Planetary Energy Balance

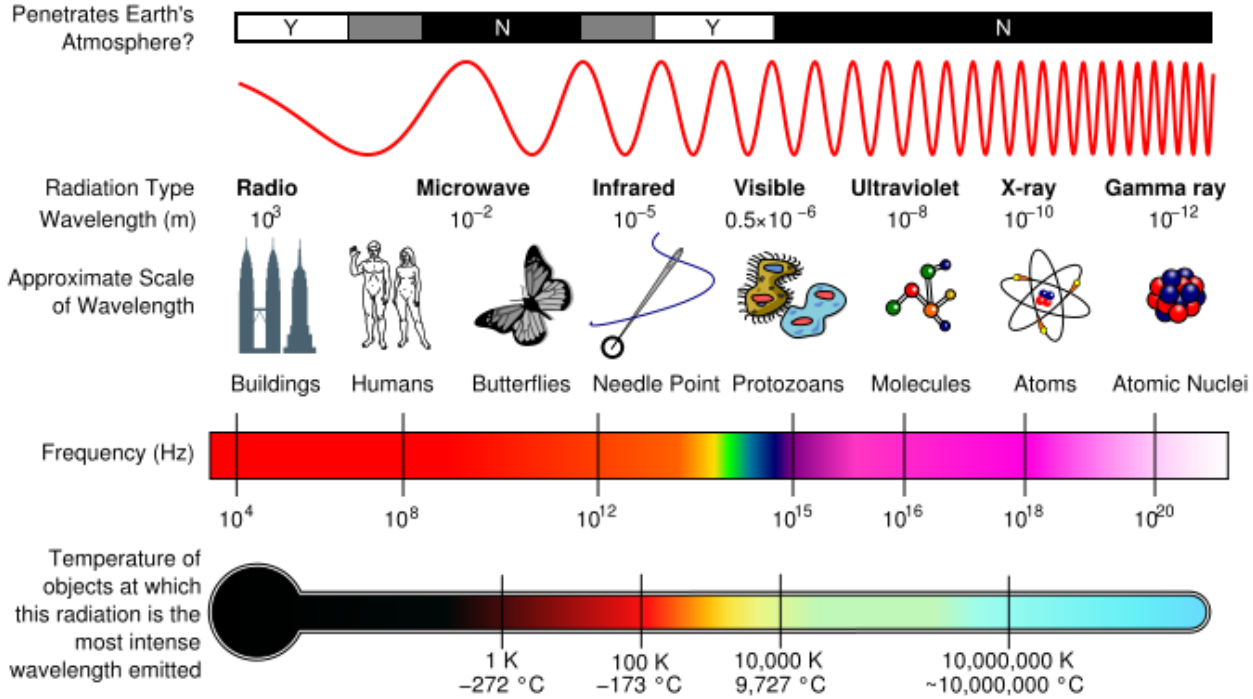
Electromagnetic Spectrum

Different types of radiation enter the Earth's atmosphere and they're all a part of the electromagnetic spectrum.

One end of the electromagnetic (EM) spectrum has radio waves. They have a long wavelength. That's where there is a lot of space between the curves of the red line.

The light we see, visible light, is a narrow band in the middle.

The other end of the spectrum has gamma rays. They have a short wavelength. Notice that there is virtually no space between the curves of the red line.



Take a look at the white, black and grey bar at the top of the diagram.
It shows which types of radiation can get through the Earth's atmosphere.
Not all types of radiation can get through to the earth's surface.

Our Atmosphere is like a Chair…?!?!

The atmosphere is not uniformly transparent to all wavelengths of electromagnetic radiation.
Certain wavelengths can penetrate the Earth's atmosphere; others cannot.

What does this chair have to do with the atmosphere?

In this picture, we can see the sun, a window, and a chair.

The sun's radiation—in the form of visible light—passes through the window.
Because the window is **transparent**.

The wooden slats on the chair block the light.
Because the wood is **opaque**. The wood will even absorb some light and reflect some too.

The resulting pattern on the floor has dark areas, where the light is blocked. It also has light areas, where the light could pass through.

Our atmosphere is sort of like the chair. It is transparent to some forms of radiation and opaque to other forms.

