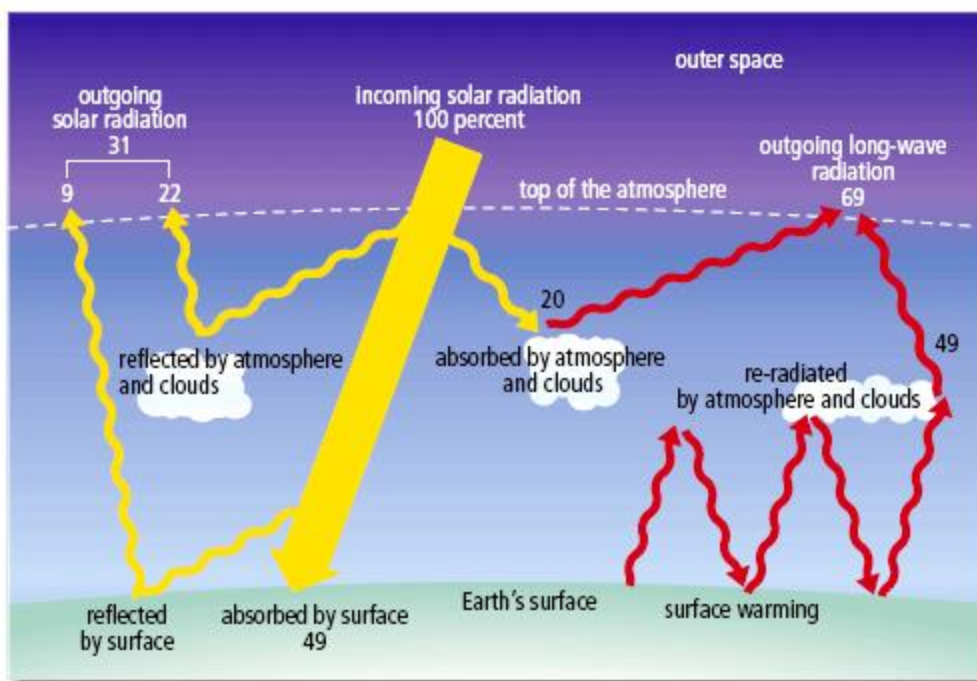


Science 20F

Solar Radiation

Lesson # 7



Date: _____

S2-4-02 Outline factors influencing the Earth's radiation budget.

Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude.

GLO: D4, D5, E2, E3

Solar Radiation

The only way that energy can travel from the Sun to the Earth is by **Radiation**, which travels in waves!!

Waves in the electromagnetic spectrum vary in size from very long radio waves the size of buildings, to very short gamma waves smaller than the size of the nucleus of an atom.

The electromagnetic spectrum (EMS) is made up of different types of radiation (energy) each with their own wavelength, and frequency. The only waves that carry radiant energy from the sun to the earth are:

