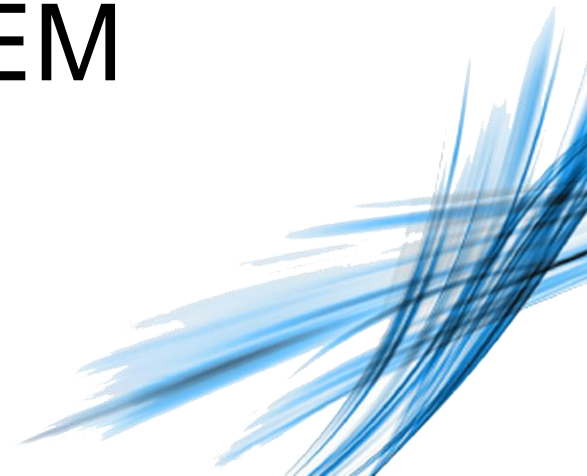


BIO 2129: ECOLOGY

LECTURE 1

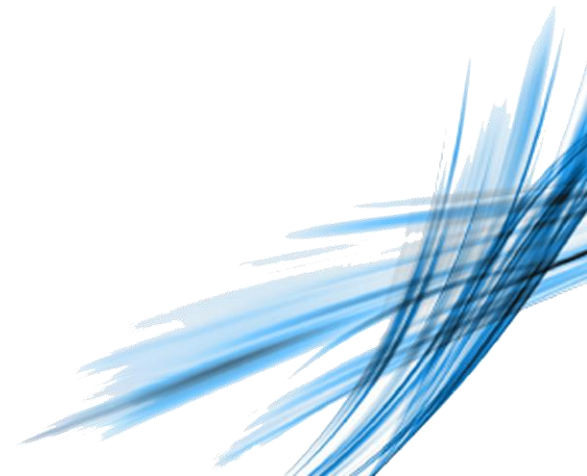
THE ECOSYSTEM



Definition of terms

The word *Ecology* originated from the Greek word *oikos*, which means *house, place to live* or *Environment*

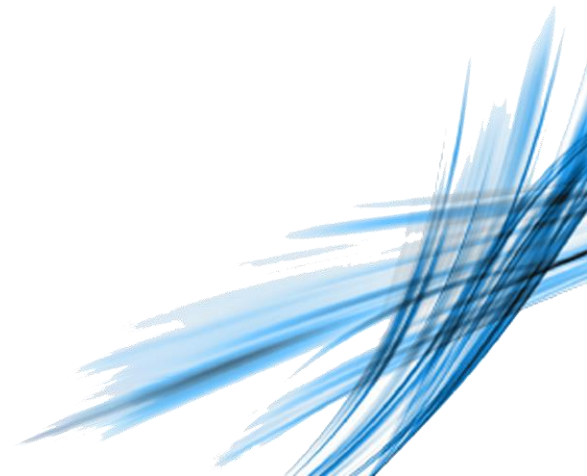
Ecology is literally the study of organisms in their habitat



Definition of terms

Ecology is the study of Ecosystems

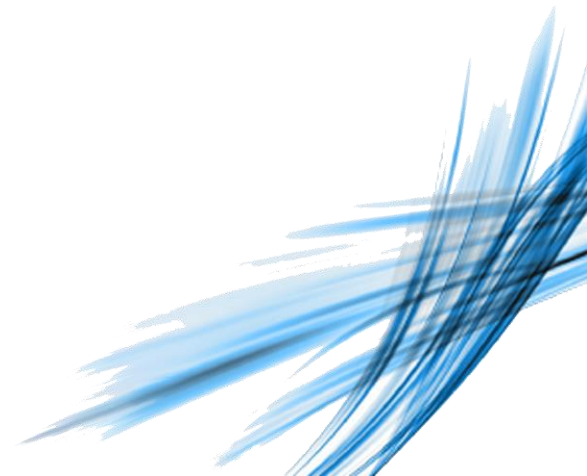
An Ecosystem involves the complex inter-relationships between biotic and abiotic components of a given area, varying in scale from small sites, local, regional to the global scale



Definition of terms

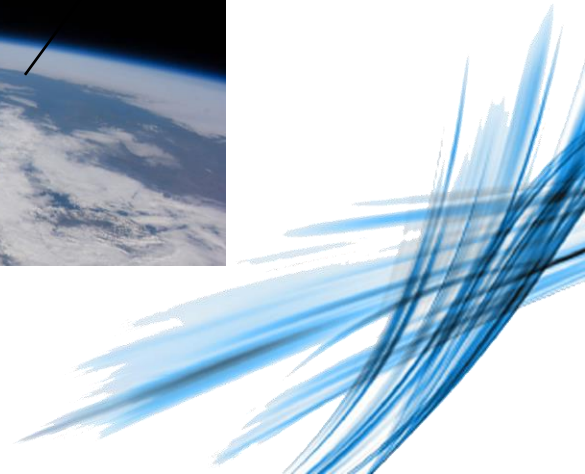
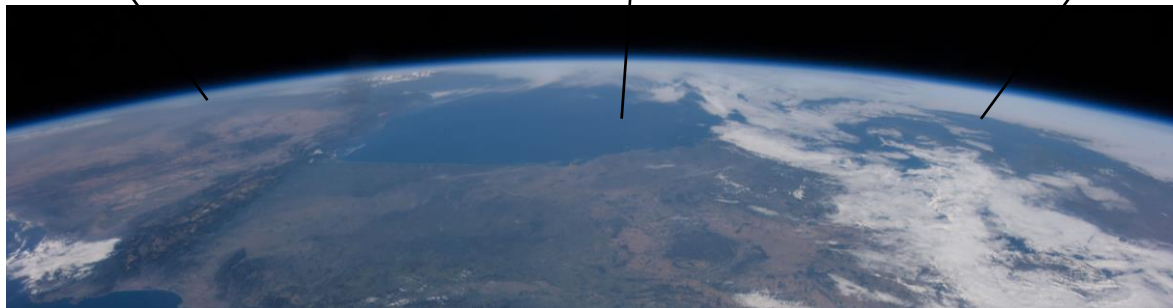
Combining the two definitions above gives an expanded definition of Ecology thus:

Ecology is the study of the complex inter-relationships between biotic and abiotic components of a given area, varying in scale from local to regional



Definition of terms

The interaction of all of the earth's living organisms with the physical environment, when aggregated globally occurs in what is described as the biosphere (Greek: bios – life) or ecosphere



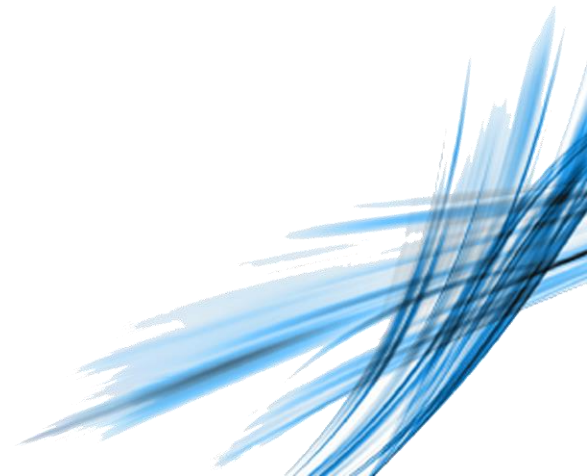
Major of Ecosystems

There are two major Ecosystems in the Biosphere:

- Terrestrial Ecosystem

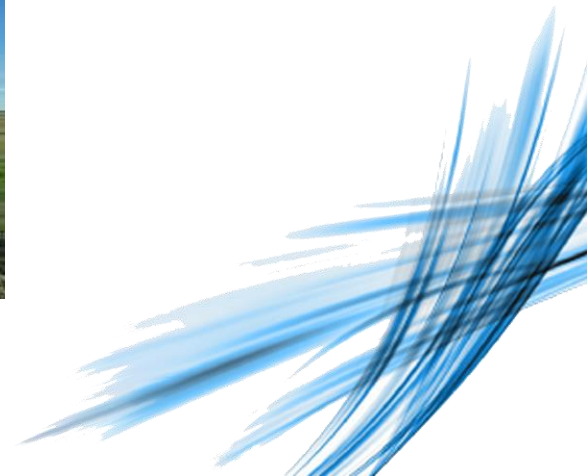
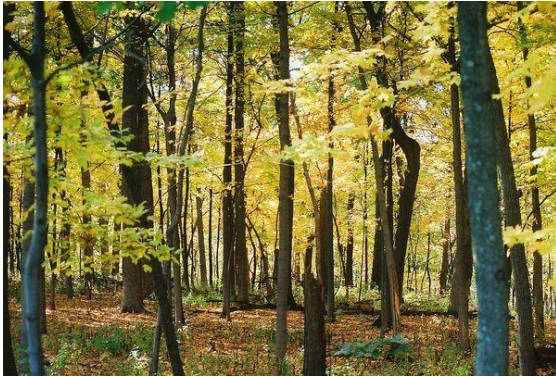
- Aquatic Ecosystem

(comprising Freshwater, Marine and Estuarine)



Biotic components of an ecosystem

➤ Plants



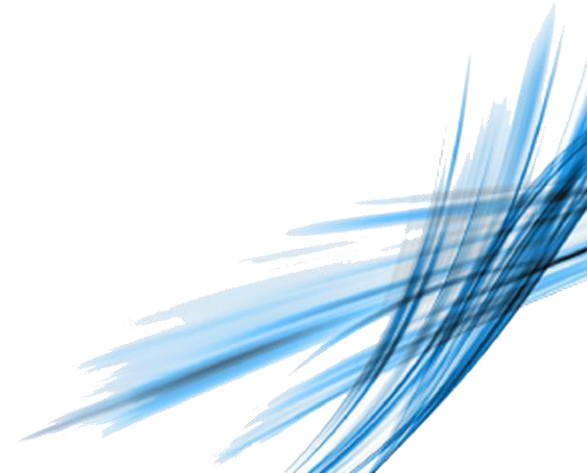
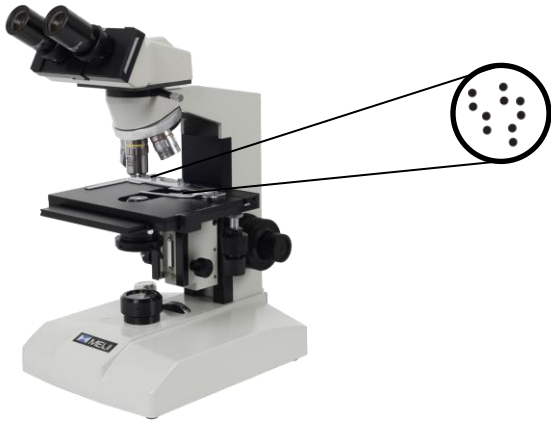
Biotic components of an ecosystem