Darks Colors Absorb, Lighter Colors Reflect

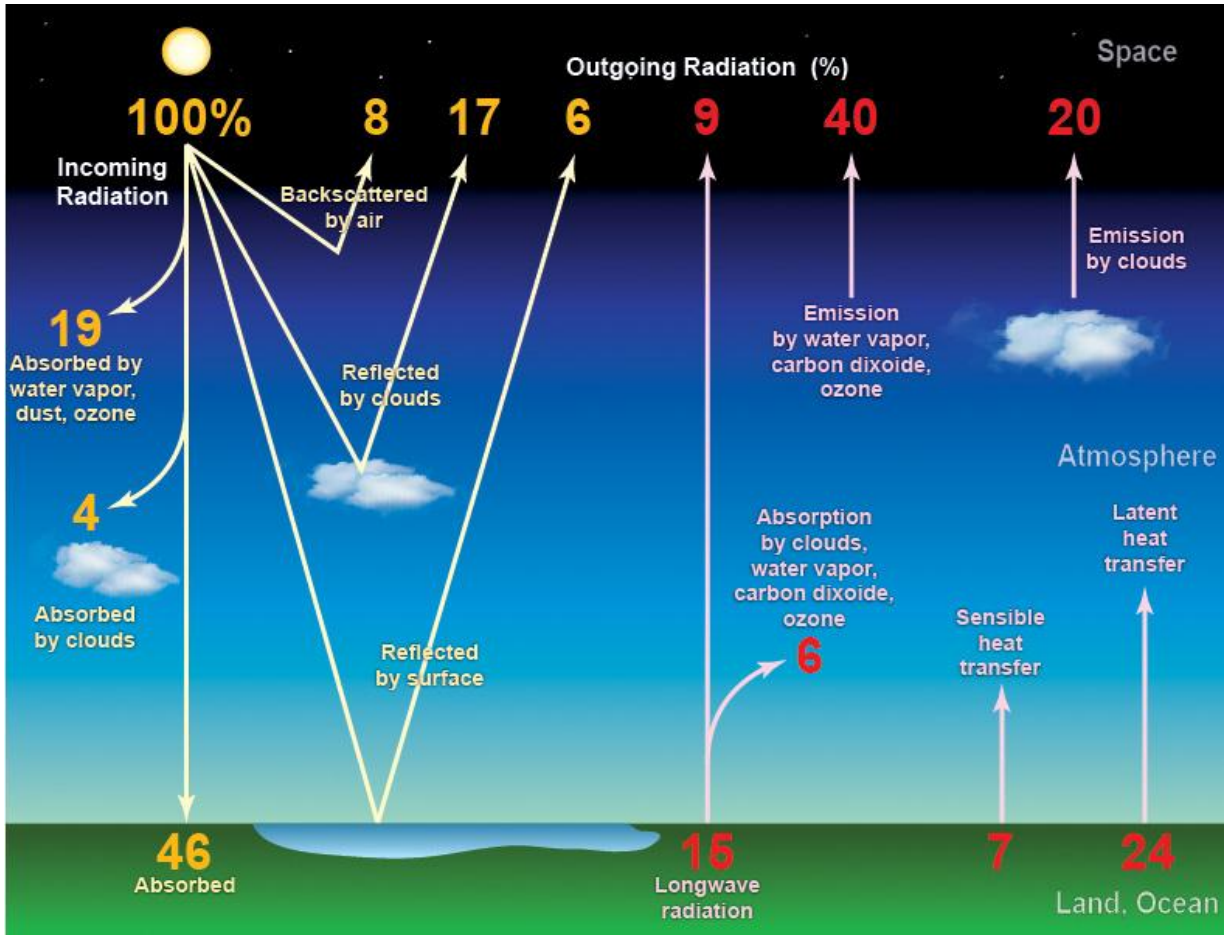
Once the electromagnetic radiation reaches the earth's surface, it is absorbed or reflected, depending on the nature of the material.	Ever walked barefoot on black pavement on a hot sunny day? The pavement gets really hot! That's because dark colors absorb radiation.	When your feet get so hot you can't stand it, you jump onto the concrete sidewalk, which feels much cooler. That's because lighter colors reflect radiation.

