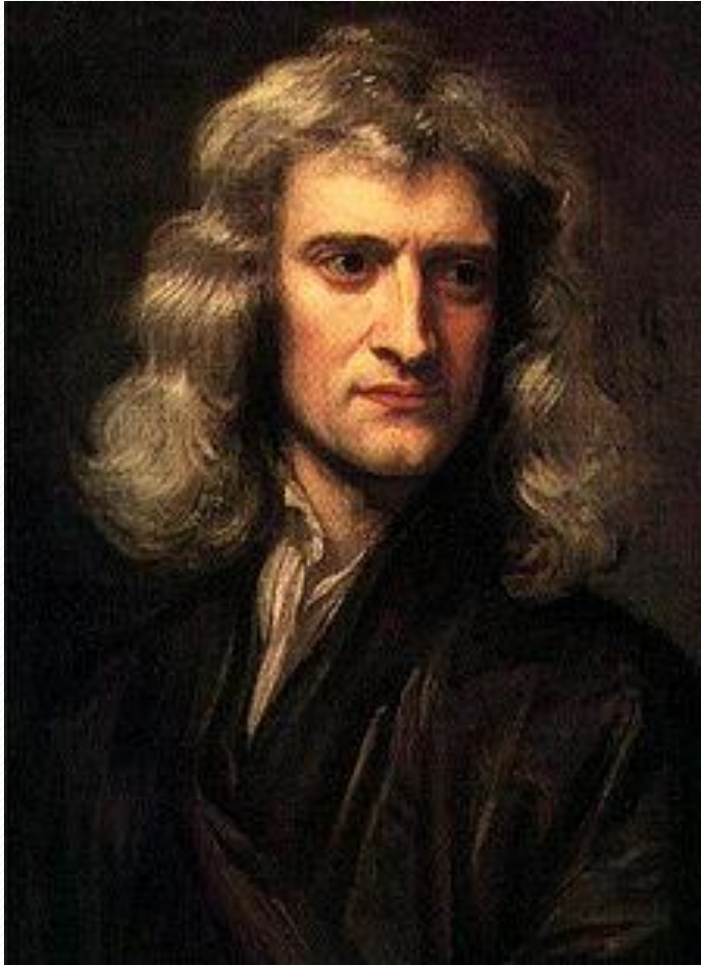


Tides and Sun's Fusion

To explain Tides we need to understand Gravity

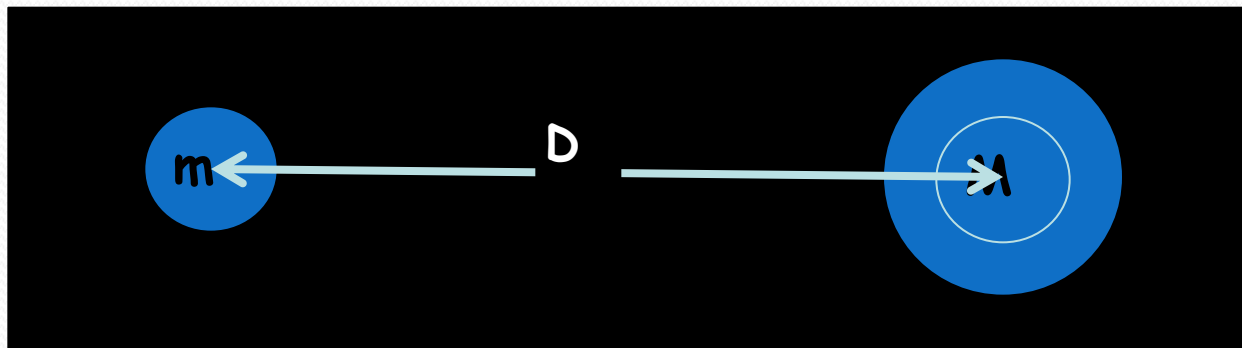


Sir Issac Newton
1642-1727
English Scientist



Newton's Universal Law of Gravitation

- All objects attract or pull on each other with an **invisible force without contact**
- The pull of gravity between 2 objects depends on their masses and distance distance between them
- The bigger the objects the greater the attraction
- Gravity gets weaker as distance gets bigger



Tides

- Are daily changes in the elevation of the ocean surface
- Ocean tides result from the gravitational attraction exerted upon Earth by the moon and, to a lesser extent, by the sun.
- Tide-Causing Forces
 - *Gravity
 - *Inertia

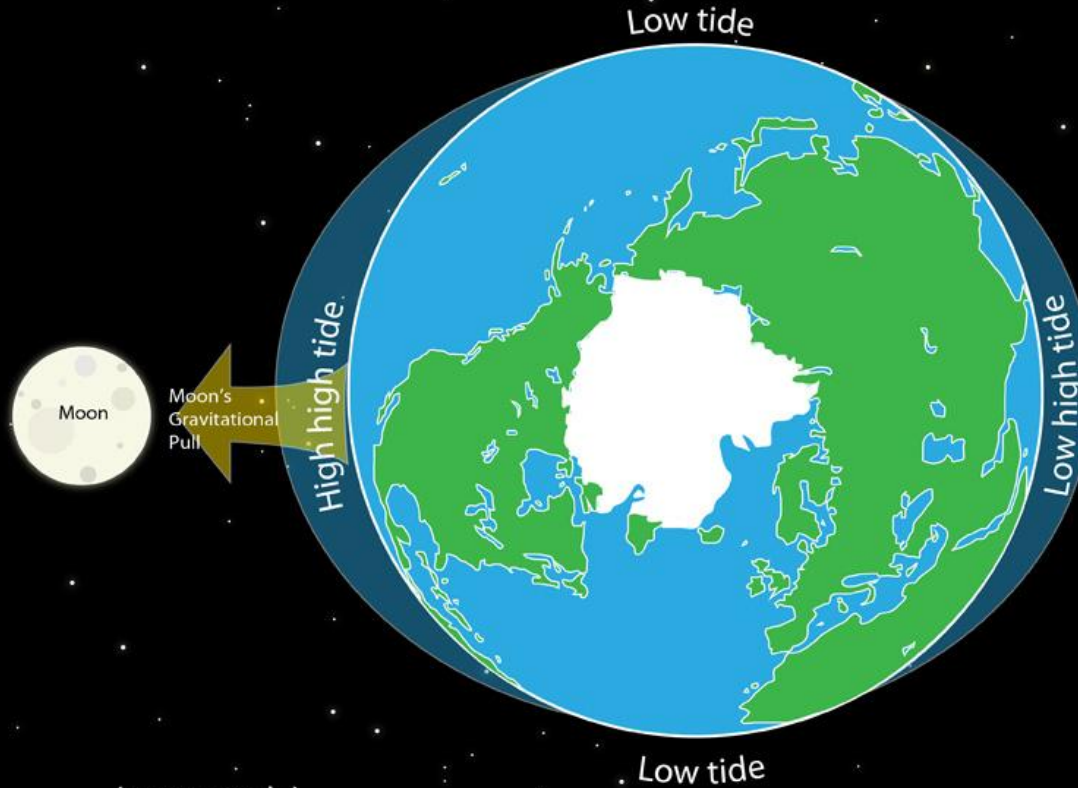
[Explain-it: How do the tides work? - YouTube](#)

The moon affects the oceans.
The moon's pull is called **gravity**.

