

The Earth's Radiation Budget



Outcomes:

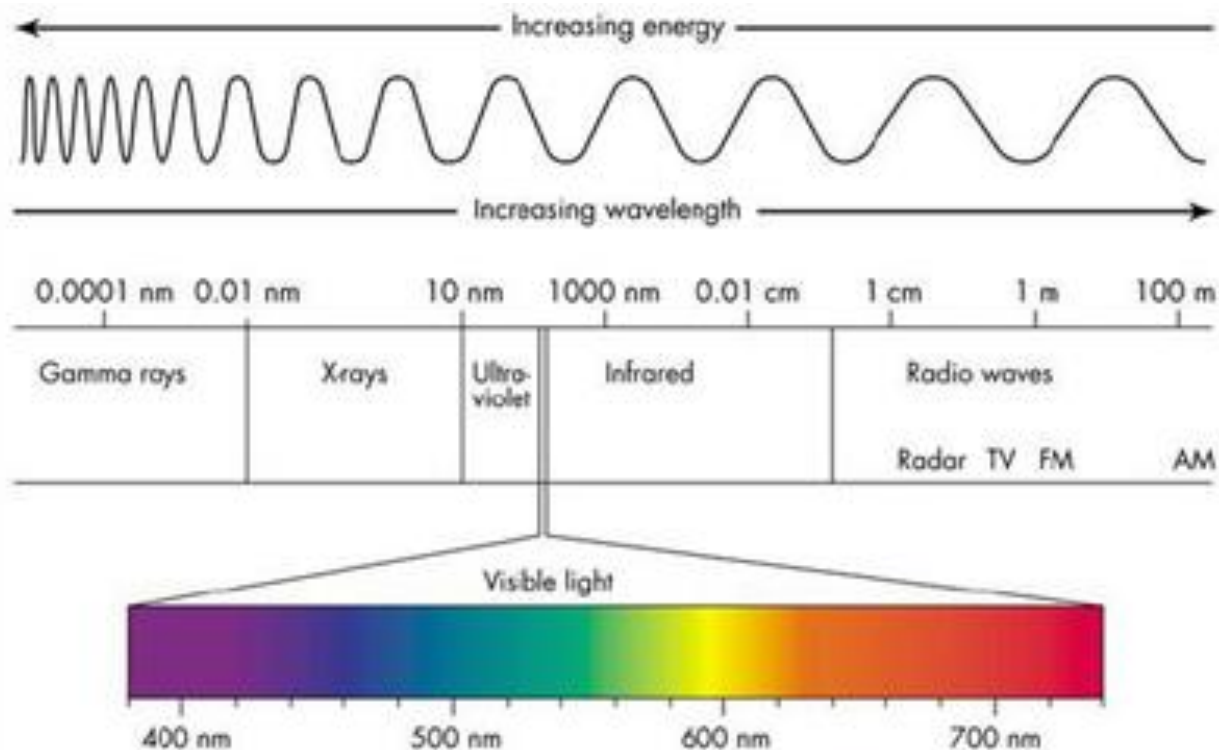
S2-4-02 Outline factors influencing the Earth's radiation budget. *Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude.*

Electromagnetic Radiation...

Almost all of the HEAT and LIGHT (i.e. ENERGY) that make things happen on Earth comes our way from the SUN.