Dark colored surfaces absorb more of the incoming visible radiation. Earth's darkest materials include ocean water, and to a lesser extent plants and trees. These areas soak up the sun's radiation and warm the earth.

Bright surfaces such as ice and snow, and to a lesser degree desert sand, reflect most incoming radiation. Reflected radiation passes back through the atmosphere and into space without warming the earth.

It All Balances Out

The Earth and its atmosphere maintain an energy balance by either absorbing incoming radiation or reflecting it energy back into space.



Solar energy radiates towards Earth. The atmosphere and the Earth's surface absorb some of the energy and reflect some of it too. Incoming solar radiation is absorbed in the atmosphere by clouds, water vapor, dust, and ozone. The earth's surface also absorbs radiation. Clouds and surfaces on the Earth also reflect radiation. Heat that is absorbed on the Earth is reradiated into the atmosphere. Some of this reradiated heat is absorbed by clouds, water vapor, ozone, and carbon dioxide. Energy coming into the Earth's atmosphere from the sun is always in balance with the energy leaving Earth's atmosphere going back out into space. However, carbon dioxide traps infrared radiation. As humans emit more carbon dioxide into the atmosphere, this natural balance becomes altered, resulting in less heat escaping into space. As a result, our planet is becoming warmer.

The Sun Controls the Temperature

Solar energy is energy from the sun. The sun's energy reaches Earth in the form of sunlight. The temperatures we experience on Earth are directly related to how much sunlight is received.

Some areas on Earth receive more solar energy which results in higher temperatures. Areas near the equator, sometimes known as the Tropics, are examples of places where the temperatures are warmer.

Other areas on Earth receive less solar energy which results in lower temperatures. The North Pole and South Pole are good examples of places where the temperatures are colder.

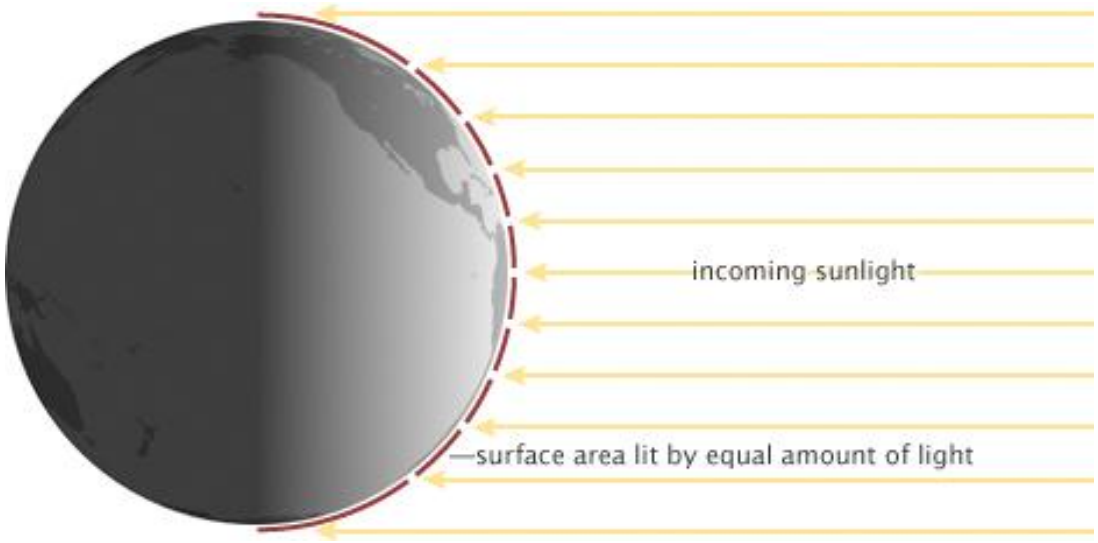
Soaking Up the Sun

The Poles are cold and the Tropics are warm because of the curvature of the Earth.

Scenario A

The sunlight at the Poles is less intense for several reasons:

- The sun's rays strike the Earth at a slanted angle and spread out over of a large area.
- The arriving radiation from the sun are less intense at the Poles due to a smaller arriving angle of the sun's rays.