➤ Animals



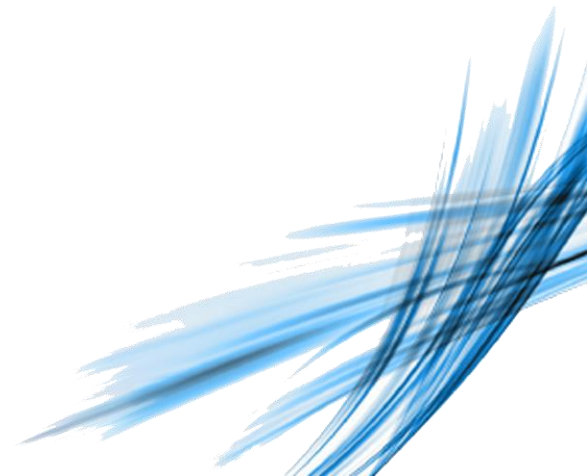
Biotic components of an ecosystem

➤ Bacteria and Fungi



Abiotic components of an ecosystem

- Solar radiation
- The Atmosphere
- Climate
- Water
- Soil



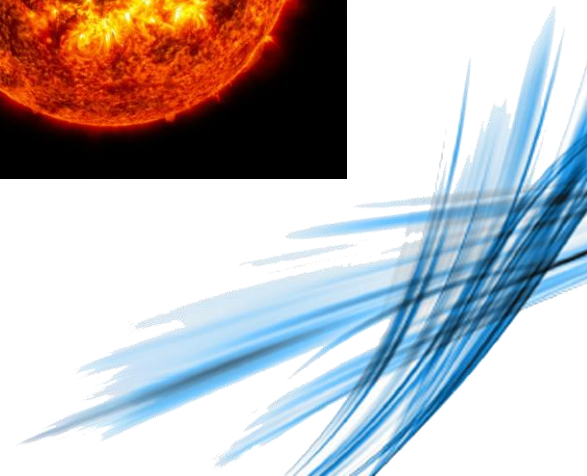
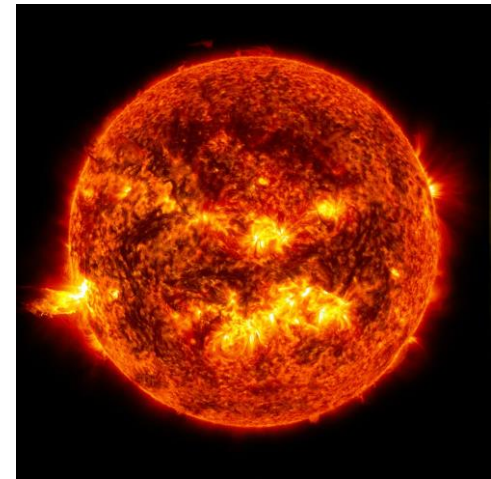
Solar radiation

The sun with a temperature of 6.000°C is the source of energy available to the Earth

The solar radiation spectrum is divided into three regions:

- Ultraviolet
- Visible,
- Infrared

Wavelengths on the spectrum are measured in micrometers (μm ; 10^{-6} m, one ten-thousandth of a centimeter).

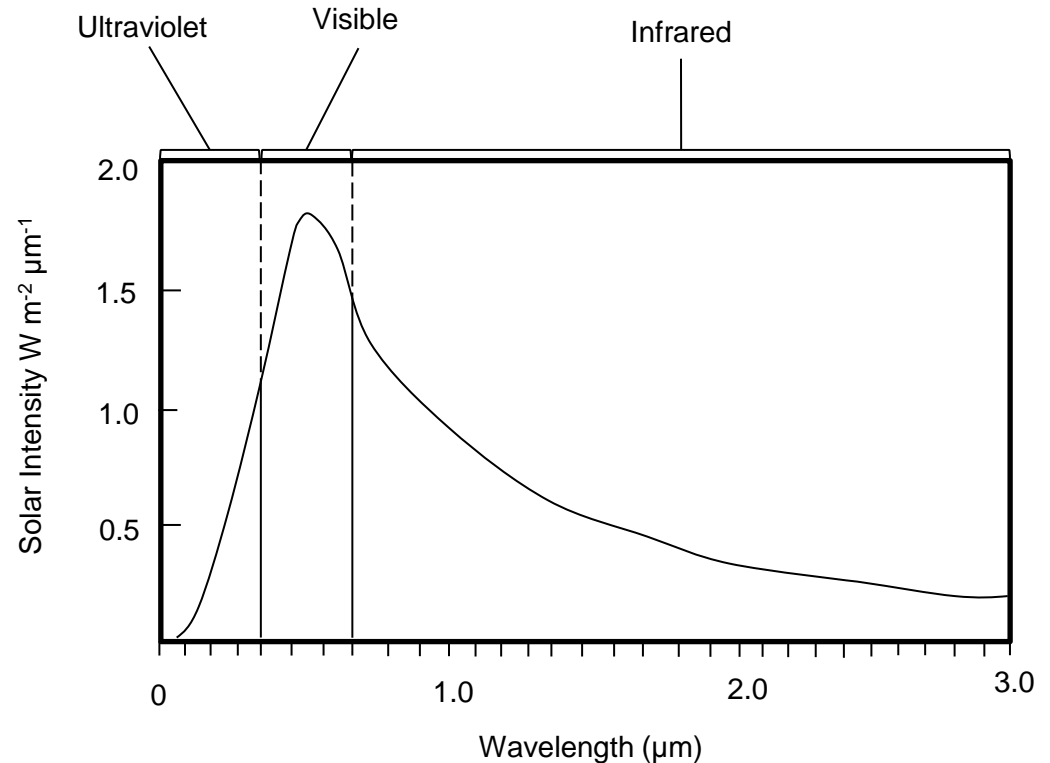


Solar radiation

Shortwave ultraviolet rays - wavelengths from approximately $0.4 \mu\text{m}$ downward

Visible light - radiation with wavelengths from approximately 0.4 to $0.7 \mu\text{m}$

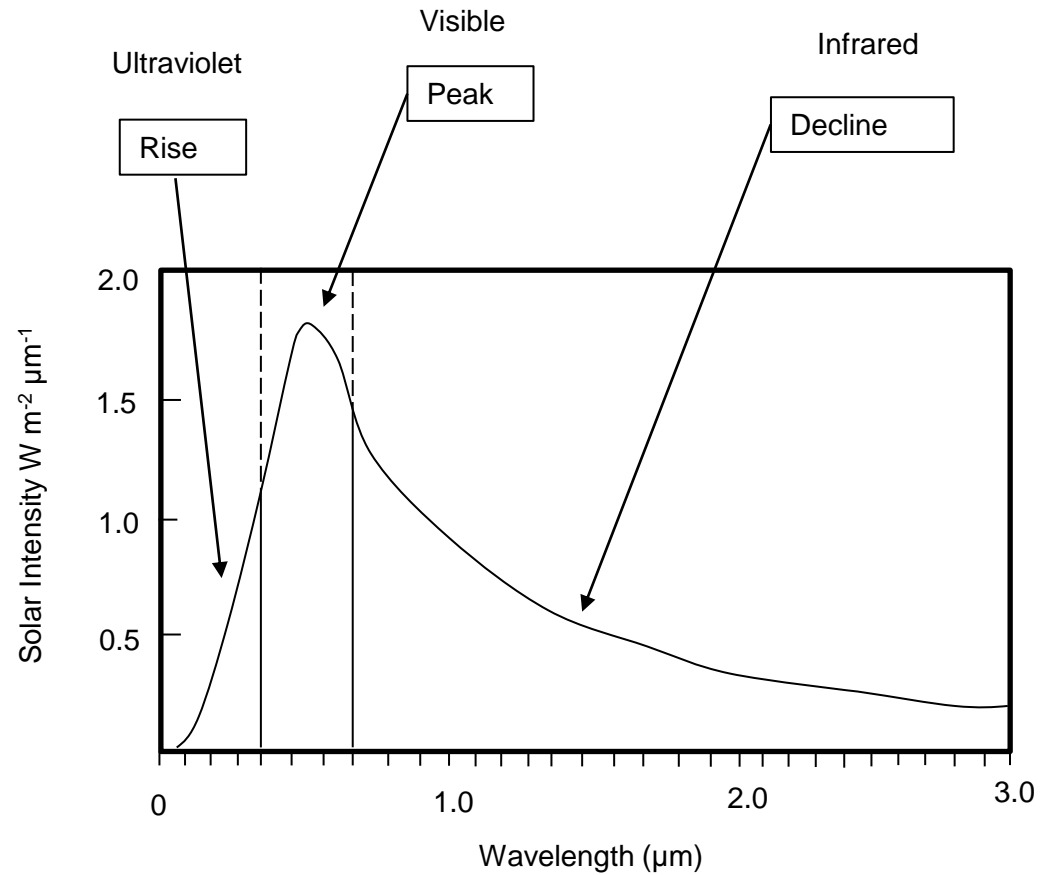
Longwave infrared region - wavelengths ranging approximately from $0.7 \mu\text{m}$ upward



Solar radiation

Energy intensity on the radiation spectrum:

- Rapid rise through the ultraviolet range
- Peak in the visible portion
- Decline in the infrared portion