Gravity pulls on the oceans and causes the tides.



Earth's Tides



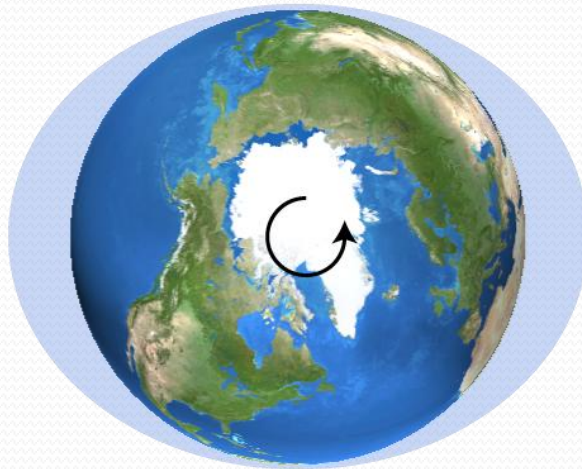
(not to scale)

Sun's Influence on Tides

- Sun is:
 - larger than moon
 - Further away from Earth than is Moon
 - Effect is about 46% of that of the Moon

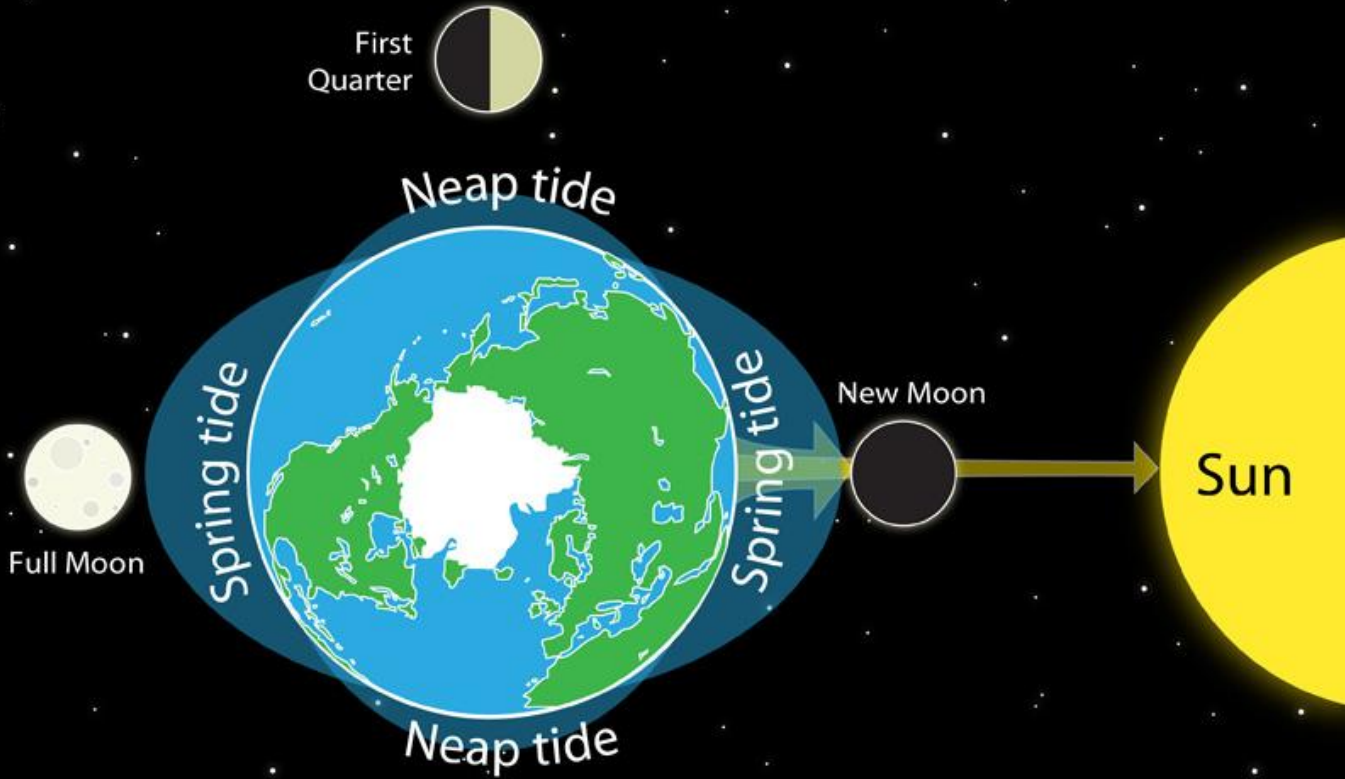
What causes tides?

- The gravitational field of the Moon causes the Earth's oceans to bulge. It is the Earth rotating through these 'tidal bulges', which causes the tides.
- For the majority of locations, two high tides and two low tides are experienced every day.
- This is due to the presence of a tidal bulge in the Earth's oceans, which appears on both sides of the planet.