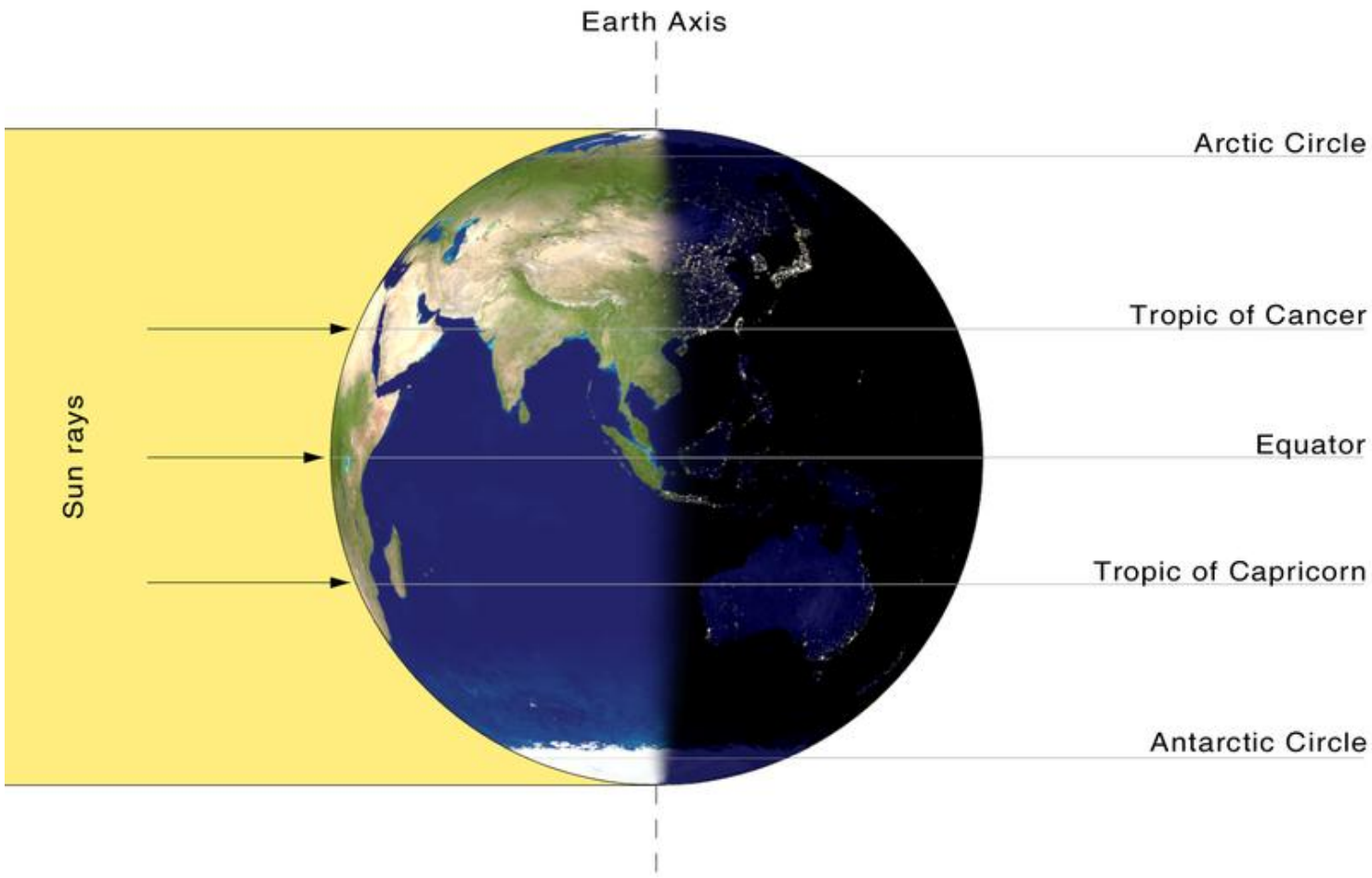
Scenario B

The sunlight at the Equator is more intense for several reasons:

- The sun's rays strike the Earth at a 90 degree angle and in a straight line.
- The intensity of the sun's rays is focused on a smaller area.

