Climate: Big Ideas

- Humans cause global climate change through fossil fuel combustion, land-use changes, agricultural practices, and industrial processes.
- Water's unique physical and chemical properties are essential to the dynamics of all of Earth's systems
- Understanding geologic processes active in the modern world is crucial to interpreting Earth's past
- Over Earth's vast history, both gradual and catastrophic processes have produced enormous changes.
- Earth scientists do reproducible experiments and collect multiple lines of evidence.

Human Activities Could Result in Changes in Earth's Climate System

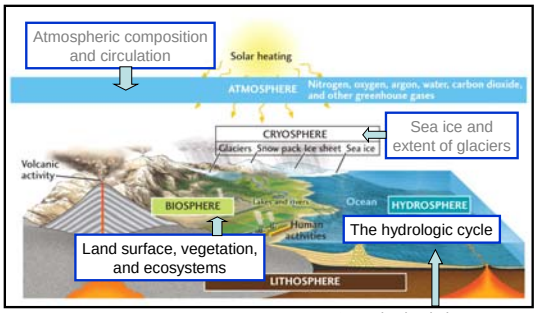


Fig. 15.1

Incoming and Outgoing Radiation in the Earth's Atmosphere

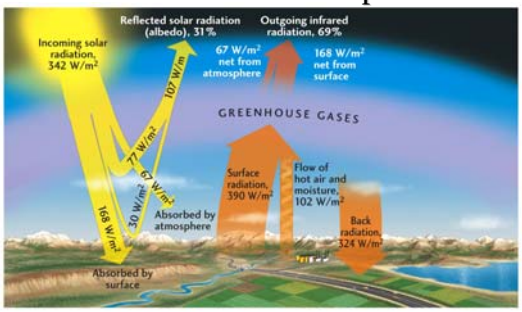
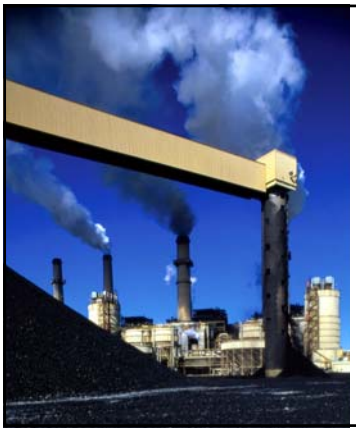


Fig. 15.7

What are the greenhouse gases? (excluding H_2O)

- Carbon Dioxide: 49%
- Methane: 18%
- "CFC's": 14%
- Nitrous Oxides: 6%
- Others: 13%



Coal Fired Power Plant

Where does the added CO_2 come from?

- Burning of Fossil Fuels: 75%
- Land clearing: 15%
- Manufacturing: 7%
- Fuel wood: 3%

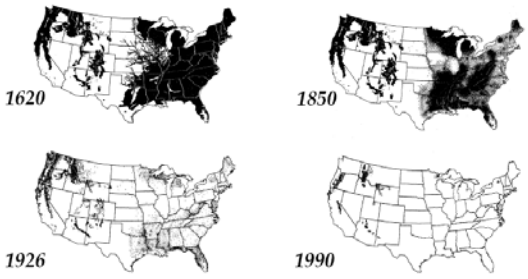
Deforestation

Old Growth Forests

- Giant Trees (~ 500 years old)
- Carbon Sink
- Oxygen Source
- Inhibits Soil Erosion
- Provides Nutrients for Soils, Surface Water
- Biodiversity
- Fire Resistant

Old Growth Forest Logging

Loss of Old Growth Forest



Global Temperatures Compared to Increased CO_2 Concentration

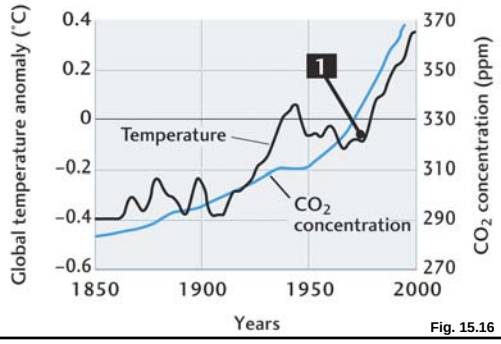


Fig. 15.16

Global Temperatures and CO_2 Concentrations Over the Last Millennium

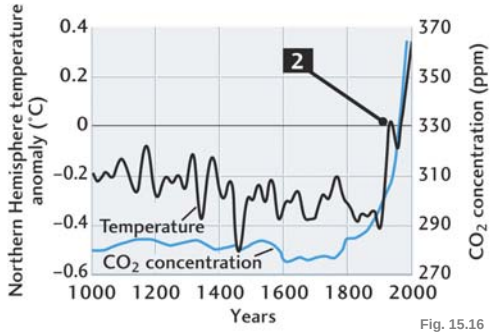


Fig. 15.16

The ice core, such as at Vostok Science Station in Antarctica provides over 100,000 years of data on:

1) temperature,
2) CO_2 content, and
3) methane content

Box 15.1

Temperature and greenhouse gas concentrations both decline during glacial periods

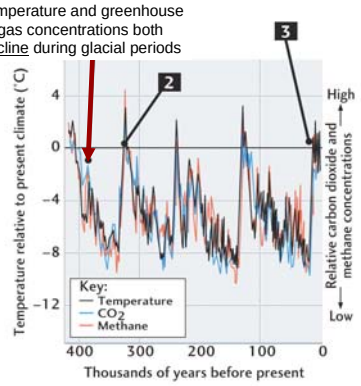


Fig. 15.10

Temperature and greenhouse gas concentrations both rise rapidly during deglaciation

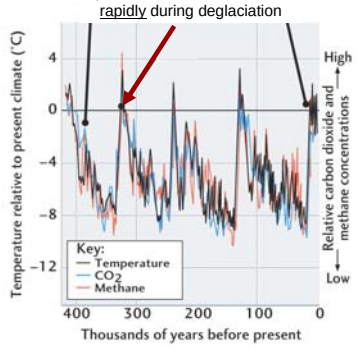


Fig. 15.10

Climate has been relatively warm and stable during the last 10,000 yrs, the Holocene interglacial period

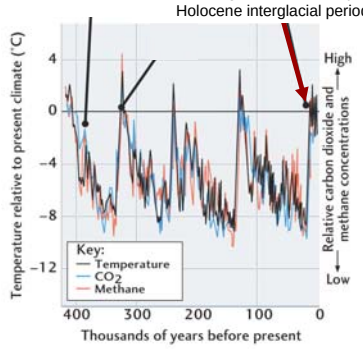


Fig. 15.10

The periodicity of glacial and interglacial cycles is best explained by cyclic variations in solar energy, governed by periodic variations in the Earth's:

- **Eccentricity** of Earth's orbit around sun
- **Tilt** of Earth's rotation axis
- **Precession** (rotational "wobble")

Orbital Eccentricity (~100,000 cycle)

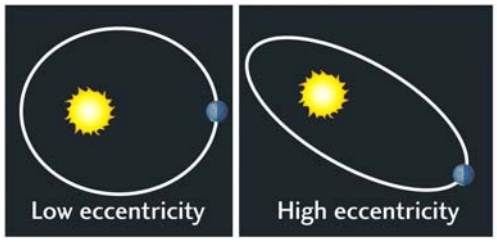
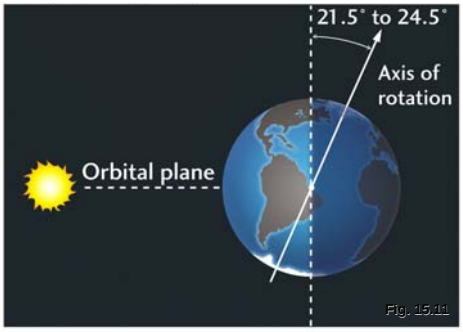


Fig. 15.11

Orbital Tilt (~41,000 cycle)



Orbital Precession (~23,000 cycle)

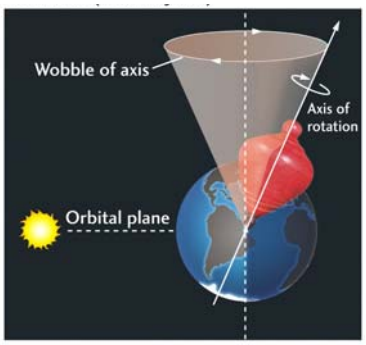


Fig. 15.11

Redistribution of Heat by Currents

Fig. 15.3

The Ocean's Circulation System Plays a Major Role in Controlling the Earth's Climate

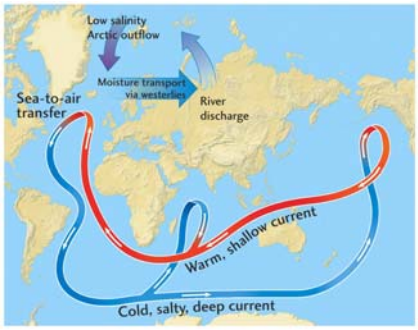
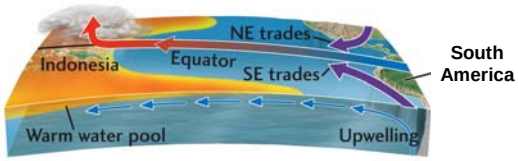


Fig. 15.3

El Nino - During "Normal Years"

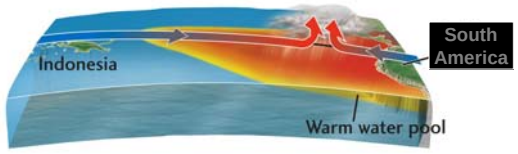
Warm water in the western Pacific causes low pressure and high rainfall;
pressure system drives tradewinds from east to west;
tradewinds drive warm water to the west;
causing cold water to rise off South America and flow west.