The sun bombards our planet with ELECTROMAGNETIC RADIATION

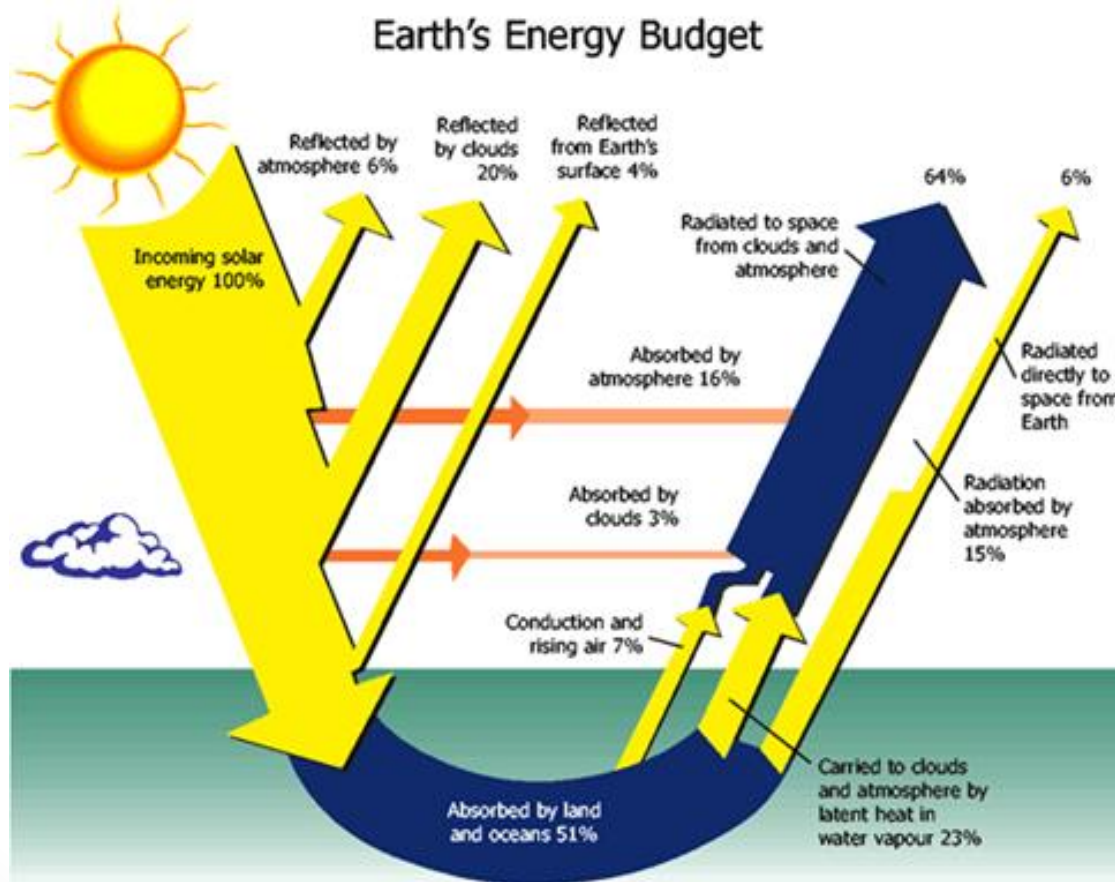
→ different types of RADIATION with different WAVELENGTHS and ENERGIES.



Reflection and Absorption of the Sun's Energy

100% of Incoming Solar Energy can be broken down as follows:

Reflection	Absorption
4% by the earth's surface	51% by the earth's surface
6% by the atmosphere	16% by the atmosphere
20% by clouds	3% by clouds