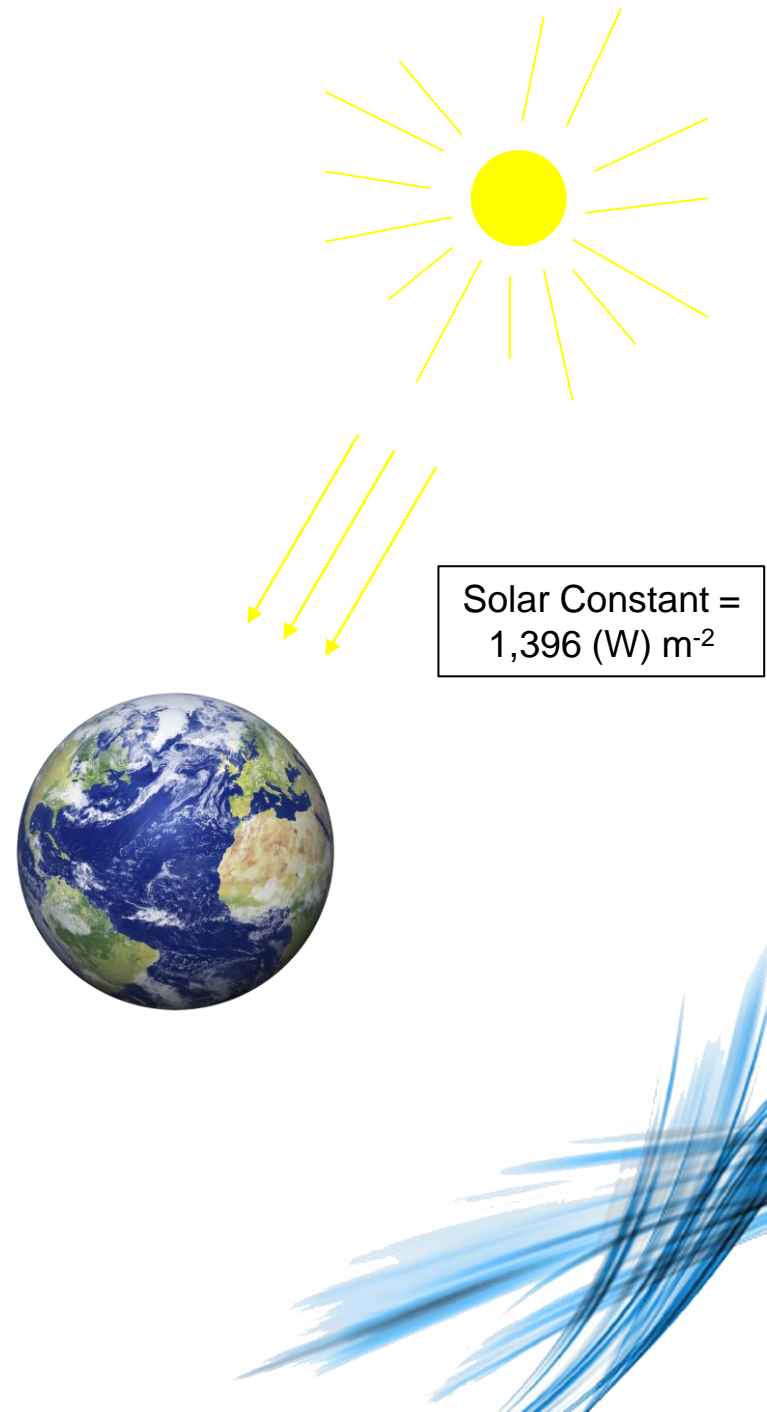


Solar radiation

Shortwave radiation makes up most of the incoming radiation

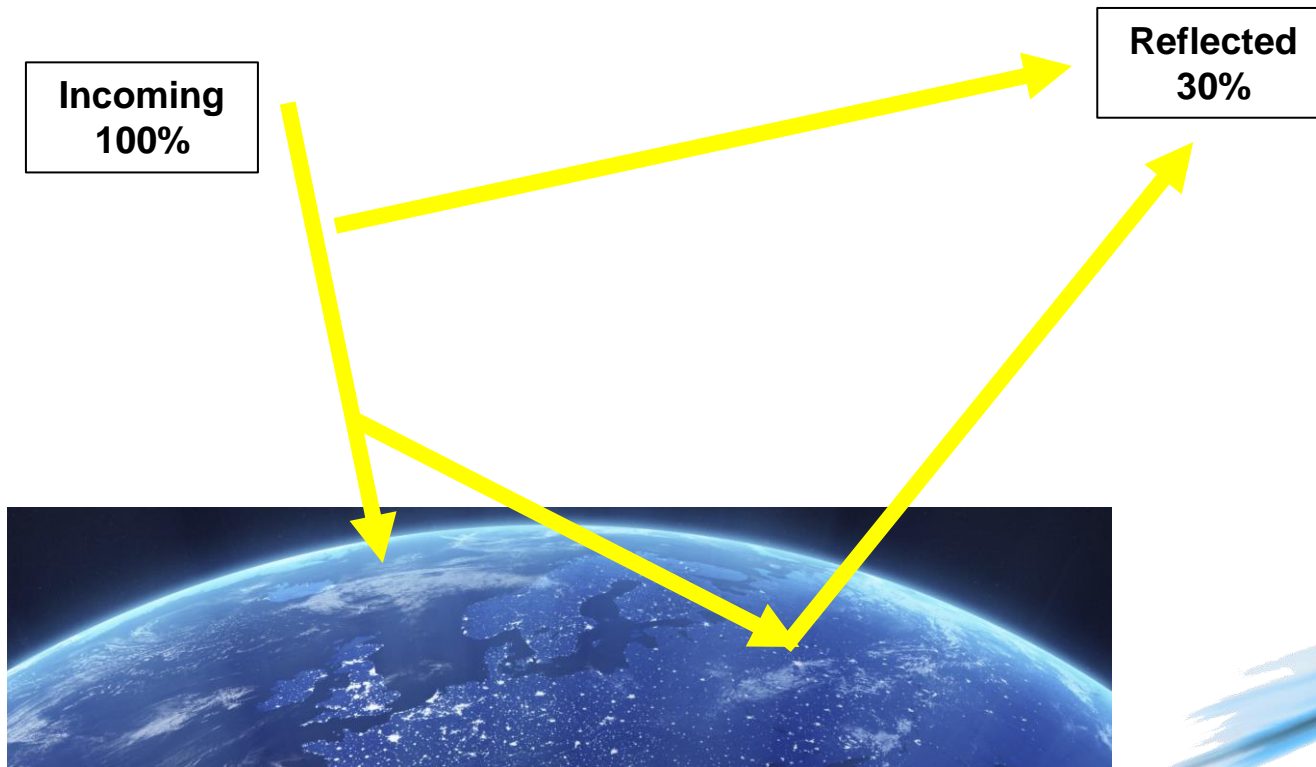
Solar radiation arriving outside the Earth's atmosphere:

- Known as the solar constant
- Approximately 1,396 Watts (W) m⁻²
- Varies slightly with the level of the sun's activity and the distance between the sun and the Earth



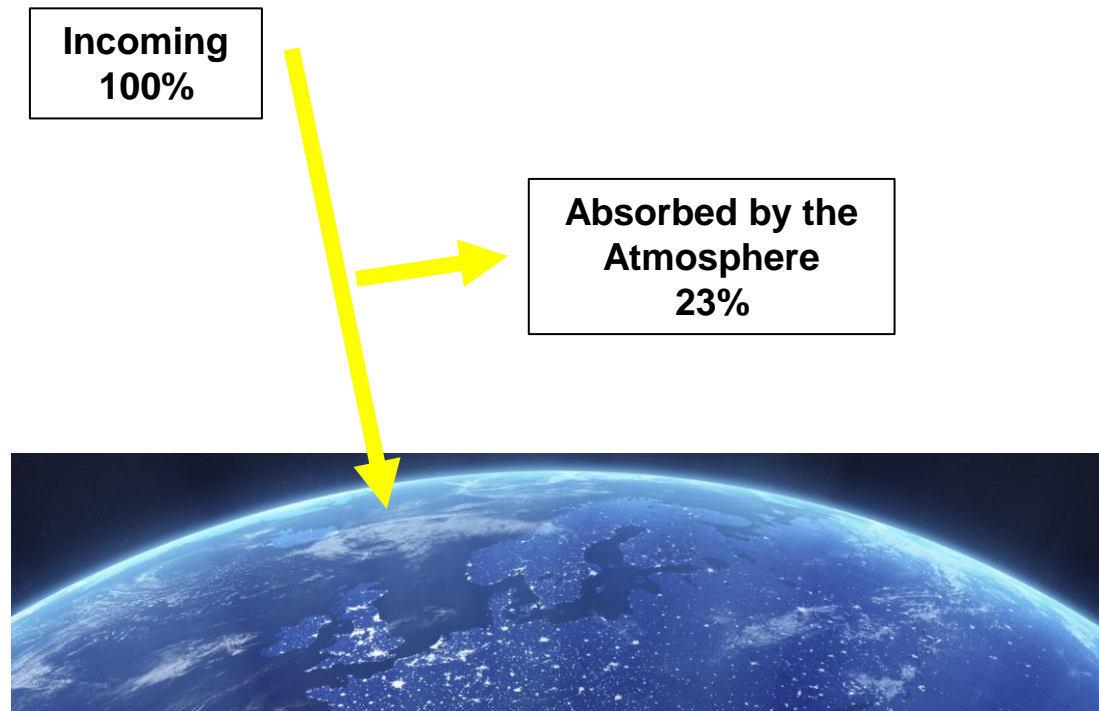
Solar radiation

30% of solar radiation of is reflected back to space by clouds, air molecules, dust, haze, and the Earth's surface



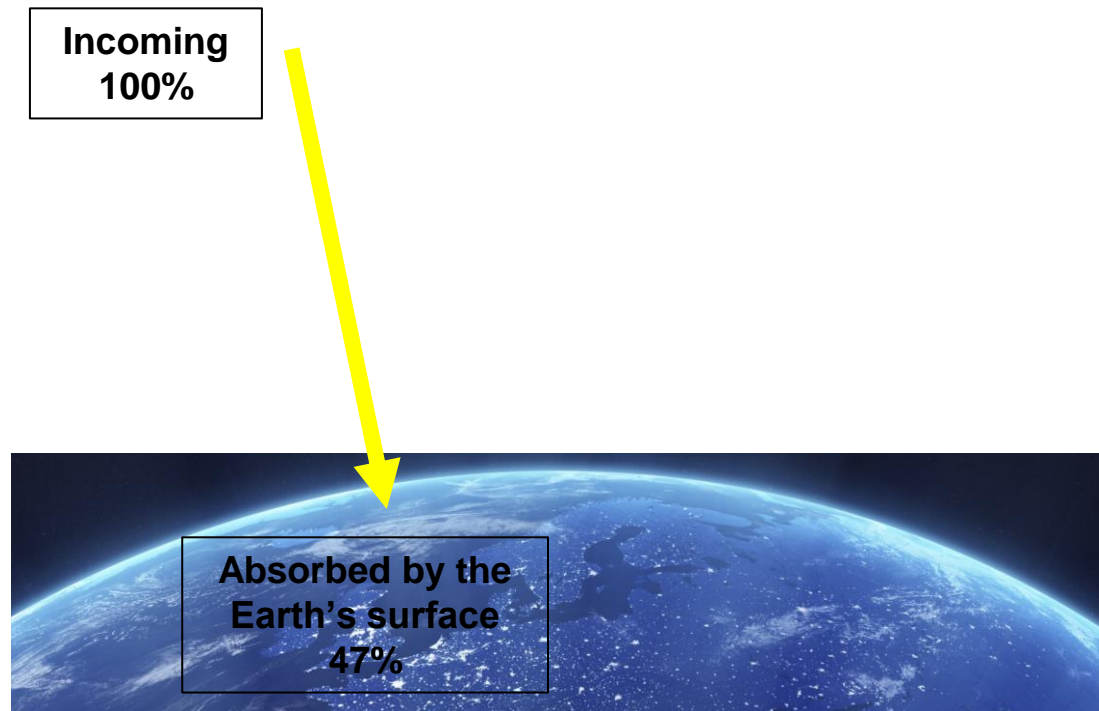
Solar radiation

23% is absorbed by the atmosphere (particularly by ozone there), clouds and water vapor