Note : The tidal bulge in this image is exaggerated for demonstration purposes

Neap Tides and Spring Tides



First Quarter 

Full Moon 

New Moon 

Sun 

Neap tide

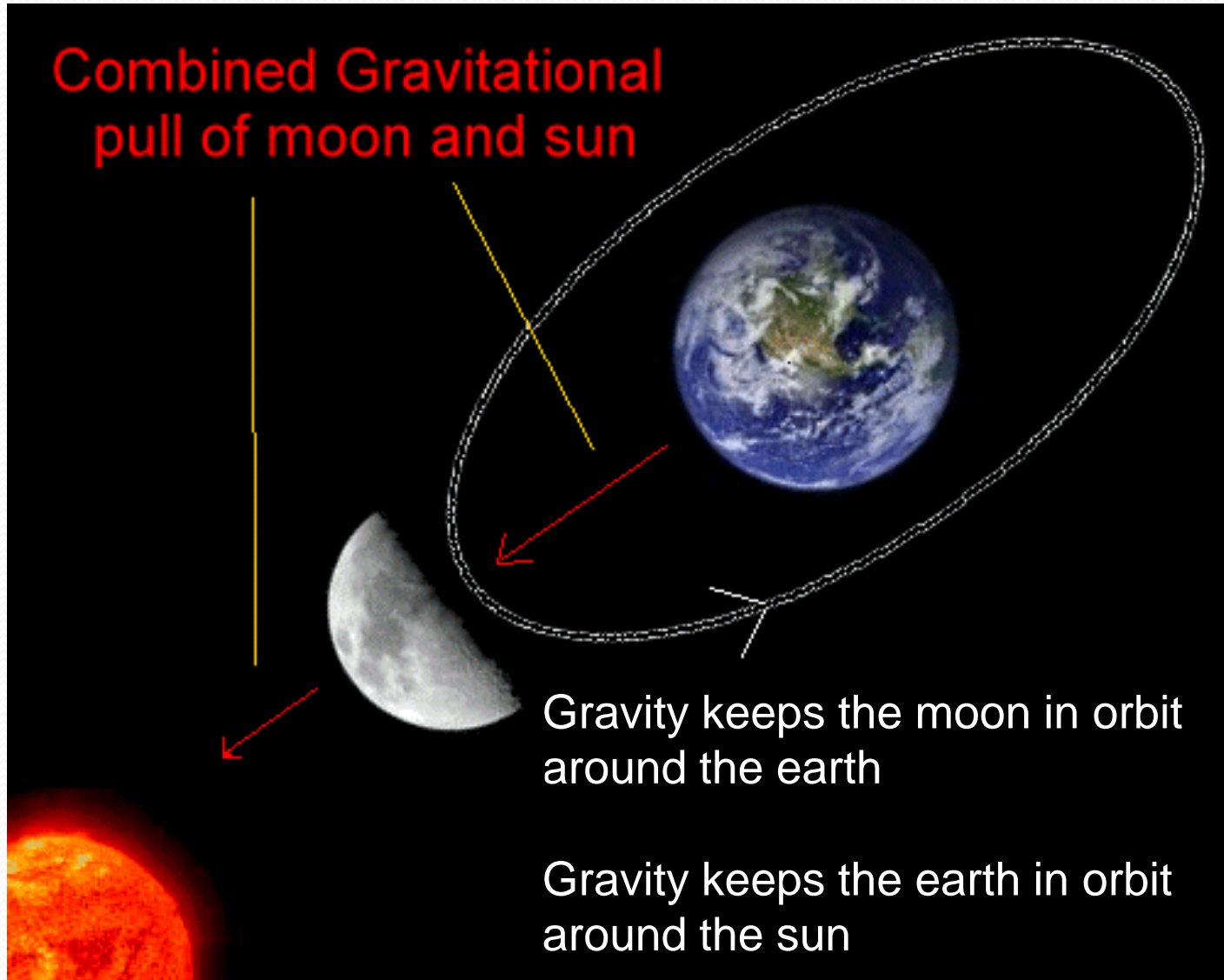
Spring tide

Spring tide

Last Quarter 

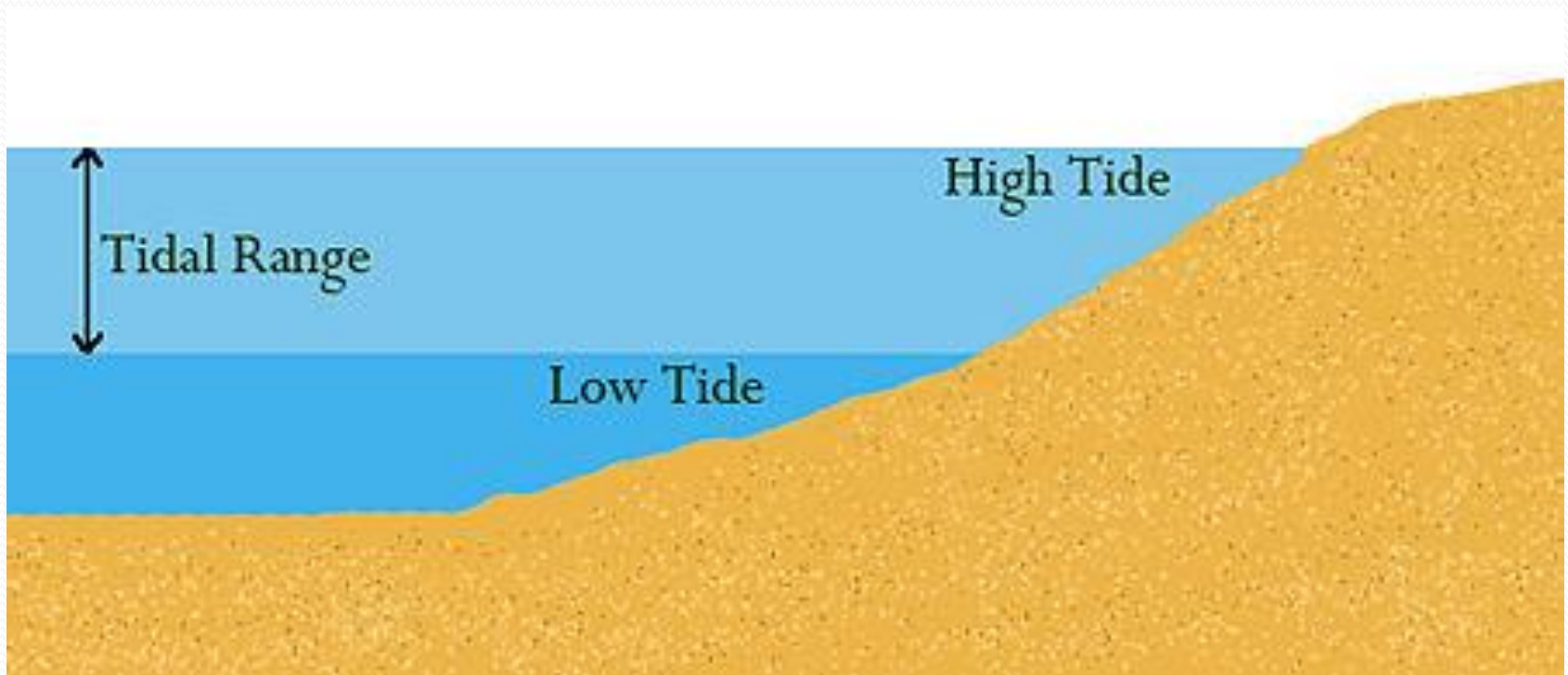
(not to scale)