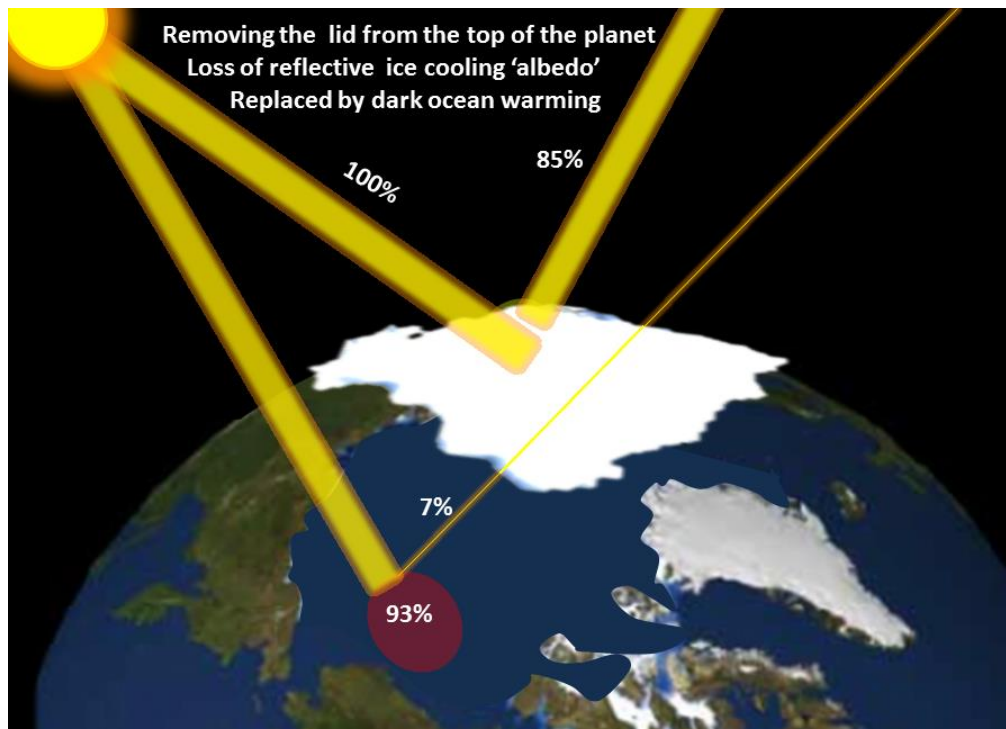


Albedo...

- **ALBEDO** is the **RATIO** of solar radiation **REFLECTED** by an object to the incoming solar radiation that **FALLS** on the object.
- The **MORE REFLECTIVE** a surface, the **HIGHER** the **ALBEDO**.

The whiter the surface the higher the albedo!

Albedo = $\frac{\text{Outgoing solar radiation reflected by a surface}}{\text{Incoming solar radiation that falls on the surface}}$



Albedo...

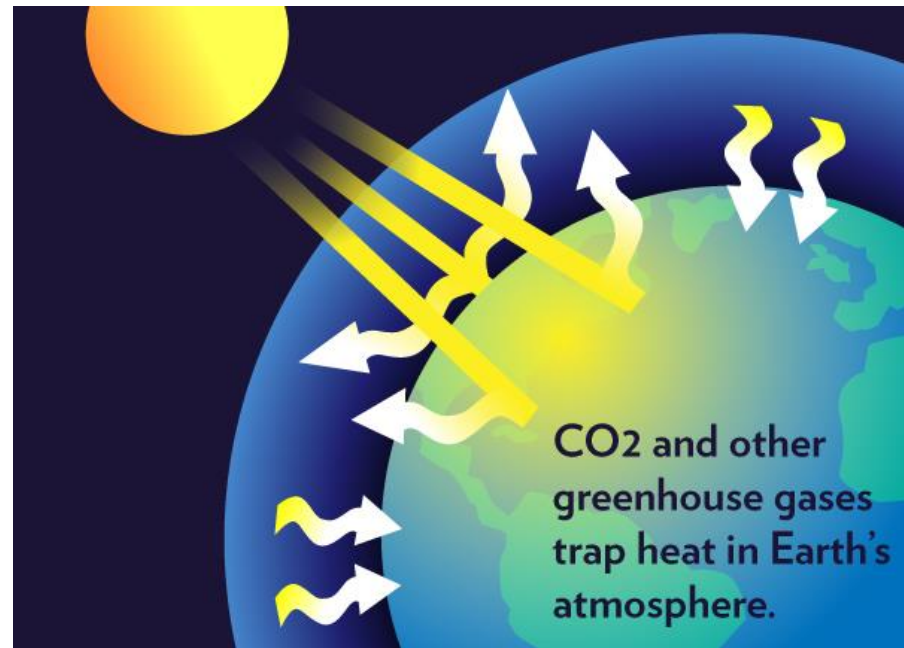
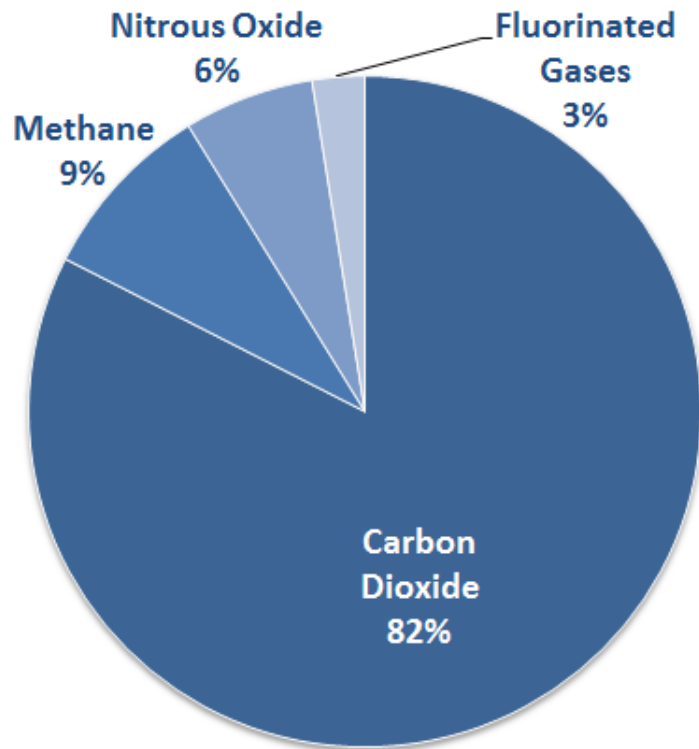
Table 1: Typical albedo of various Earth surfaces