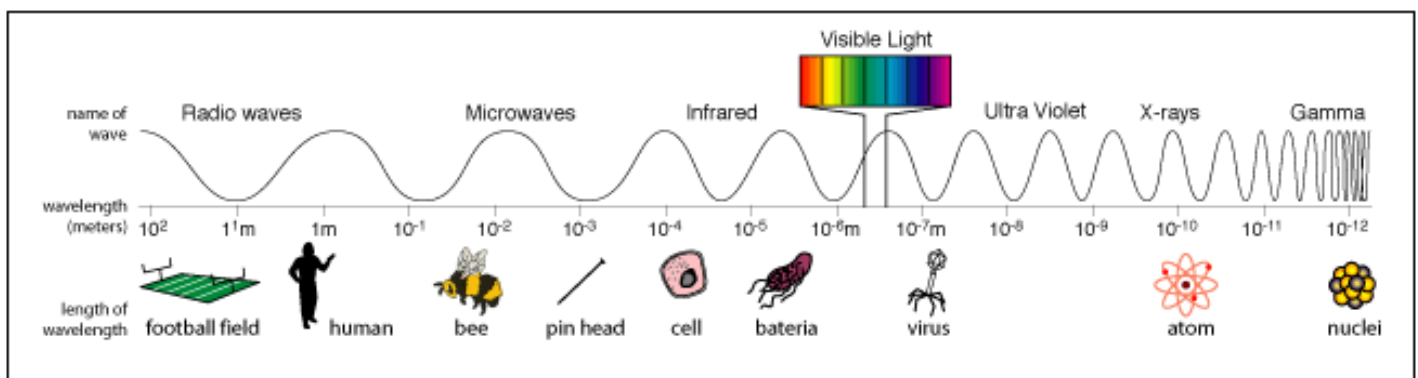
a little bit of ultraviolet,

all the visible light and

some infrared radiation.

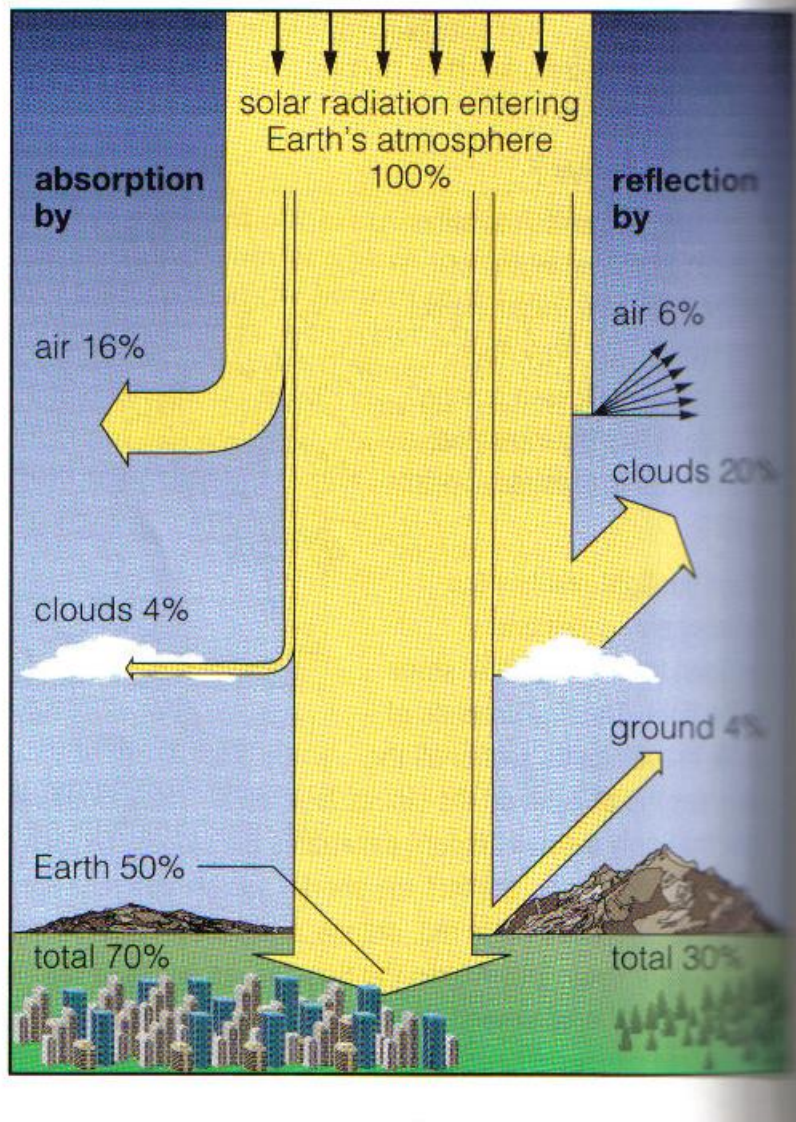
The solar energy is what drives the weather. The shorter the wavelength- the higher the energy.