Gravity of Moon & Sun pull on Earth's Oceans



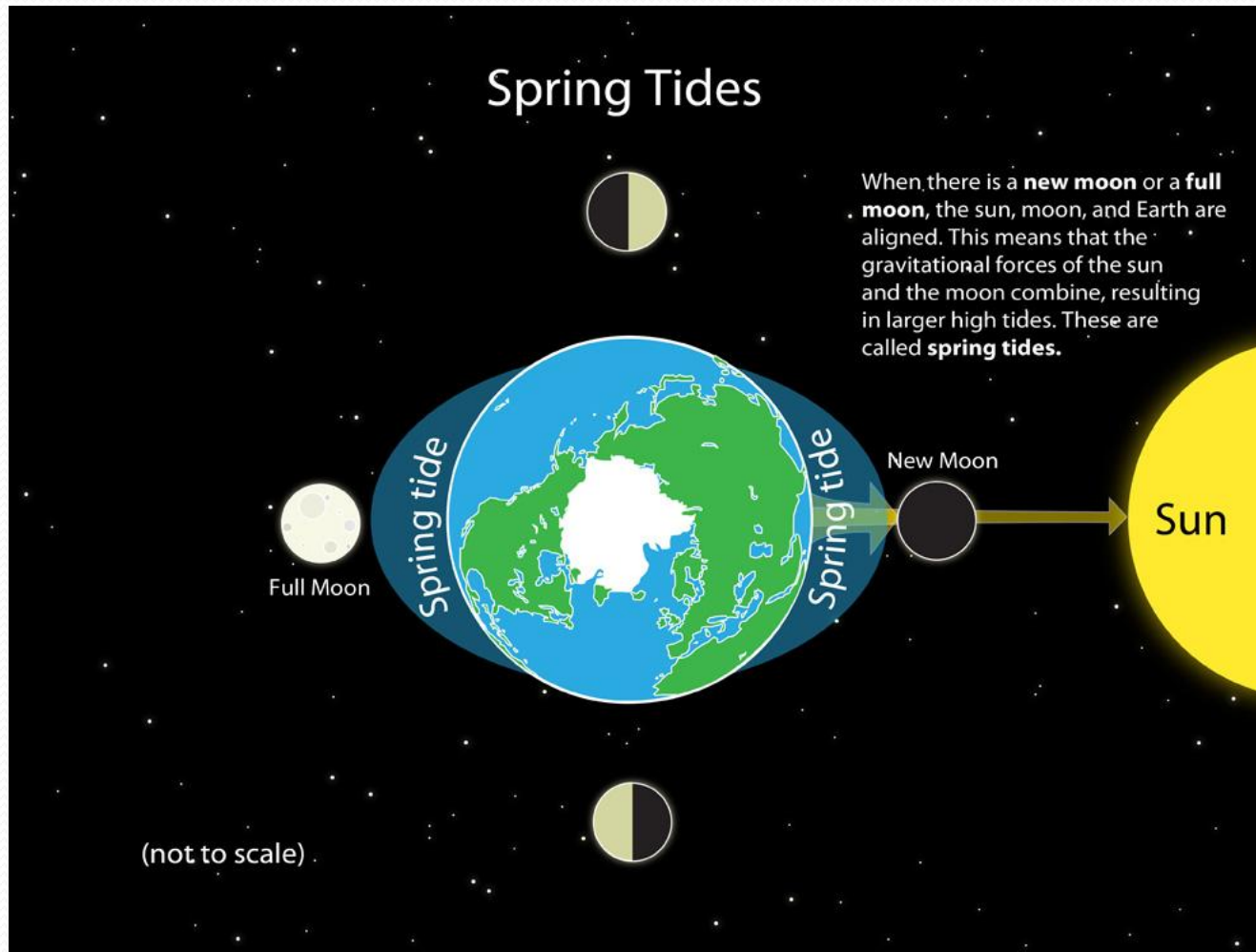
Tide Cycles

Tidal range is the difference in height between successive high and low tides.



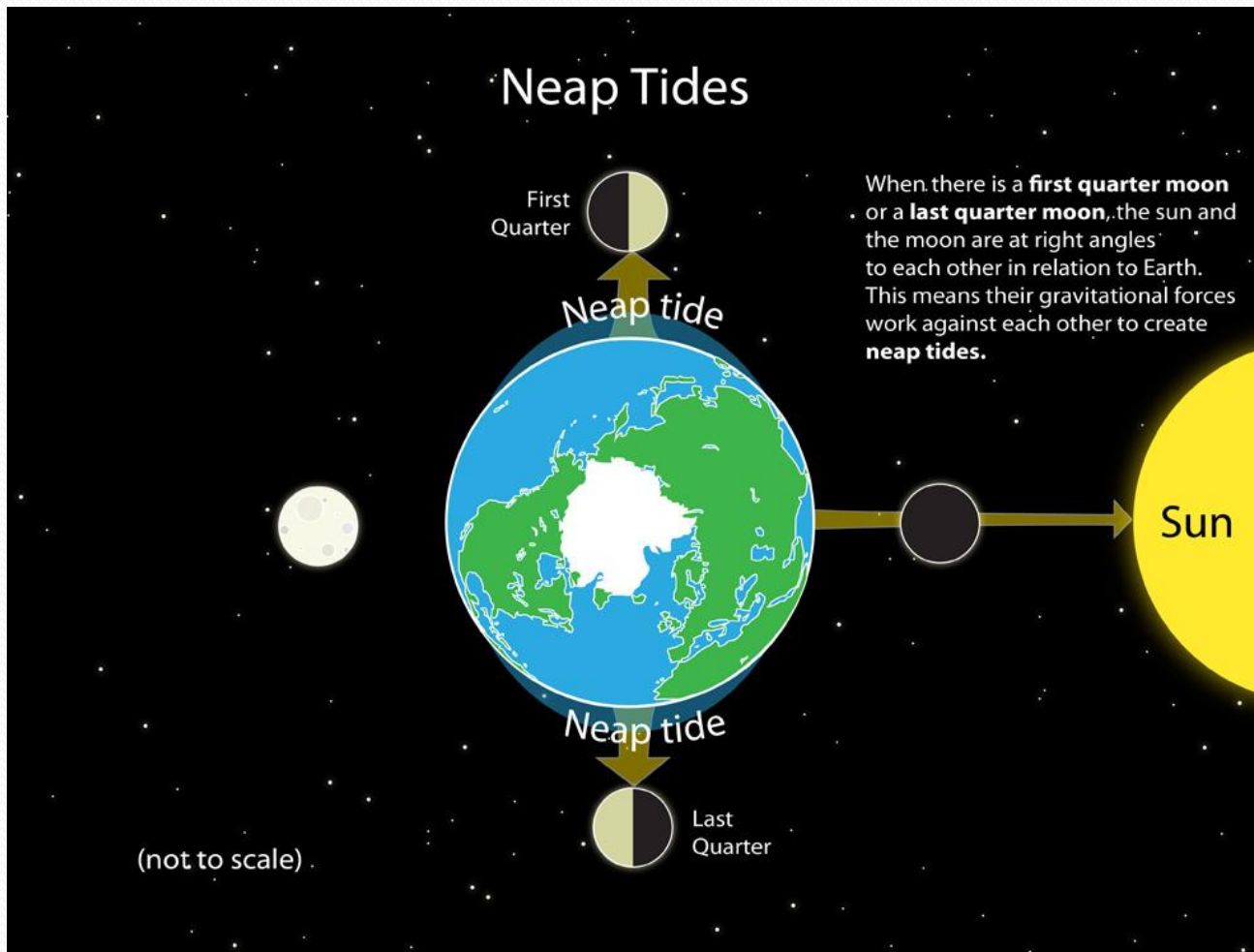
Tidal Cycles

- Spring Tides – are tides that have the greatest tidal range due to the alignment of the Earth-Moon-Sun system.