Surface	Albedo (%)
Fresh Snow	75 – 90
Thick Clouds	60 – 90
Thin Clouds	30 – 60
Earth and its Atmosphere	30
Venus (planet)	78
Ice	30 – 40
Sand	15 – 45
Mars	17
Grassy Fields	10 – 30
Dry, Plowed Field	5 – 20
Water	10
Forested Areas	3 – 10
The Moon	7

Source: C. Donald Ahrens (2000). *Meteorology Today* (6th Edition). Used under the terms of the Access Copyright Agreement (2003-2004).

What are Greenhouse Gases...

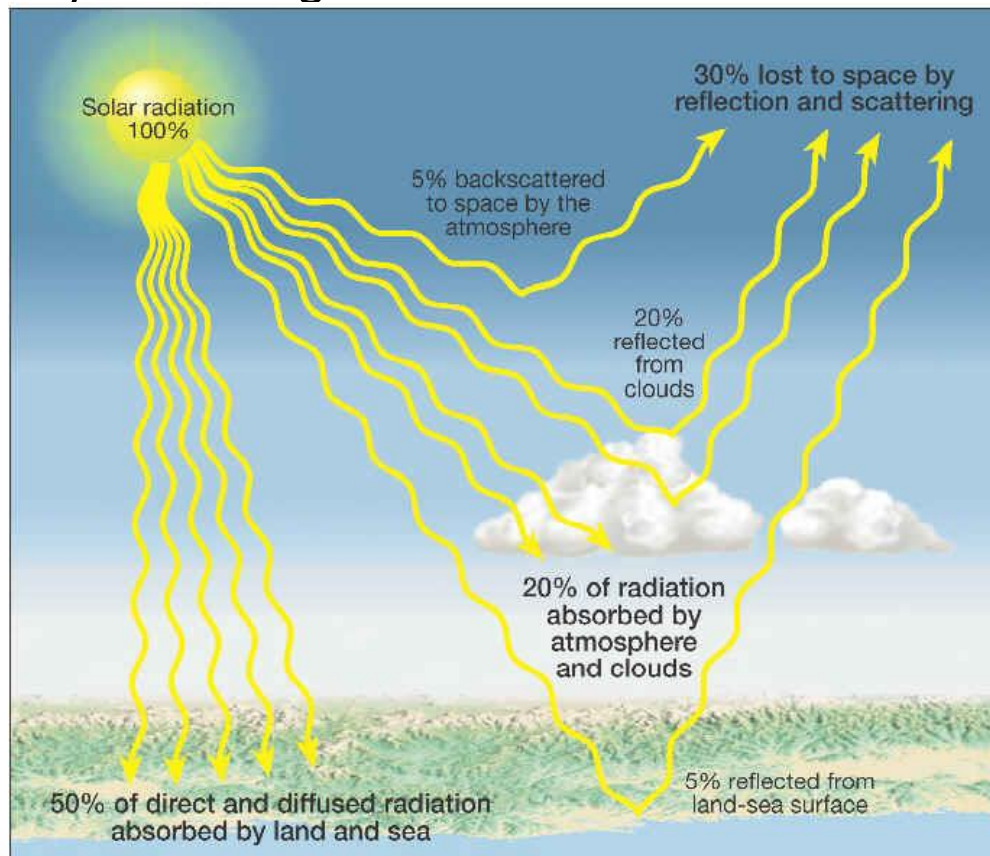
GREENHOUSE GASES are natural or polluting gases that increase the **HEAT-TRAPPING** ability of the atmosphere.