Box 15.2

During "El Nino"

Warm water shift to the eastern Pacific causes drought in western Pacific;
low pressure over the warm eastern Pacific causes heavy rains and inhibits upwellings along the coast of South America.



Box 15.2

The Carbon Cycle
(showing global reservoirs and fluxes)

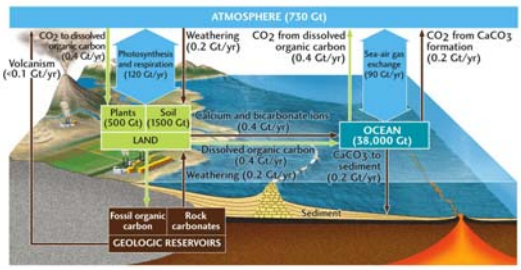


Fig. 15.14

Human Effects on the Carbon Cycle

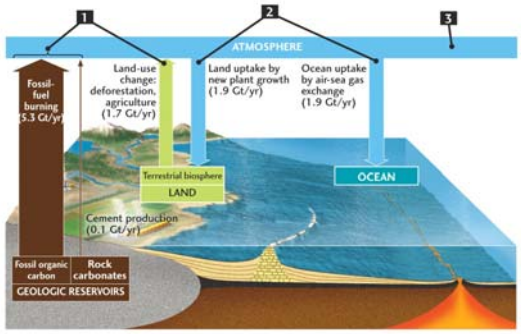
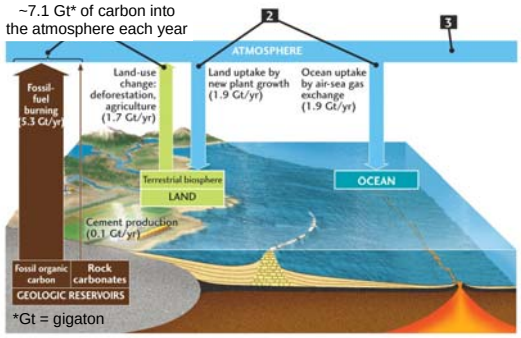


Fig. 15.14

Human Effects on the Carbon Cycle

Human activities release ~7.1 Gt* of carbon into the atmosphere each year



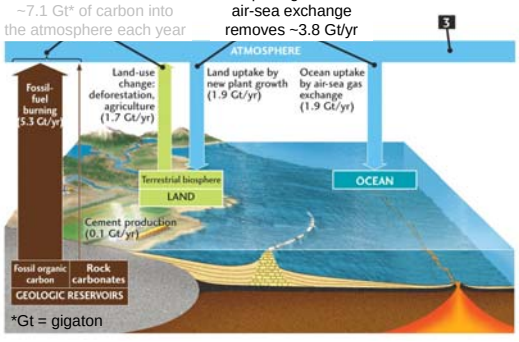
*Gt = gigaton

Fig. 15.14

Human effects on the Carbon Cycle

Human activities release ~7.1 Gt* of carbon into the atmosphere each year

New plant growth and air-sea exchange removes ~3.8 Gt/yr



*Gt = gigaton

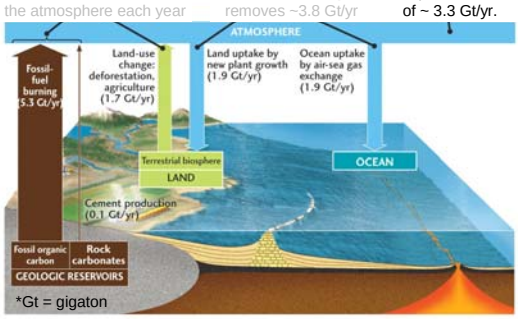
Fig. 15.14

Human effects on the Carbon Cycle

Human activities release ~7.1 Gt* of carbon into the atmosphere each year

New plant growth and Air-sea exchange removes ~3.8 Gt/yr

…yielding a net atmospheric increase of ~ 3.3 Gt/yr.



*Gt = gigaton

Fig. 15.14