Equality at the Equinox

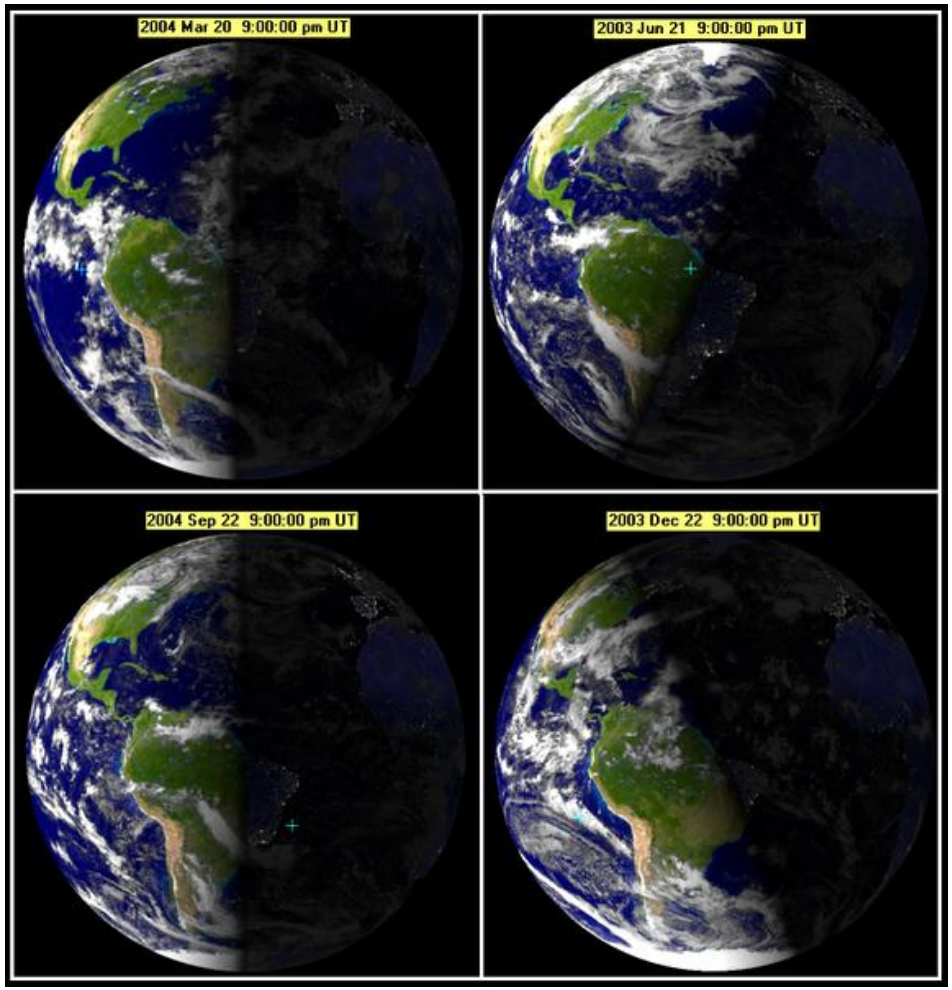
Every year, the Earth's axis completes a cycle of tilting towards the Sun, tilting away from the Sun, and finally back towards the Sun again.



Every 6 months an equinox occurs which means that the Earth is neither tilting toward the Sun nor tilting away from the Sun. The daytime is exactly the same length as the nighttime and the temperatures in the Northern Hemisphere are similar to the temperatures in the Southern Hemisphere.

Tilting Changes the Seasons

As the Earth's axis tilts, the angle of the sunlight striking Earth changes. This causes seasonal changes in temperatures around the globe.



As the Earth tilts away from the Sun, the Northern Hemisphere receives more sunlight and higher temperatures. This is the summer season in the Northern Hemisphere and the winter season in the Southern Hemisphere.

As the Earth tilts towards the Sun, the Northern Hemisphere receives less sunlight and lower temperatures. This is the winter season in the Northern Hemisphere and the summer season in the Southern Hemisphere.