What are Greenhouse Gases...

Although **ALL** the energy that reaches the Earth **EVENTUALLY** gets **RE-RADIATED** back to **SPACE** (in one form or another), the **ATMOSPHERE** (and **HYDROSPHERE**) allow for a **SLOWER** and **MORE GRADUAL** release of the energy from the Earth's surface.

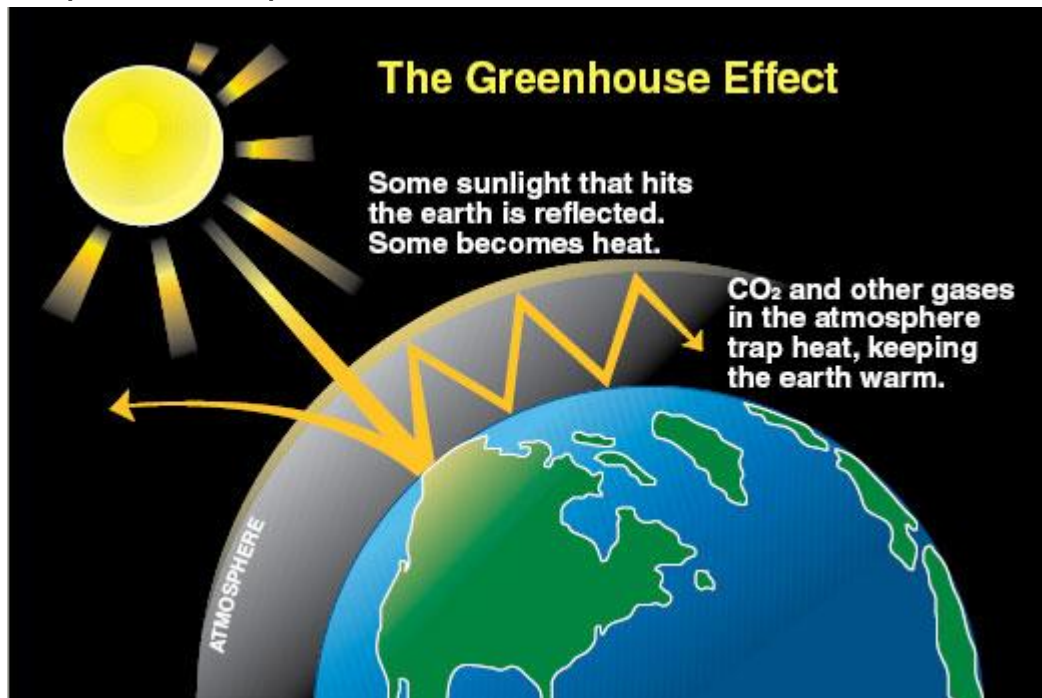
→ Without an atmosphere, we'd be boiling over in daytime and yet be very cold at night.



What are Greenhouse Gases...