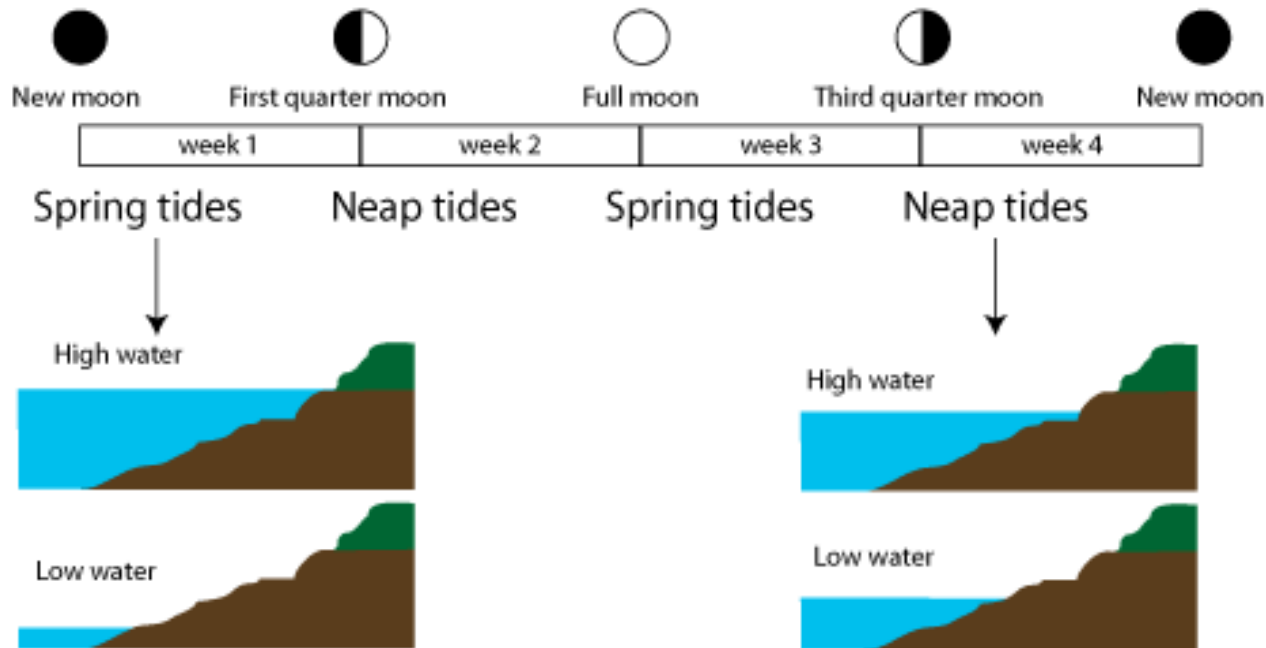


Tidal Cycles - Cont

- **Neap tides** are tides that have the lowest tidal range, occurring near the times of the first-quarter and third-quarter phases of the moon.



Based on the diagram,
which types of tides have a larger range?



SPRING TIDES



How tides work <https://www.youtube.com/watch?v=5ohDG7RqQ9I>

Spring and Neap tides - Song https://www.youtube.com/watch?v=KFYf_it461s

Tides explained in a minute <https://www.youtube.com/watch?v=gftT3wHJGtg>

Focus Question...

What process powers the Sun
and what forms of Energy does
that process produce?

A Little Bit About the Sun...

How many Earths could be lined up edge to edge to fit across the Sun?

- 109

The Sun makes up...

- 99% of the mass of the solar system!

A pair of dice with the density of the Sun...

- would weigh 2 pounds!

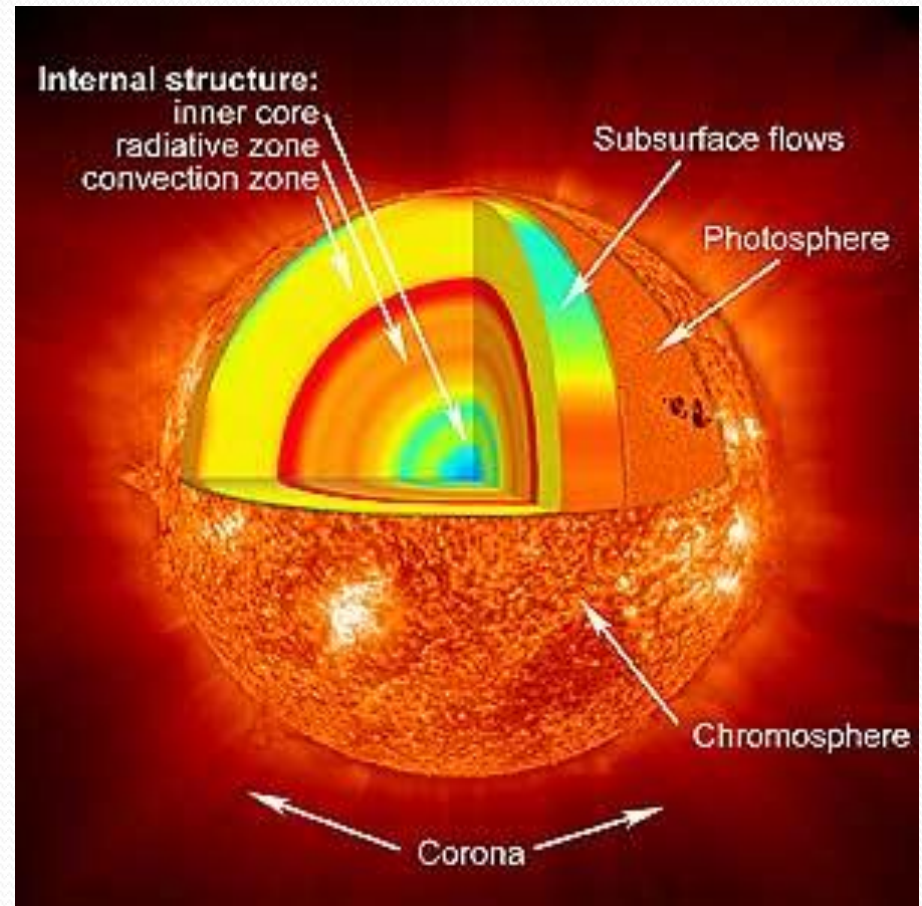
The solar interior is made of...

... plasma (one of the 4 states of matter)

The Sun's Atmosphere...

The Sun's atmosphere consists of...

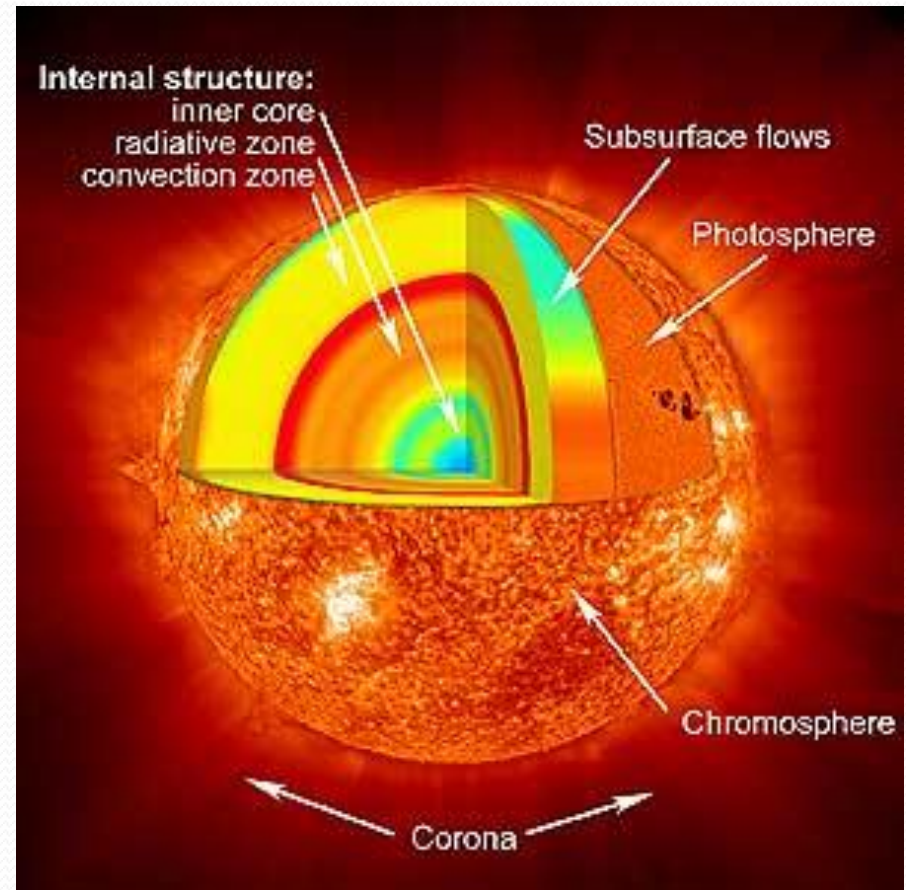
- Photosphere...
 - the lowest layer
 - 400 km thick
 - Hot! (5800 K)
 - the visible surface of the Sun



The Sun's Atmosphere...