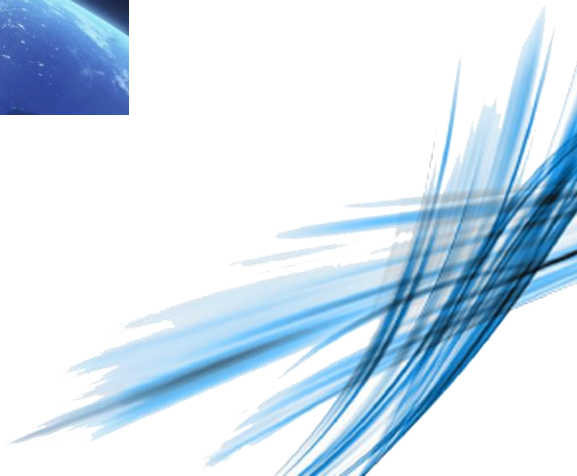
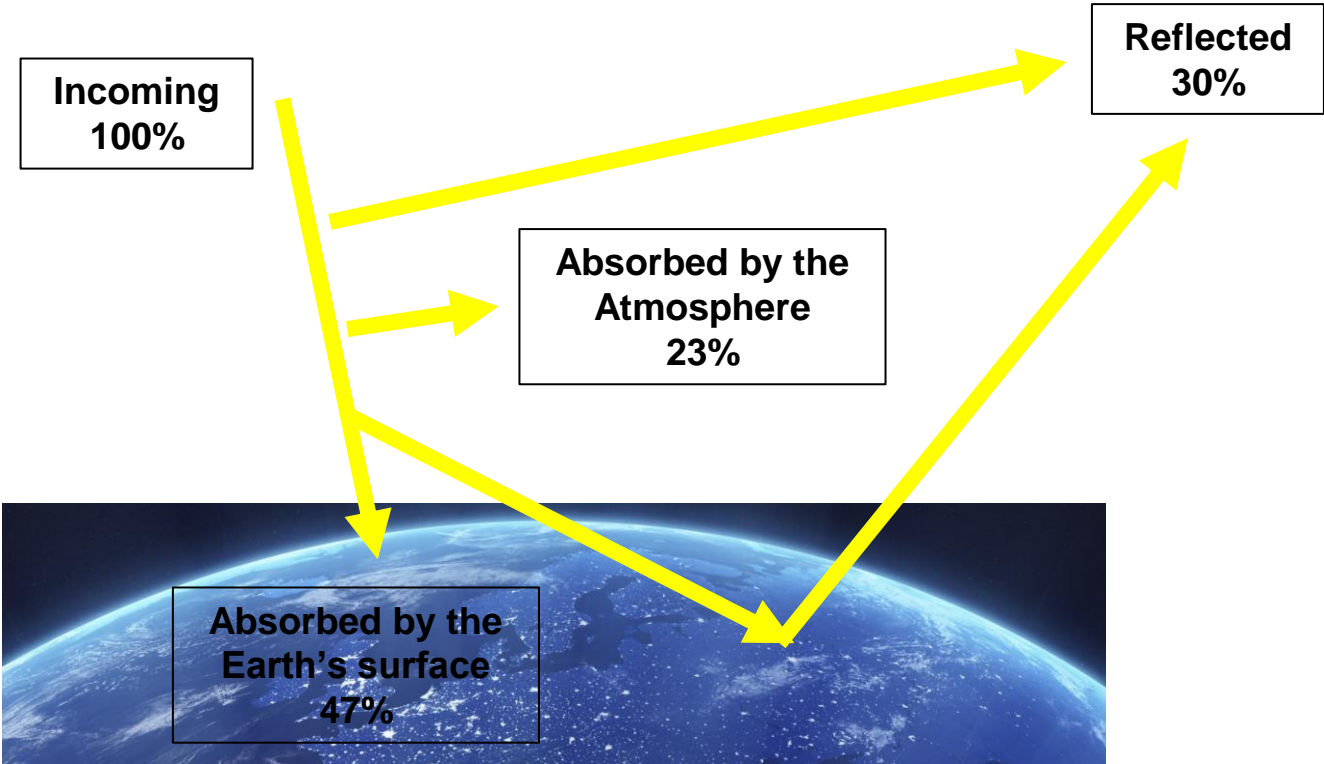


Solar radiation

47% reaches and is absorbed by the Earth's surface



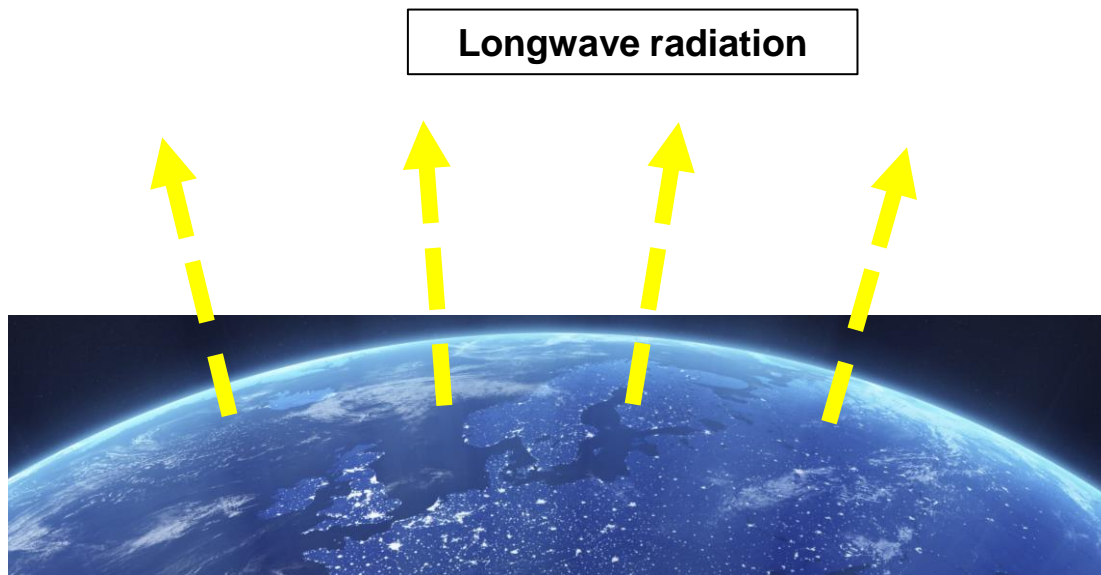
Solar radiation



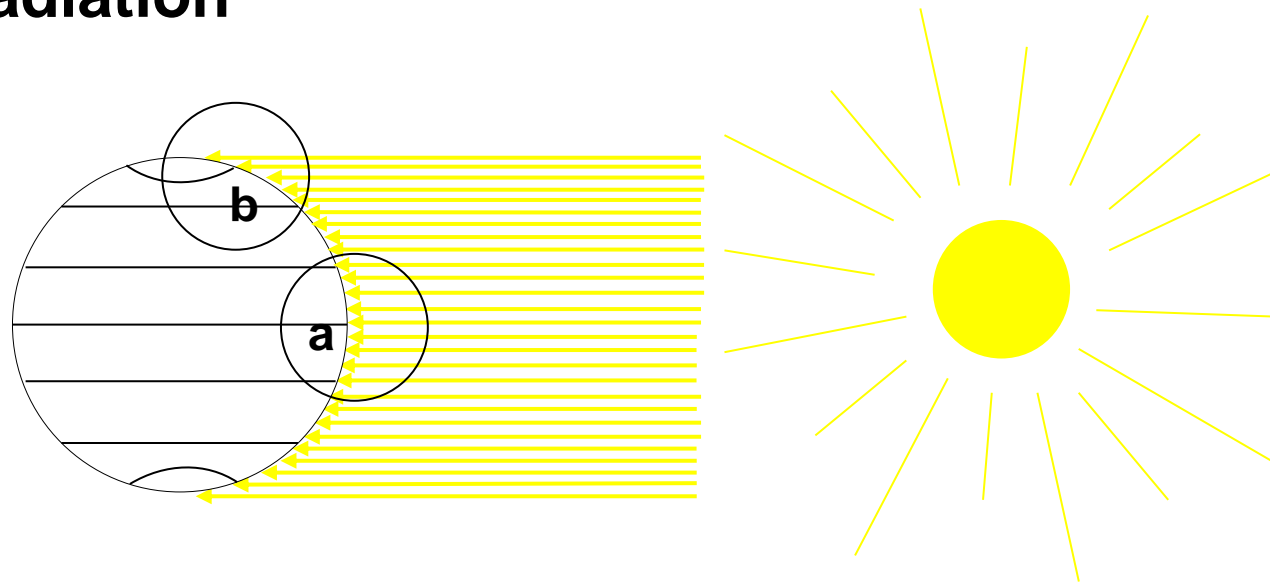
Solar radiation

Most of the energy emitted by the Earth is in the longwave radiation

Over the course of a year, areas at high latitudes receive, less radiation than areas at the equator



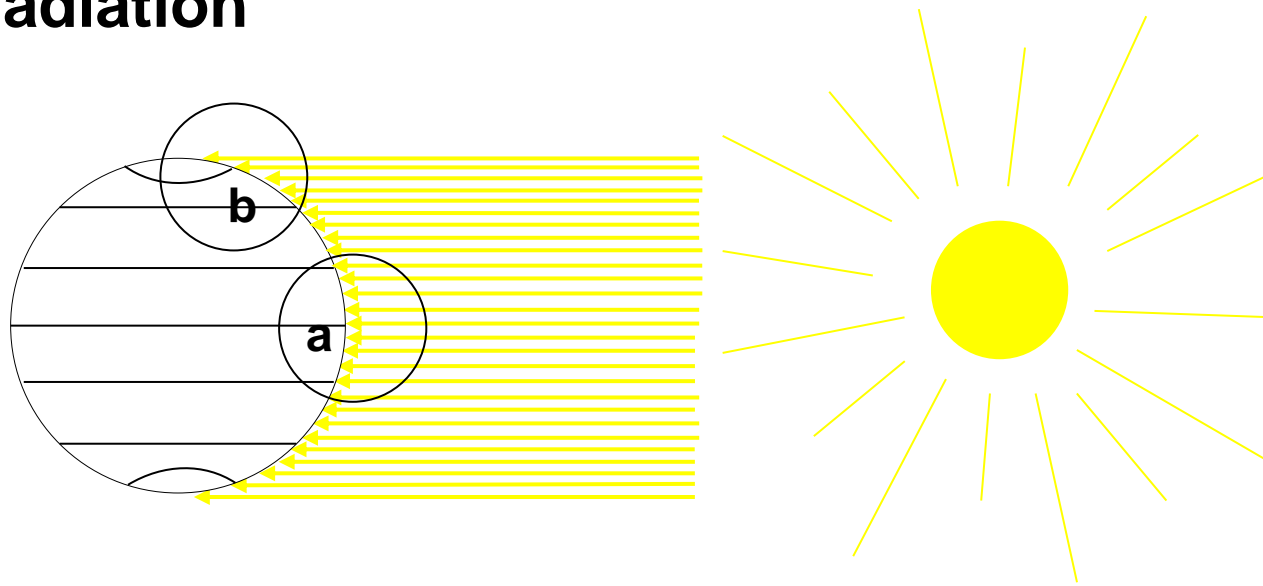
Solar radiation



There is stronger heating of the Earth at the equator than at higher latitudes because:

- At the Equator more incoming radiation is received per unit ground area from the sun's rays striking the earth's surface at an almost perpendicular angle