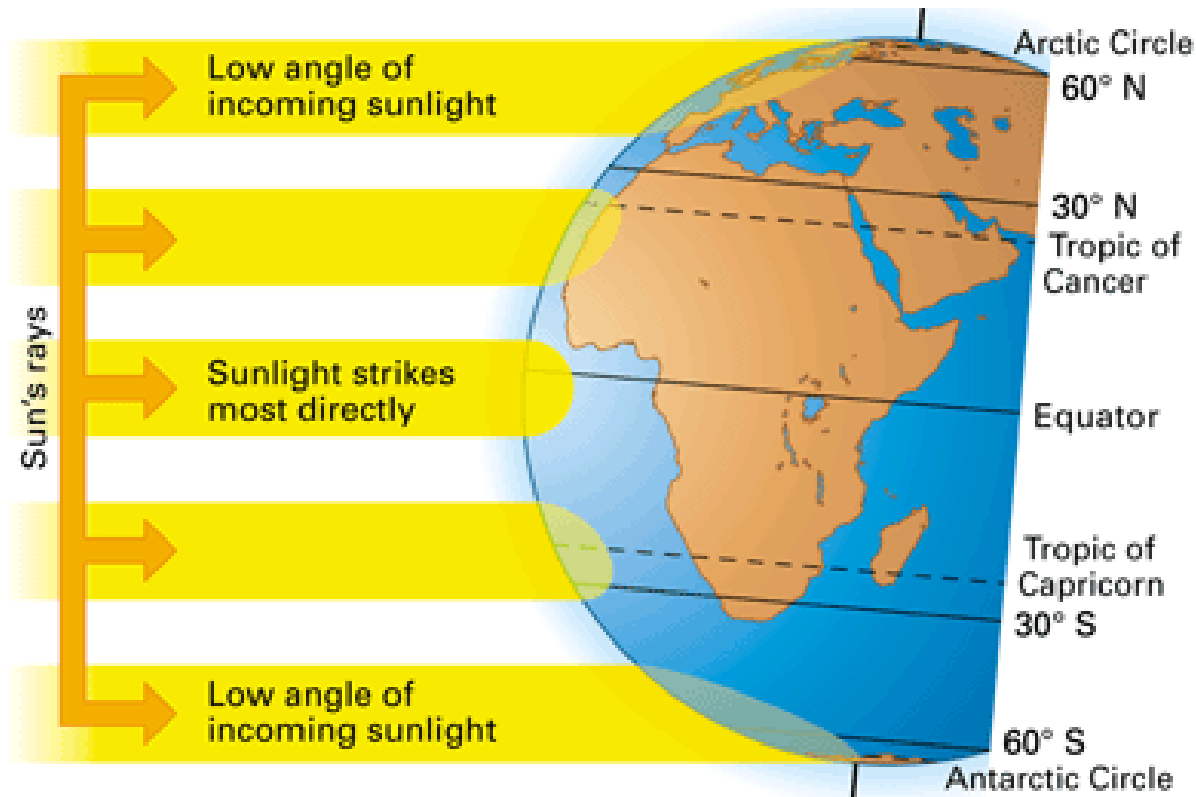
The energy that gets **RADIATED BACK** to **SPACE** from Earth's surface encounters atmospheric **GASES** and **CLOUDS** on the **WAY UP**. These, in turn, **BOUNCE BACK** some of this energy back to Earth, and the **CYCLE CONTINUES**.

- Depending on the composition of the atmosphere and the amount of clouds, this "**GREENHOUSE**" effect is increased or decreased according to how much heat the atmosphere traps.



- **CLOUDY NIGHTS** are typically **MILDER** than clear evenings for this reason, especially in colder seasons.

Latitude Affects the amount of energy from the sun...



Notice that:

- Near the **EQUATOR** the Sun's rays create a circular area of **INTENSE SUNLIGHT**.
- As you travel **AWAY** from the **EQUATOR** (increase your latitude), that same "package" of sunlight is **SPREAD OUT** over a larger area due to the decreased "**ANGLE OF INCIDENCE**", and results in **LESS ENERGY** received.

Recall latitude and longitude...