The Sun's atmosphere consists of...

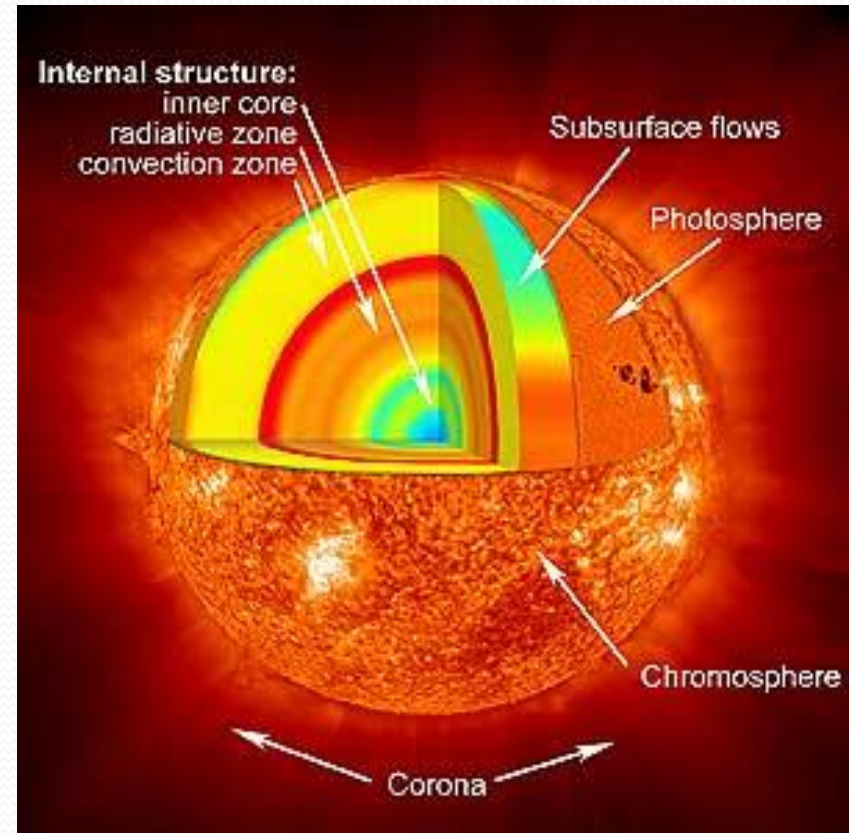
- Chromosphere...
- Above the photosphere
- 2500 km thick
- Very hot! (30,000 K)



The Sun's Atmosphere...

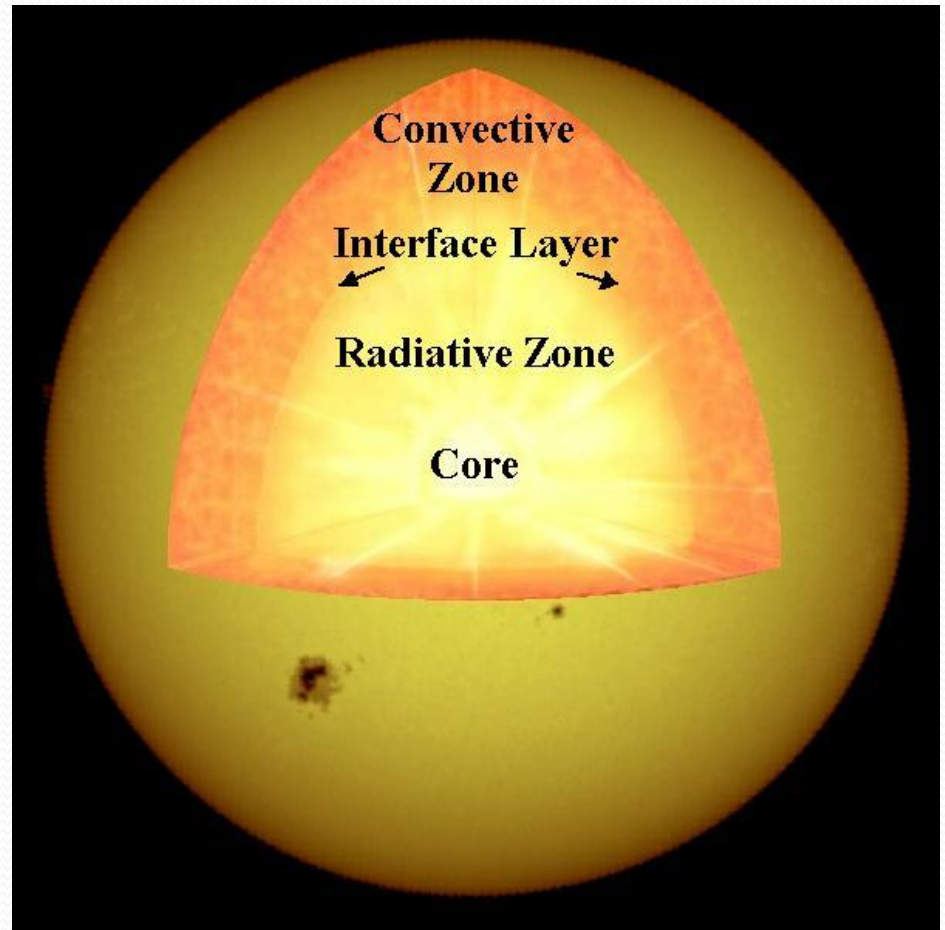
The Sun's atmosphere consists of...

