

The Greenhouse Effect and Greenhouse Gasses

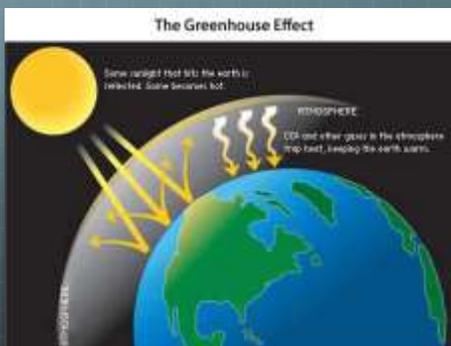
Ecology

Earth's Atmosphere Warms the Planet

- The **gasses in Earth's atmosphere help warm our planet.**
- This is called **The Greenhouse Effect.**
- Without the greenhouse effect, the Earth's average temperature would be 0° Fahrenheit instead of 57° Fahrenheit.

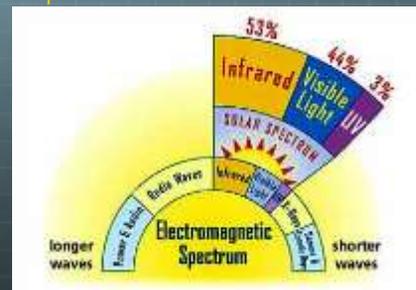


The Greenhouse Effect

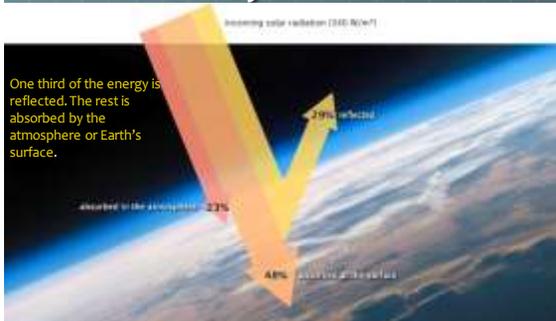


The sun emits radiation

The sun emits **infrared radiation, ultraviolet radiation, and visible light.** This energy strikes the atmosphere.



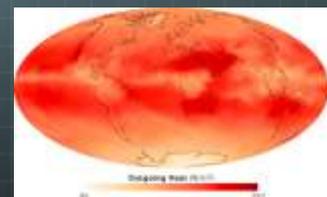
This energy is reflected or absorbed by Earth's surface



The earth and atmosphere are warmed and emit infrared radiation

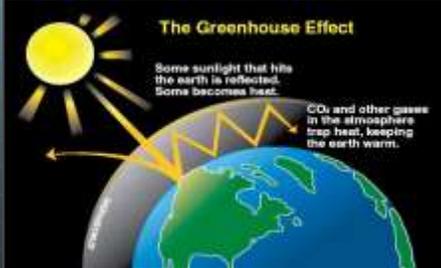
The energy is absorbed by the Earth and the atmosphere. They are warmed.

Warmed objects emit **infrared heat** – a form of energy that is not visible to humans.



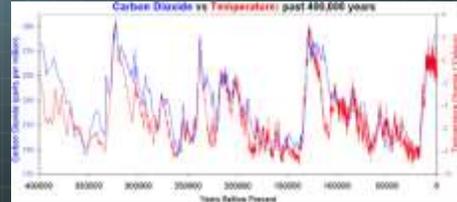
Infrared radiation is trapped by greenhouse gases

Greenhouse gasses absorb the heat again, and once again emit infrared energy. This pattern continues, warming the planet significantly*.



CO₂ is a Greenhouse Gas

- CO₂ levels and Earth's temperature have changed together for hundreds of thousands of years.
- CO₂ is an important greenhouse gas in our atmosphere.



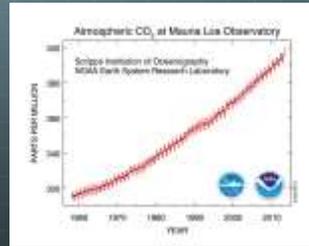
CO₂ concentrations have changed in recent years

- Levels of atmospheric CO₂ have never been above 300 ppm for 400,000 years.
- After 1950, CO₂ levels have sharply increased – why?