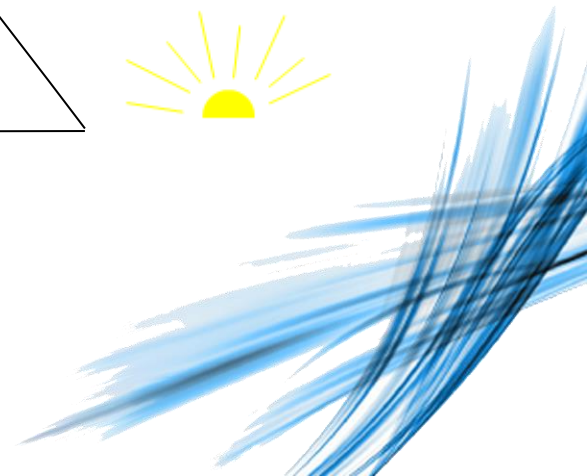
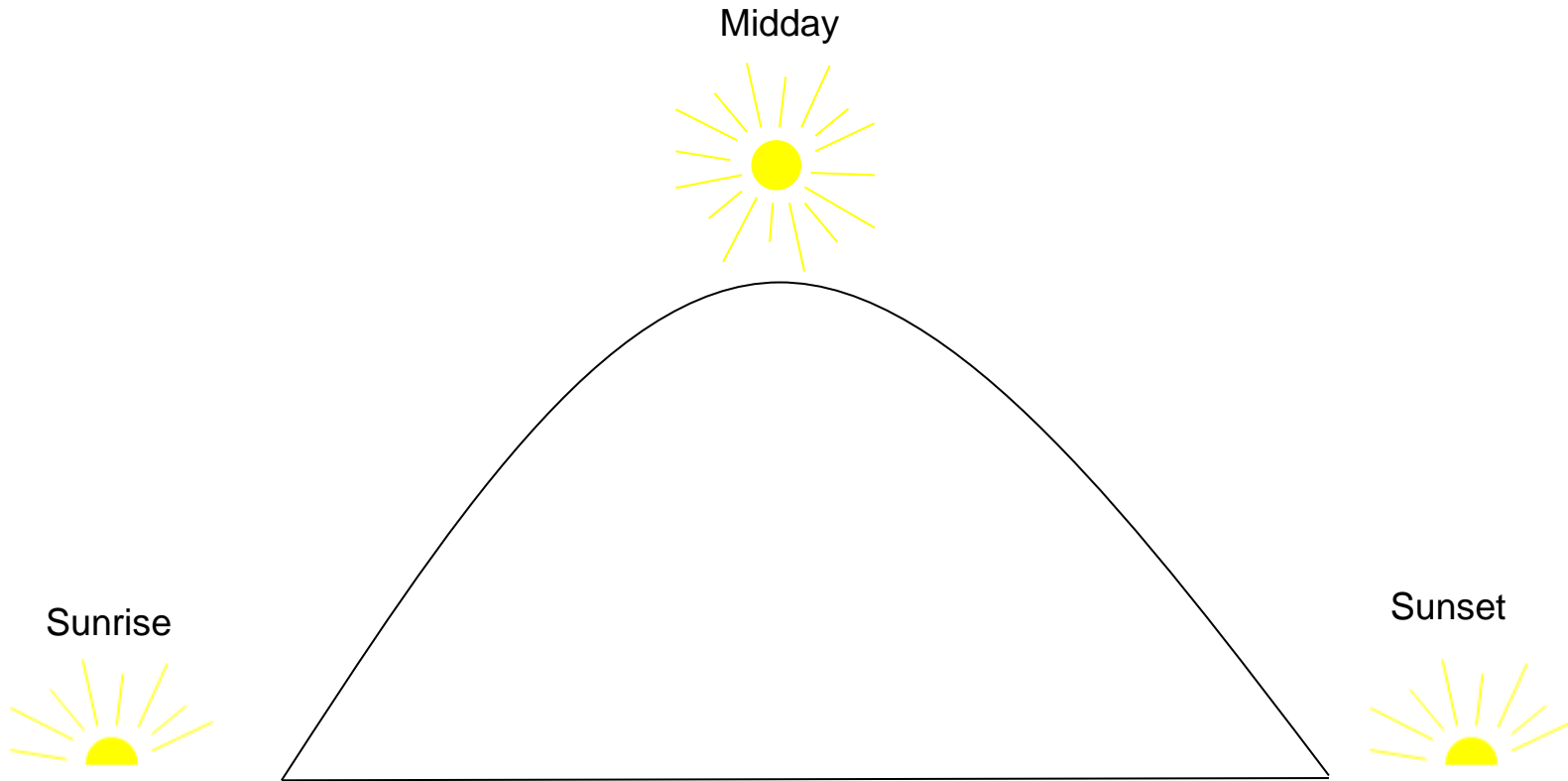
Solar radiation



- At high latitudes (b), less radiation is received per unit ground area from the sun's lower angles, the its rays spread over a larger surface area, going through a greater amount of, and longer path through the atmosphere, more incoming solar radiation absorbed, reflected, or scattered before it reaches the surface

Solar radiation

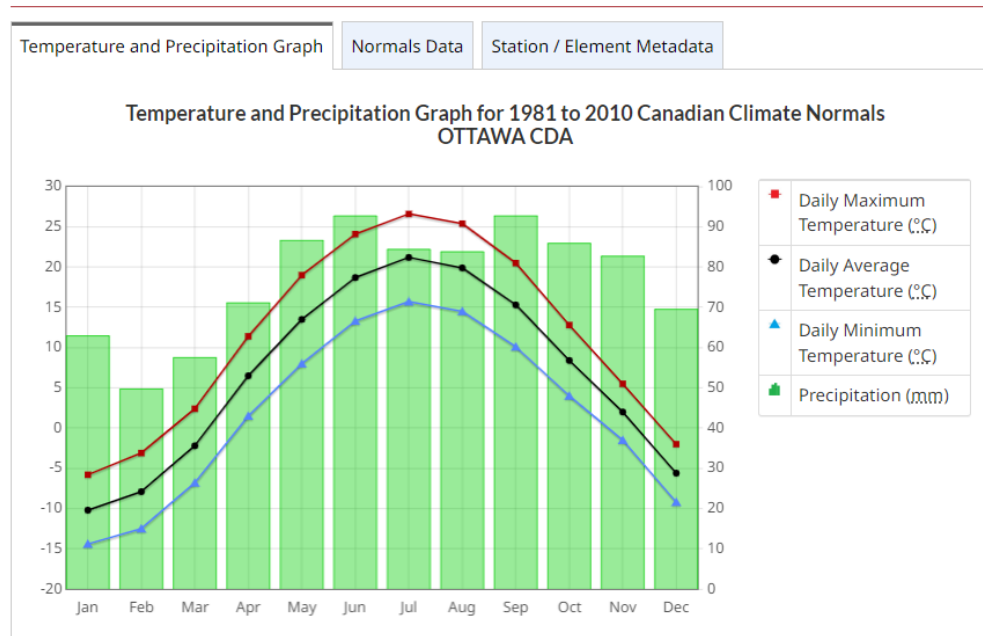
Greater radiation is received at noon than early or late in the day



Solar radiation

Greater radiation is received in the summer than during the winter

Canadian Climate Normals 1981-2010 Station Data

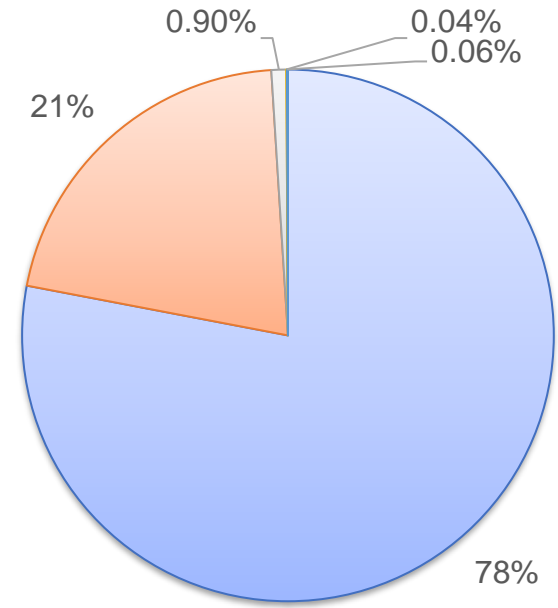


The Atmosphere

Atmospheric Composition

Composition of the Earth's dry atmosphere by volume:

- Nitrogen (N_2) - 78%
- Oxygen (O_2) - 21%
- Argon (Ar) – 0.09%
- Carbon dioxide (CO_2) – 0.04%
- Others – 0.06%



■ Nitrogen ■ Oxygen ■ Argon ■ Carbon dioxide ■ Others



The Atmosphere

Atmospheric Composition

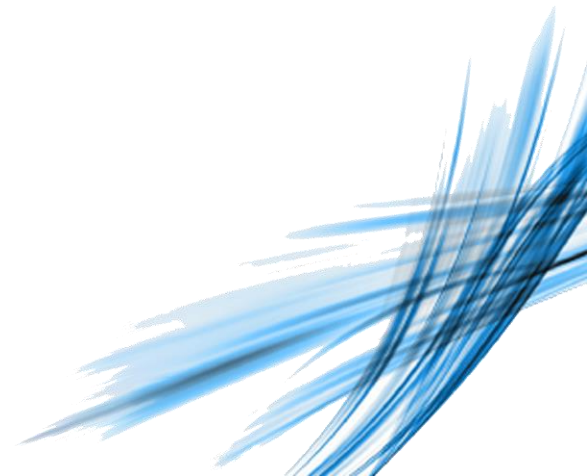
Carbon dioxide is of importance to plants, as it is used in the presence of light during photosynthesis to produce organic matter that eventually becomes the source of food for several animals, bacteria and fungi



The Atmosphere

Atmospheric Composition

Oxygen sustains life in the biosphere and is a substrate for metabolic respiration.



The Atmosphere

Atmospheric Composition

Nitrogen, the most abundant of the gases in the atmosphere, is unavailable to most organisms, until nitrogen-fixing bacteria convert it to biologically available nitrogen that is used by all organisms to build proteins



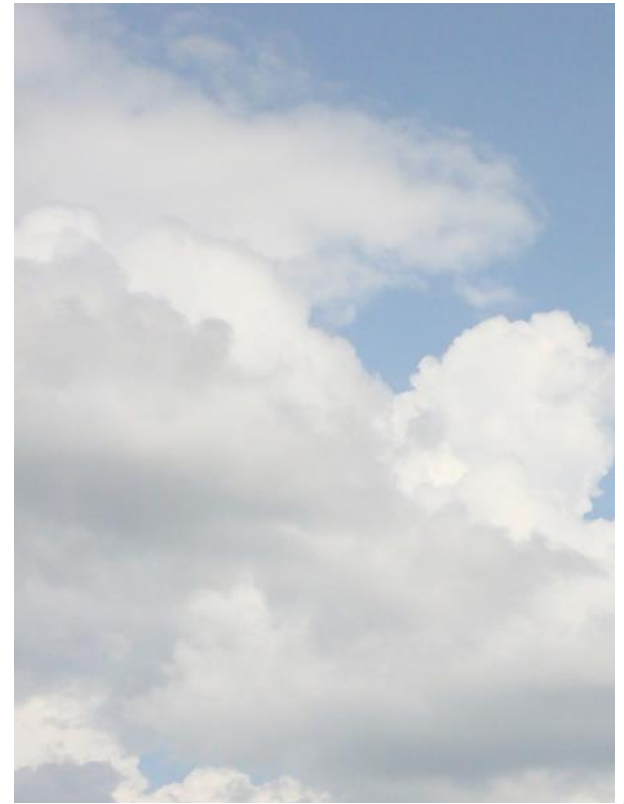
The Atmosphere

Atmospheric Composition

Clouds have complex effects on the movement of solar radiation to and away from Earth

All clouds have high albedo (reflectivity), and hence reflect much more incoming shortwave radiation than does the darker Earth surface.

However, clouds, are made up of water droplets and ice crystals, efficient absorbers of longwave radiation coming from the Earth's surface.