- Corona...
 - Extends several million km from the top of the chromosphere
 - Very low density – only visible during an eclipse
 - Extremely hot! (1 to 2 million K)



Inside the Sun

- Core
- Radiative Zone
- Convection zone

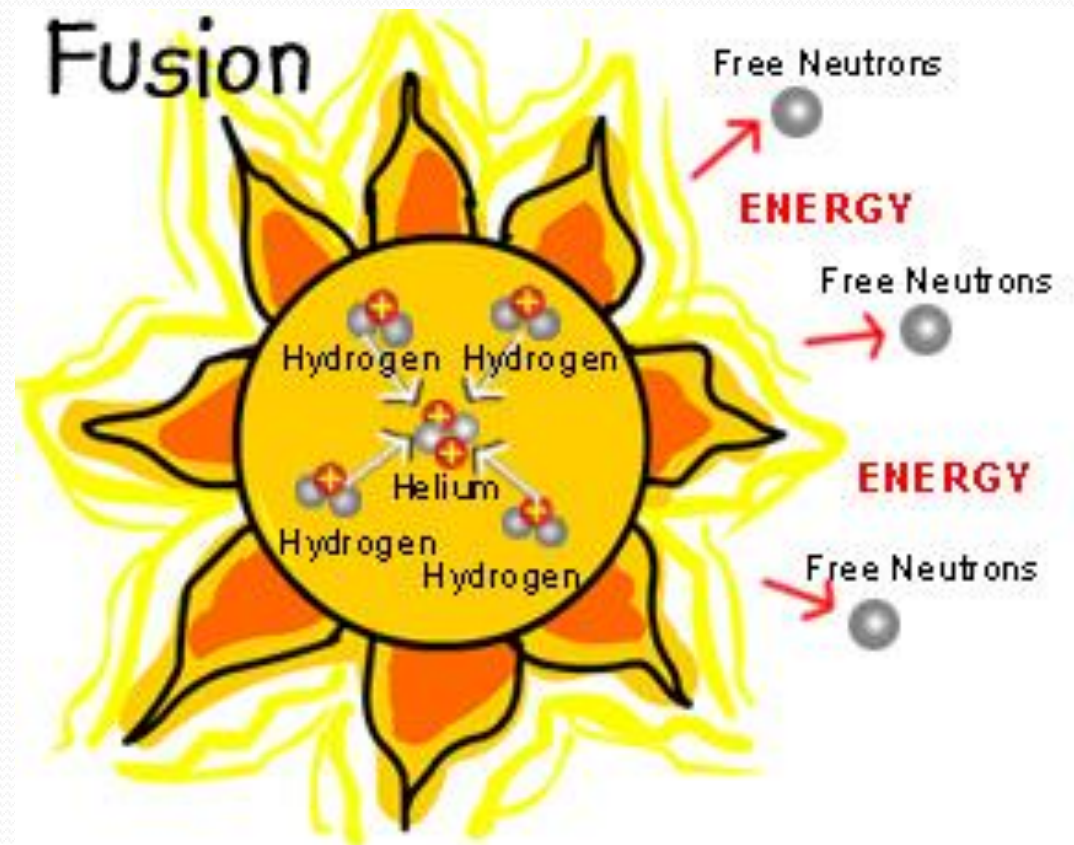


Fusion and Fission

- Nuclear energy is energy in the nucleus (core) of an atom. Atoms are tiny particles that make up every object in the universe. There is enormous energy in the bonds that hold atoms together.
- Nuclear energy can be used to make electricity. But first the energy must be released. It can be released from atoms in two ways: nuclear fusion and nuclear fission.

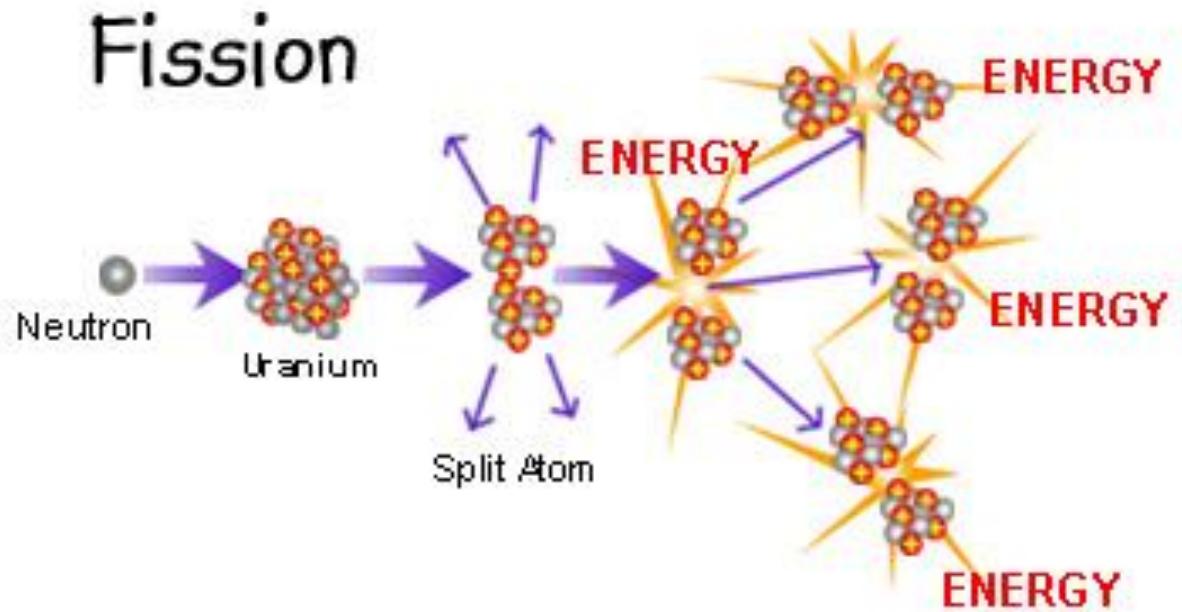
- In **nuclear fusion**, energy is released when atoms are combined or fused together to form a larger atom. This is how the sun produces energy.

When things **fuse** (fusion), you start with smaller objects (tritium, deuterium) and build larger objects (helium).



In **nuclear fission**, atoms are split apart to form smaller atoms, releasing energy. Nuclear power plants use nuclear fission to produce electricity.

When things "fiss" or break down, you start with a larger object (uranium) and finish with smaller objects



Energy from the Sun

- Nuclear chain reaction (hydrogen forming helium)
- Releases radiation (gamma rays)
- The **gamma ray** loses energy as it bounces around inside the Sun
- It is finally released at the photosphere, primarily as visible light

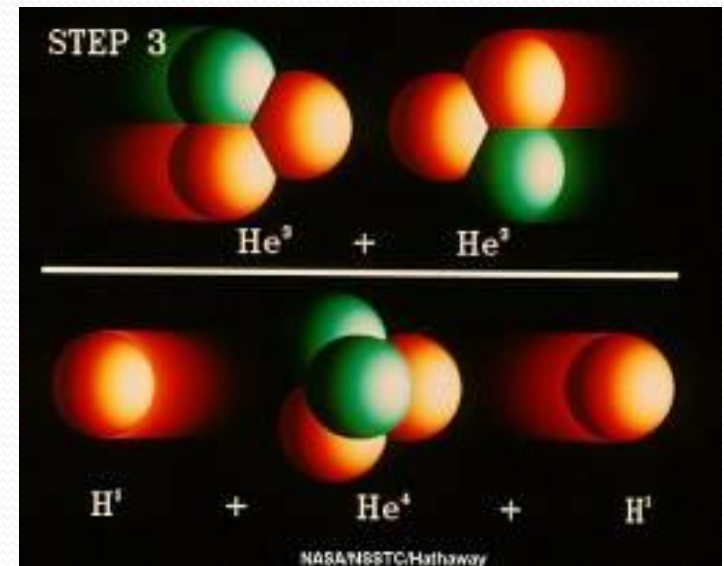


Image at <http://solarscience.msfc.nasa.gov/interior.shtml>



Think About It...

What would happen to Earth if the Sun were turned off today?