Direct Measurements at Mauna Loa Observatory

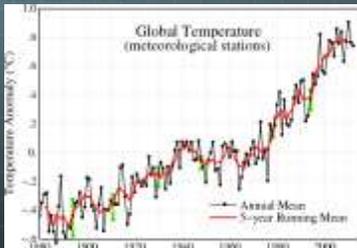
- Charles David Keeling was the first to measure CO₂ in the atmosphere over many years, beginning in 1958.



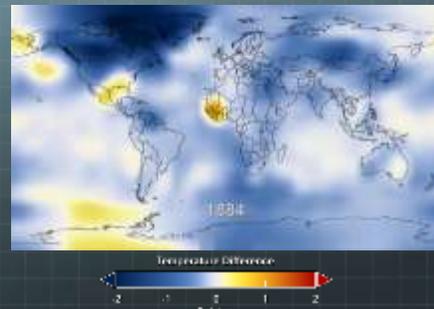
The "Keeling Curve" shows the steady rise of CO₂ in the atmosphere since the 1950's.

Global Temperatures Since 1880

- Global temperatures have increased 1.4°F since 1880. The 2000 – 2010 decade was the warmest decade on record. These are direct measurements.

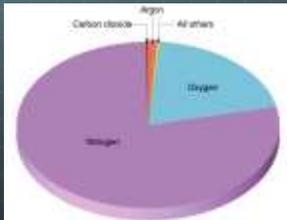


Temperature Change Across the Planet



Other Greenhouse Gasses

- Carbon dioxide is not the only greenhouse gas.
- Our atmosphere consists of a variety of gases. **Nitrogen and oxygen make up 99% of dry air in our atmosphere.** They are **not** greenhouse gases.



Other greenhouse gases

- Methane, nitrous oxide, and ozone** are also naturally occurring greenhouse gases.
- Chlorofluorocarbons** are a **powerful manmade greenhouse gas.**



Greenhouse Gas Warming Potentials

Greenhouse Gas	GWP	Lifetime (y)
Carbon Dioxide (CO ₂)	1	variable
Methane (CH ₄)	21	12.2
Nitrous Oxide (NO ₂)	206	120
Hydrofluorocarbons (HFC)	140-11700	1.5-264
Perfluorocarbons (PFC)	6500-9200	3200-50000
Sulfur Hexafluoride (SF ₆)	23000	3200
Chlorofluorocarbons (CFC)	12000-18000	

Despite its low warming potential, **carbon dioxide is the most abundant greenhouse gas and most closely linked with global temperature.**

Natural Sources of Greenhouse Gases: Methane

- In **low oxygen environments**, many **decomposers produce methane instead of carbon dioxide.** Methane is also produced in the **guts of animals that eat wood or grass.**



Natural Source: Volcanic Eruptions

- Volcanic eruptions release many greenhouse gases**, many of which are toxic and responsible for thousands of deaths. They account for **1%** of yearly CO₂ added to the atmosphere.



Anthropogenic Source: Farming Practices

- Because they consume grass, **livestock such as sheep and cows release large amounts of methane** just like termites do.



Anthropogenic Source: Deforestation

- Less living trees to remove CO_2 from the environment.
- When trees are destroyed by burning or decompose in large numbers, this also contributes CO_2 .
- Burning vegetation also releases methane and nitrous oxide.



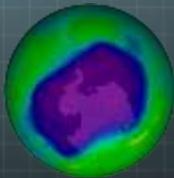
Anthropogenic Source: Landfills

- In landfills, household waste decays without access to oxygen, producing what greenhouse gas? Methane



Anthropogenic Source: Chlorofluorocarbons

- Chlorofluorocarbons, manmade chemicals used in aerosols, air conditioners, freezers and refrigerators, damage the protective ozone layer and are potent greenhouse gases.



Anthropogenic Source: Fossil Fuels

- The combustion of fossil fuels is by far the largest contributor of CO_2 to the atmosphere (94%).

