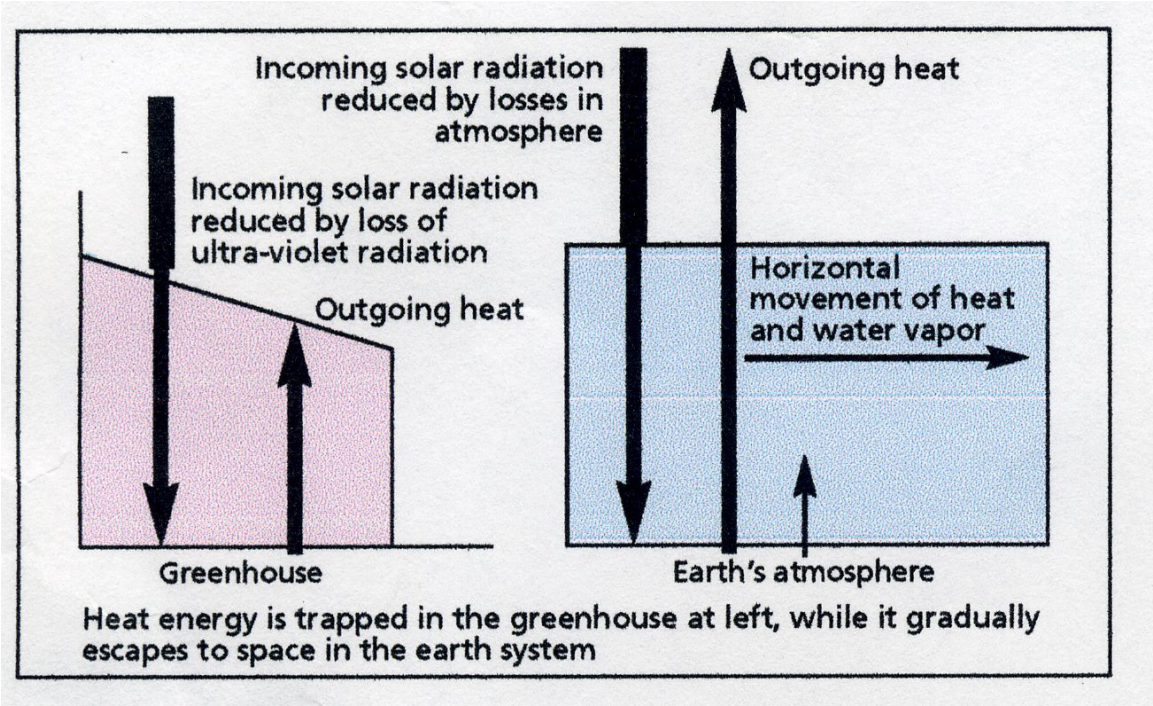
The Greenhouse Effect

By Dr Timothy Ball

Education uses analogies all the time. They are a useful tool, but also have limitations because the analogy is rarely exact in all except very limited circumstance. The classic example currently bedeviling the world is the Greenhouse Effect (GE). Everyone knows the term but few know how a greenhouse works and even fewer know it is not a good analogy for the Earth's atmosphere.



In the greenhouse on the left the sunlight, technically known as incoming solar radiation insolation, passes through the glass but 100% of the ultraviolet radiation is removed. This is why you cannot get a tan or even sunburn through glass. All the remaining sunlight strikes surfaces in the greenhouse and raises their temperature. The air in touch with the surfaces is heated and gradually the temperature of the greenhouse rises. The heat, known as sensible heat because a person can feel it, cannot pass through the glass. The glass has acted like a one-way valve letting sunlight in but blocking heat from escaping. As long as sunlight comes in the temperature will keep rising unless a window or door is opened.

In the atmosphere the sunlight reaches the top of the atmosphere and approximately 95 percent of the ultraviolet is absorbed in creating ozone. The remaining 5 percent passes through to the surface. A portion is absorbed by dust and water droplets and directly warms the atmosphere. Unlike the greenhouse only about half the sunlight reaches the surface. Some of the energy heats the surface but much also goes to evaporate water, especially over the oceans. Like the greenhouse the air in contact with the ground is heated by the surface, however, unlike the greenhouse the heat is carried up by convection and most importantly moved sideways by the wind and thus distributed throughout the atmosphere. The vertical movement of air is known as convection, the horizontal movement is advection.

Unlike the glass in the greenhouse the greenhouse gases retain the heat only briefly. Over time the heat escaping at the top of the atmosphere equals the amount of sunlight coming in as if the windows and doors of the greenhouse were at least partially open all the time.

Despite what many think the Greenhouse Effect is not just global warming, it can also result in cooling if less energy comes from the sun or more escapes through the atmosphere.

The term Greenhouse Effect is so much part of our lexicon it will remain. However, once people realize that CO2 is less than 4 percent of the total Effect, it will likely fade into history as a poor analogy.

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