Each type of radiation is traveling in waves. Each wave is traveling through empty space at the speed of light 300 000 km/s



Radiant Energy Reaching Earth

We know that solar energy is the principle source that warms the earth and our oceans. **But...** If direct solar energy which strikes the earth's surface is the only energy source warming the air, then the atmosphere would be much colder than it is today. **This diagram is on 424 in Science Power 10 Textbook**



When Solar Energy penetrates the atmosphere of the earth

70 % is absorbed 30 % is reflected

- 1) Some energy is reflected back into space - 30%
- 2) The remainder of the energy is absorbed by the Earth's atmosphere and the Earth's surface. - 70%

The effects of solar radiation on the earth

1. **Albedo** (reflexivity of a surface)
2. **The spherical form of the Earth** and latitude p.454
3. **The axis of rotation of the Earth** inclined to $23\frac{1}{2}^{\circ}$ p.455
4. **Greenhouse Gasses.**

Factors that influence absorption and reflection

1. Albedo

1. **Albedo:** [the reflection of energy from the earth's surface.](#) The more reflective the surface the higher the albedo.

- Oceans reflect [less than 10%](#) of the solar radiation that falls on them which is why they appear so dark.
- Clean, dry snow can reflect [between 75-90% of](#) solar radiation.
- What would be the albedo of a desert?
- Any idea as to why Venus has 78% albedo?

[Venus is cloud covered \(clouds consisting of sulfuric acid\) which reflect the sun's light.](#)

What would you "guess" the earth's albedo would be? [approx. 35%](#)

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

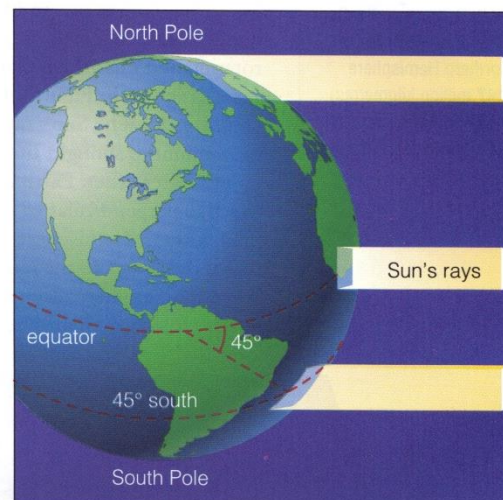
Source: C. Donald Ahrens (2000). *Meteorology Today* (6th Edition). Used under the terms of the Access Copyright Agreement (2003-2004).

Factors that influence absorption and reflection

2. The Spherical Shape of the Earth (Hot and Cold Regions)

The northern area of the earth is not as warm as the area around the equator because the sun's rays are almost perpendicular to the equator. Therefore, more solar energy reaches the earth at the equator.

The sun's rays are less effective in the north because they cover a larger area.



3. The "Tilt" of Earth's Axis

It is this "tilt" that the earth has as it's revolving around the sun that causes us to have seasons.

The earth is tilted on its axis at 23.5°

The earth revolves around the sun every 365 days.

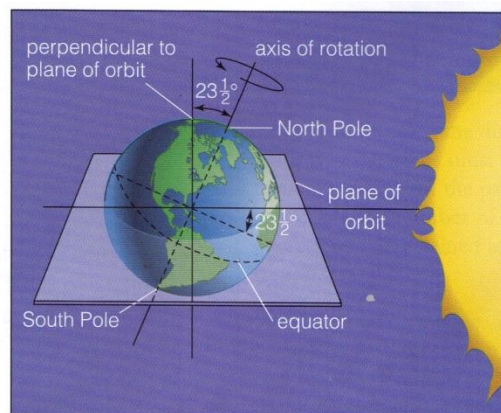


Figure 14.4 In this orientation, Earth's surface $23\frac{1}{2}^\circ$ north of the equator absorbs the maximum amount of solar energy. Therefore it has the highest average temperatures.

4. The "Greenhouse Gasses"

The greenhouse gases trap the solar radiation that is reflected from the earth's surface.

Greenhouse gases are produced by natural processes and human activities.

Name the three most prominent greenhouse gasses:

Name	Chemical Formula
• <u>Carbon Dioxide</u>	<u>CO₂</u>
• <u>Methane</u>	<u>CH₄</u>
• <u>Water Vapour</u>	<u>H₂O</u>