The Atmosphere

Atmospheric Composition

The reflection of shortwave solar radiation by clouds back to space has a cooling effect

The absorption of longwave radiation from the Earth's surface, preventing energy from escaping to space has a warming effect



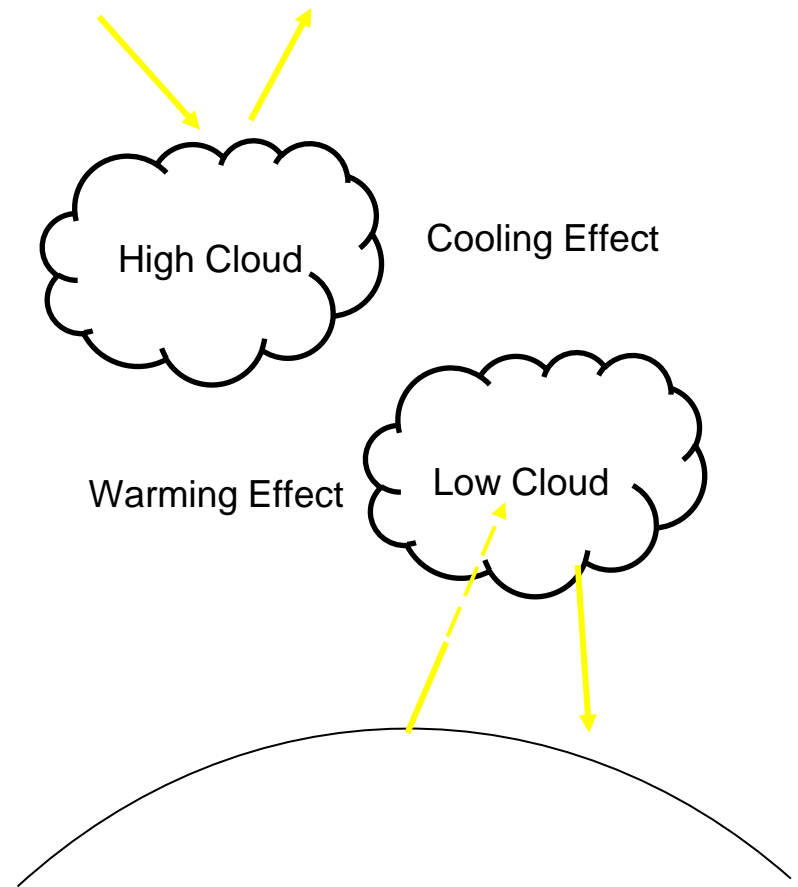
The Atmosphere

Atmospheric Composition

The balance of these two effects depends on factors such as cloud type, temperature, thickness, and height

The reflection of shortwave radiation is usually dominant in high clouds, causing cooling

The absorption and re-emission of long wave radiation is generally dominant in low clouds, resulting in a warming effect

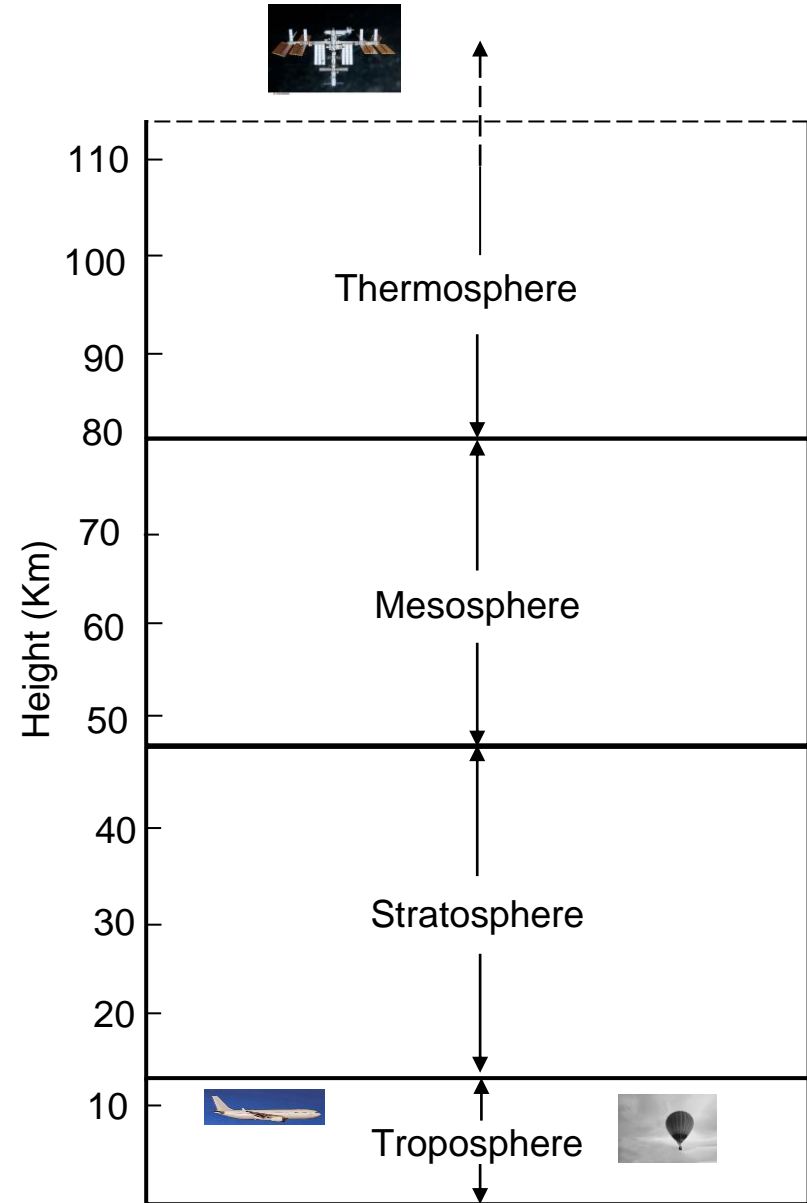


The Atmosphere

Atmospheric Structure

The Earth's atmosphere is structured as follows:

- Troposphere
- Stratosphere
- Mesosphere
- Thermosphere

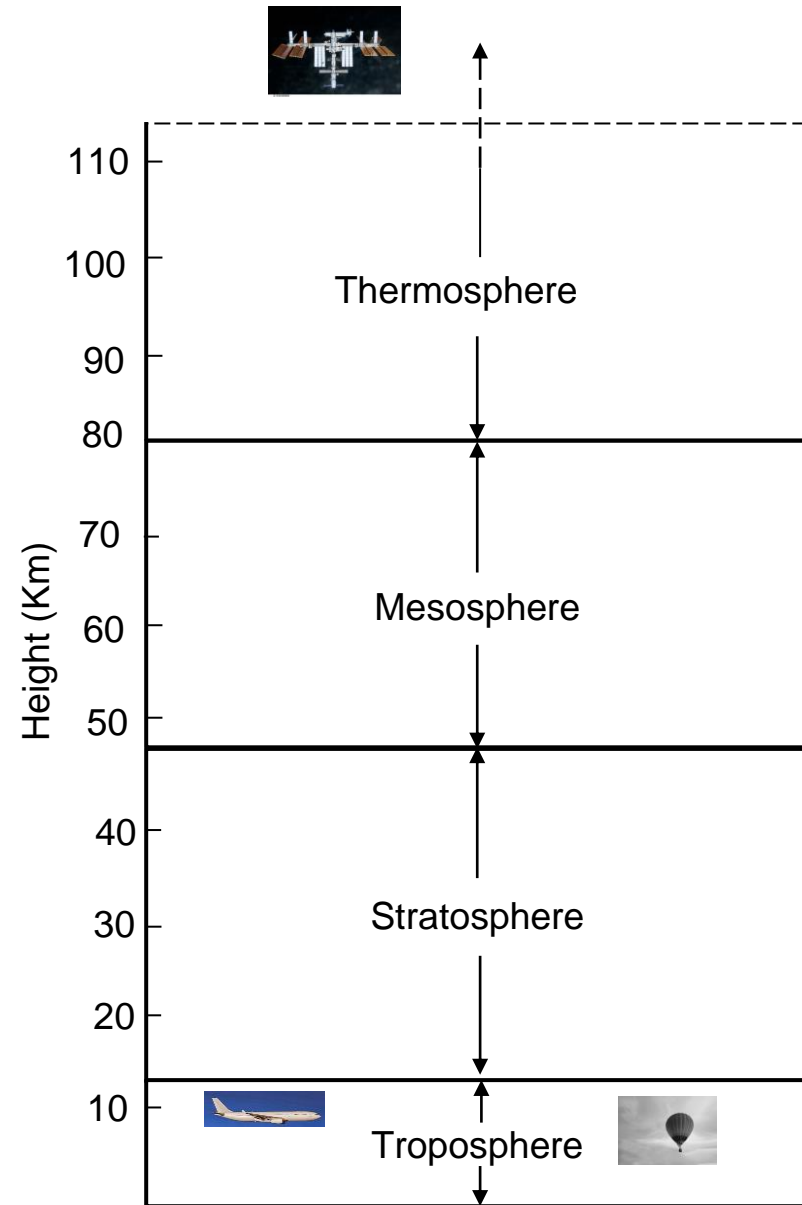


The Atmosphere

Atmospheric Structure

Atmospheric pressure and density decline with height above Earth's surface

Gravity keeps most of the mass of the atmosphere close to Earth's surface

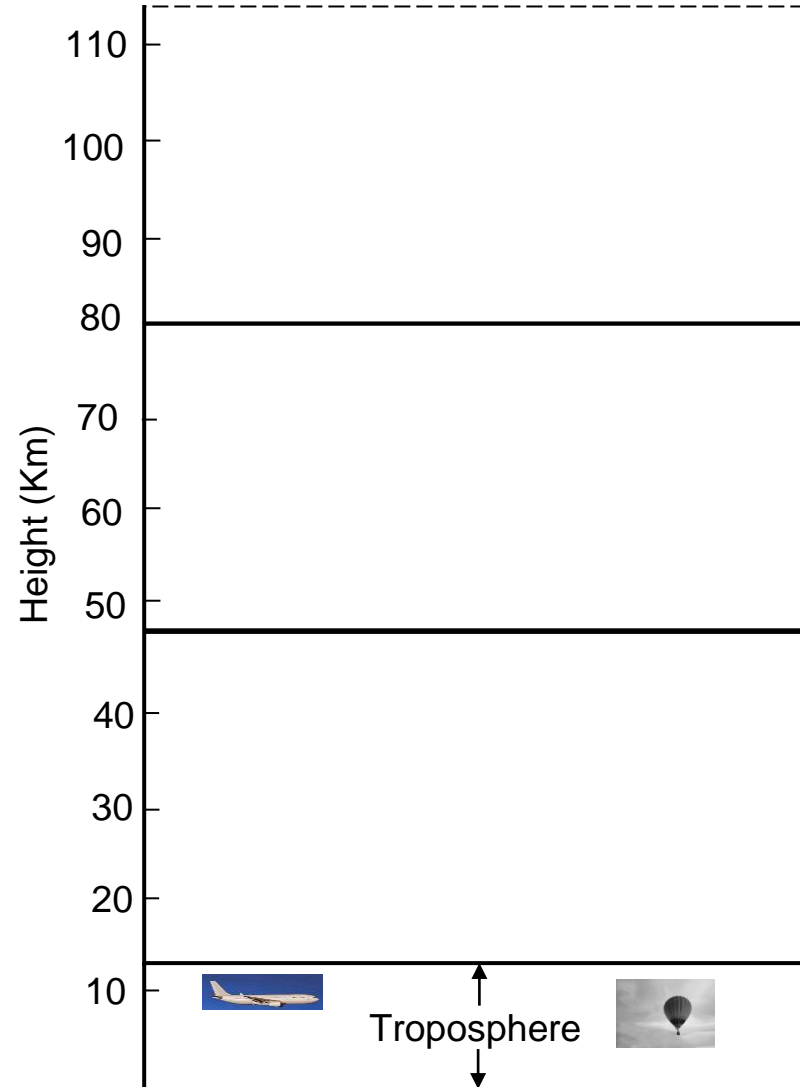


The Atmosphere

Atmospheric Structure

The troposphere

- The lowest layer of the atmosphere
- Contains 75% of atmospheric mass
- Heated primarily by longwave radiation from Earth's surface
- Decrease in temperature with height

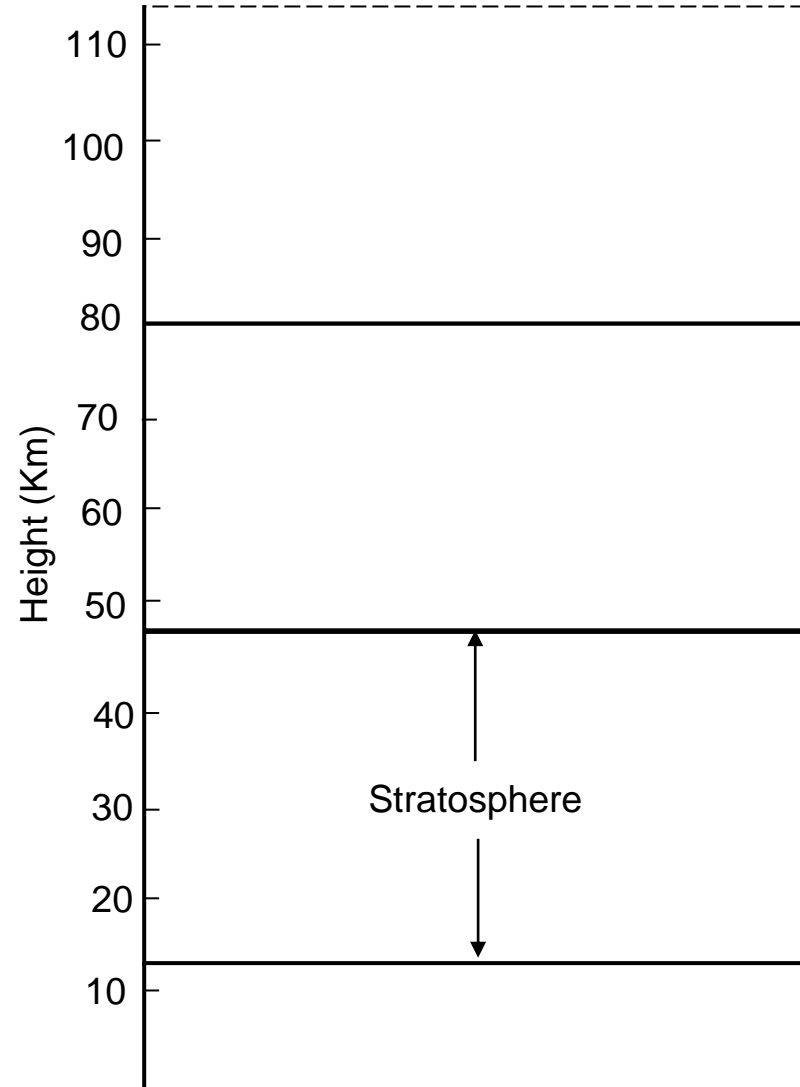


The Atmosphere

Atmospheric Structure

The stratosphere

- Above the troposphere
- It is heated from the top
- Temperature increase with height
- Absorption of ultraviolet radiation by ozone (O_3) in the upper stratosphere warms the air

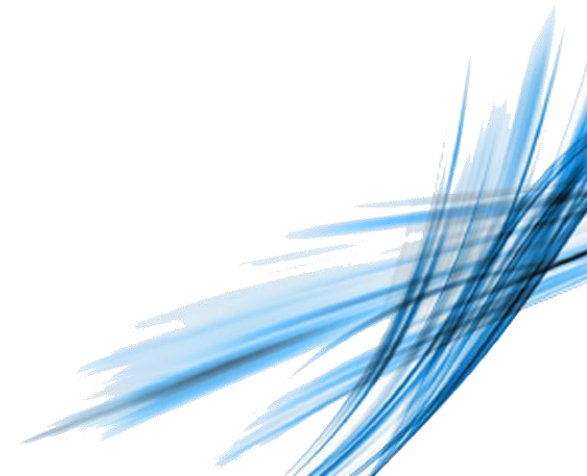


The Atmosphere

Atmospheric Structure

The stratosphere

The ozone layer protects living organisms in the biosphere from UV radiation which can damage Deoxyribonucleic acid (DNA) containing genetic information required to drive cellular processes

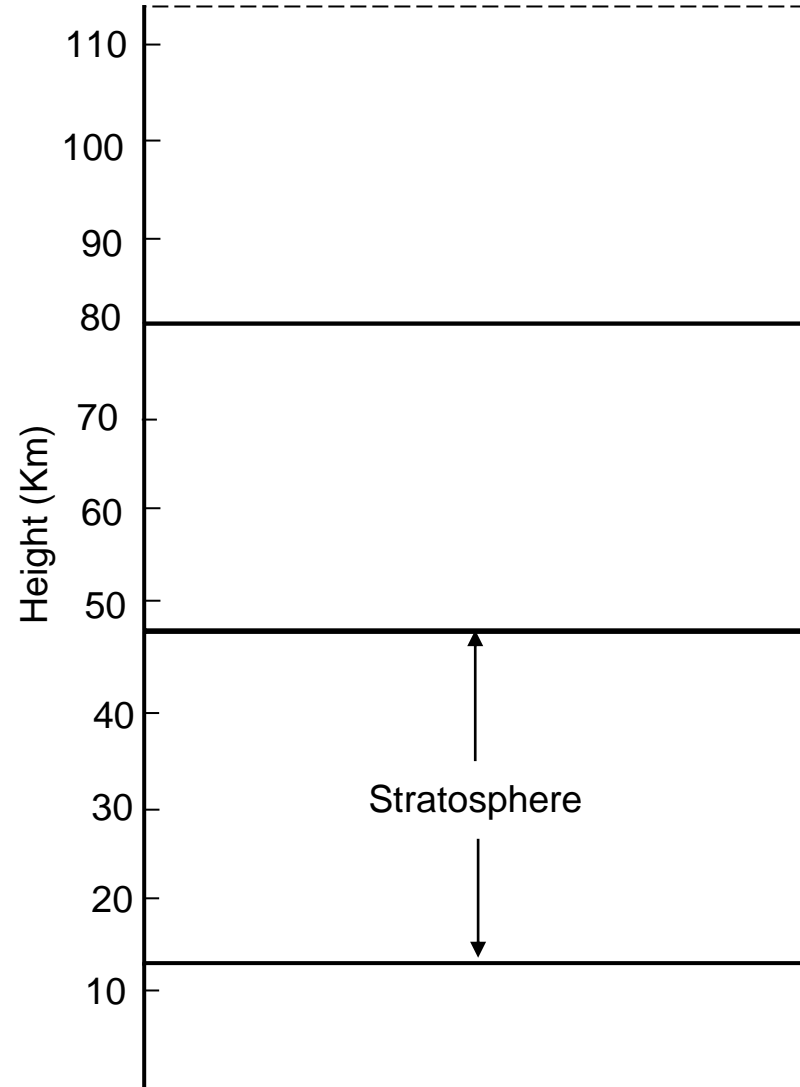


The Atmosphere

Atmospheric Structure

The stratosphere

- High ozone concentration is required for
- Reflecting incoming UV radiation
- Providing the substrate for formation of O_3

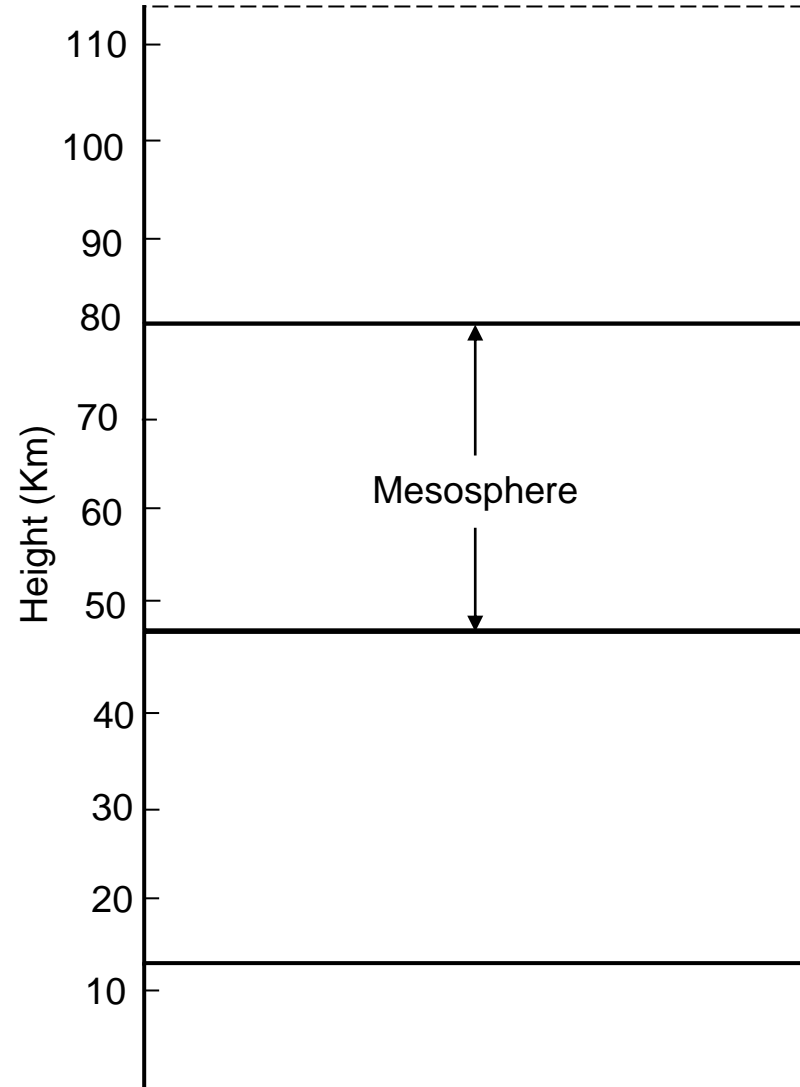


The Atmosphere

Atmospheric Structure

The mesosphere

- Above the stratosphere
- Like the troposphere temperature decreases with height

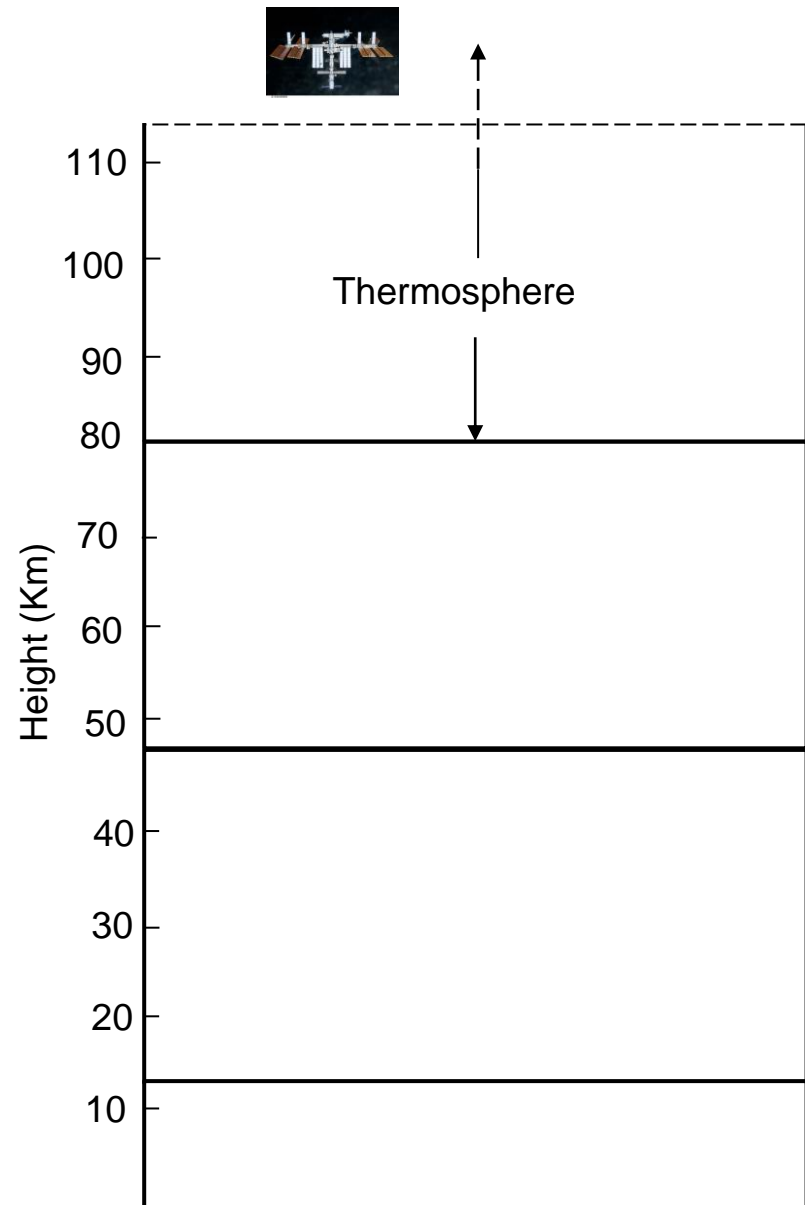


The Atmosphere

Atmospheric Structure

The thermosphere

- The uppermost layer of the atmosphere
- Begins at approximately 80 km, extending into space
- It has a very small fraction of the atmosphere's total mass

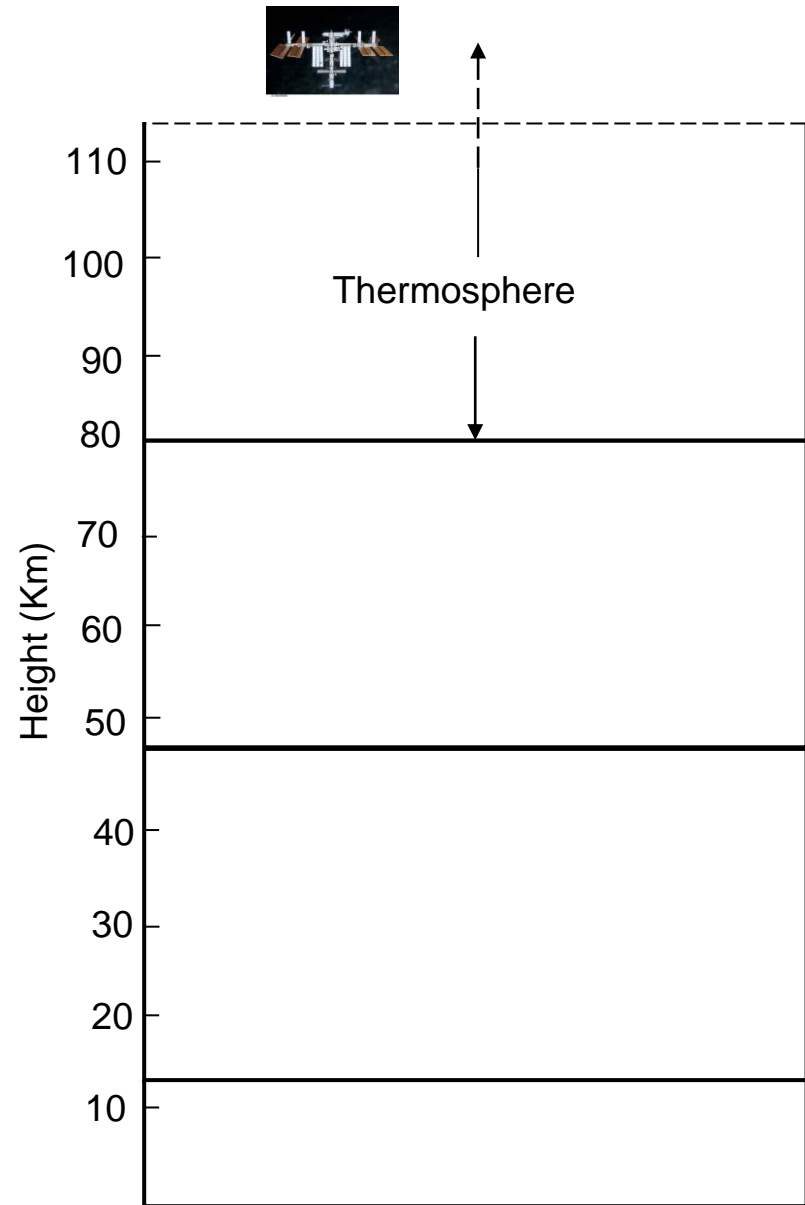


The Atmosphere

Atmospheric Structure

The thermosphere

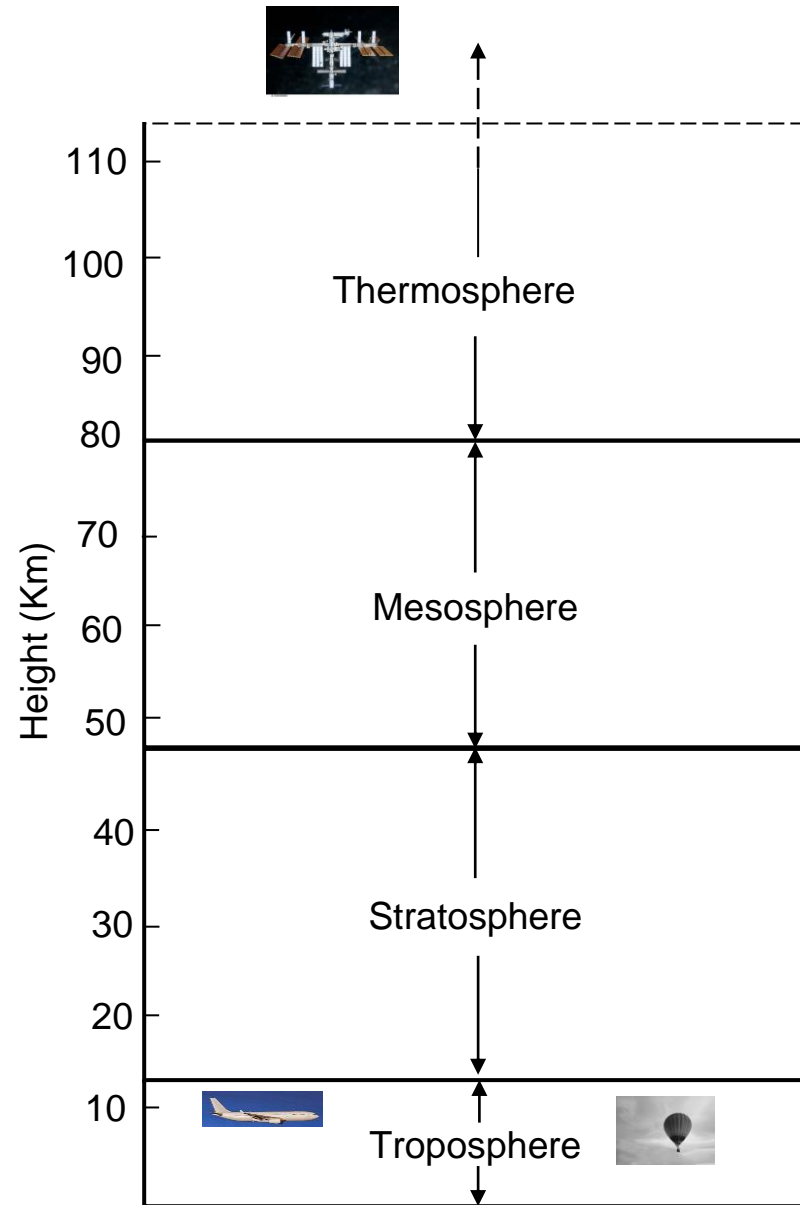
- It is primarily composed of O and N atoms
- it absorbs energy from extremely short wavelengths,
- Increase in heating with height



The Atmosphere

Atmospheric Structure

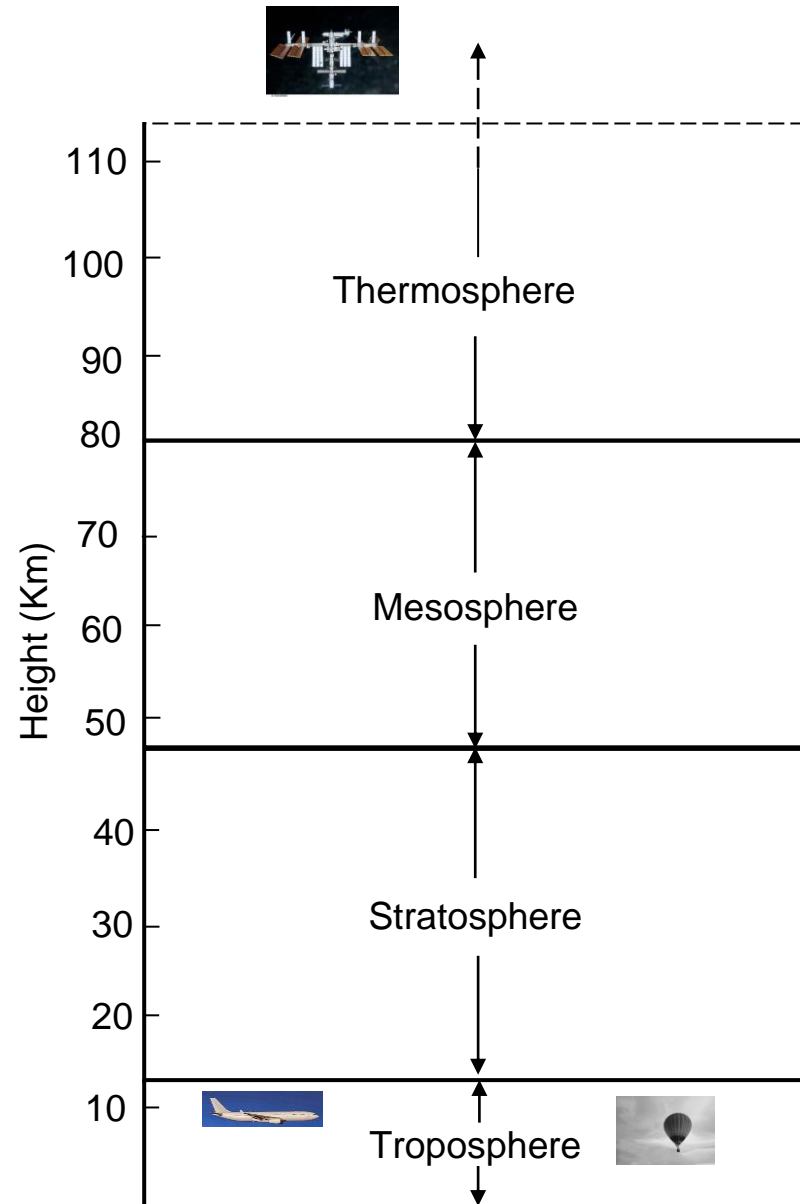
- The impact of the mesosphere and thermosphere on the biosphere is relatively little



The Atmosphere

Atmospheric Structure

- The portion of the atmosphere that directly responds to and affects ecosystem processes is the troposphere
- The troposphere is the atmospheric layer where most weather activity including thunderstorms, snowstorms, hurricanes, and high- and low-pressure systems



The Atmosphere

Atmospheric Structure

The Tropopause

- Boundary between the troposphere and the stratosphere
- Its height occurrence varies with temperature from 16 km in the tropics, 9 km in polar regions