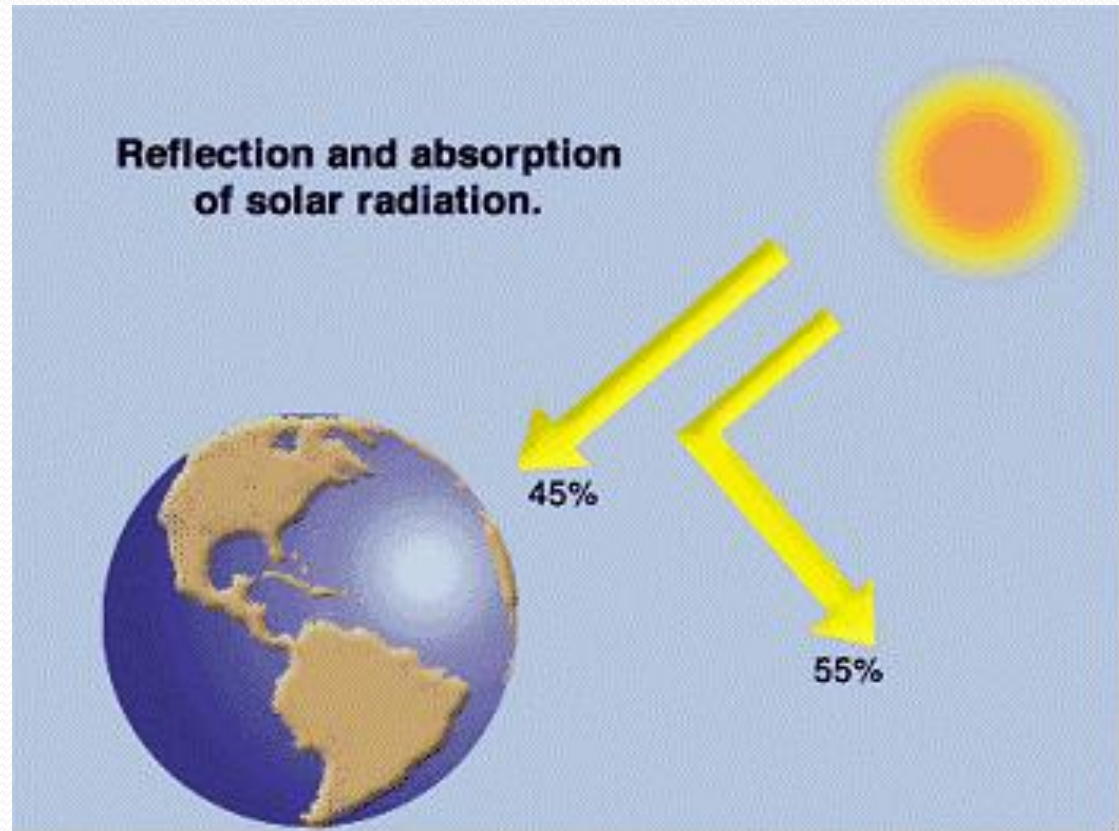
Focus Question...

How does the Sun's energy warm Earth's surface and atmosphere?

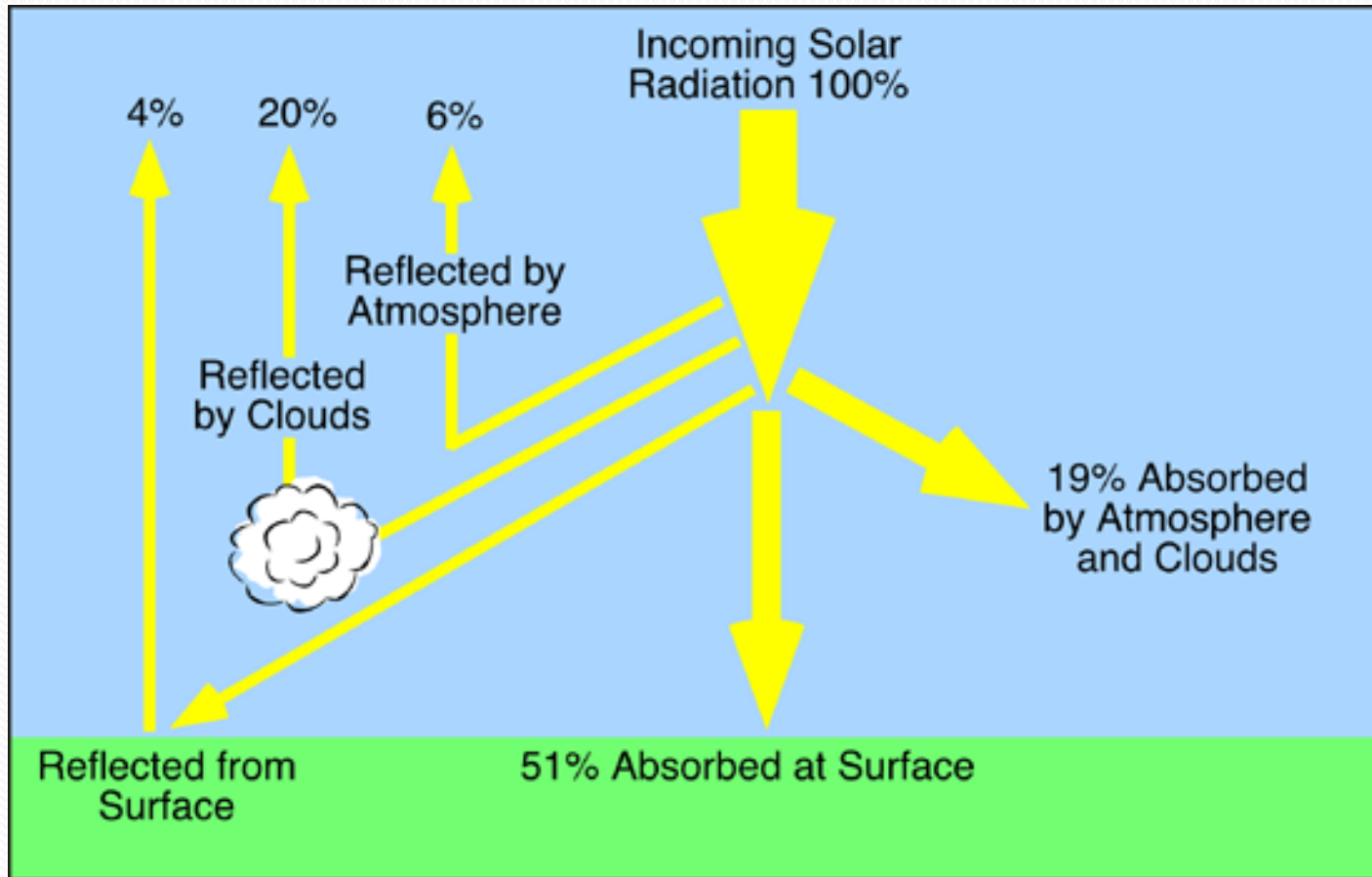
Energy For Earth...

Radiation is ...

the transfer of energy through space by visible light, ultraviolet radiation, and other electromagnetic waves



What Happens to the Sun's Energy?



Differential Heating...

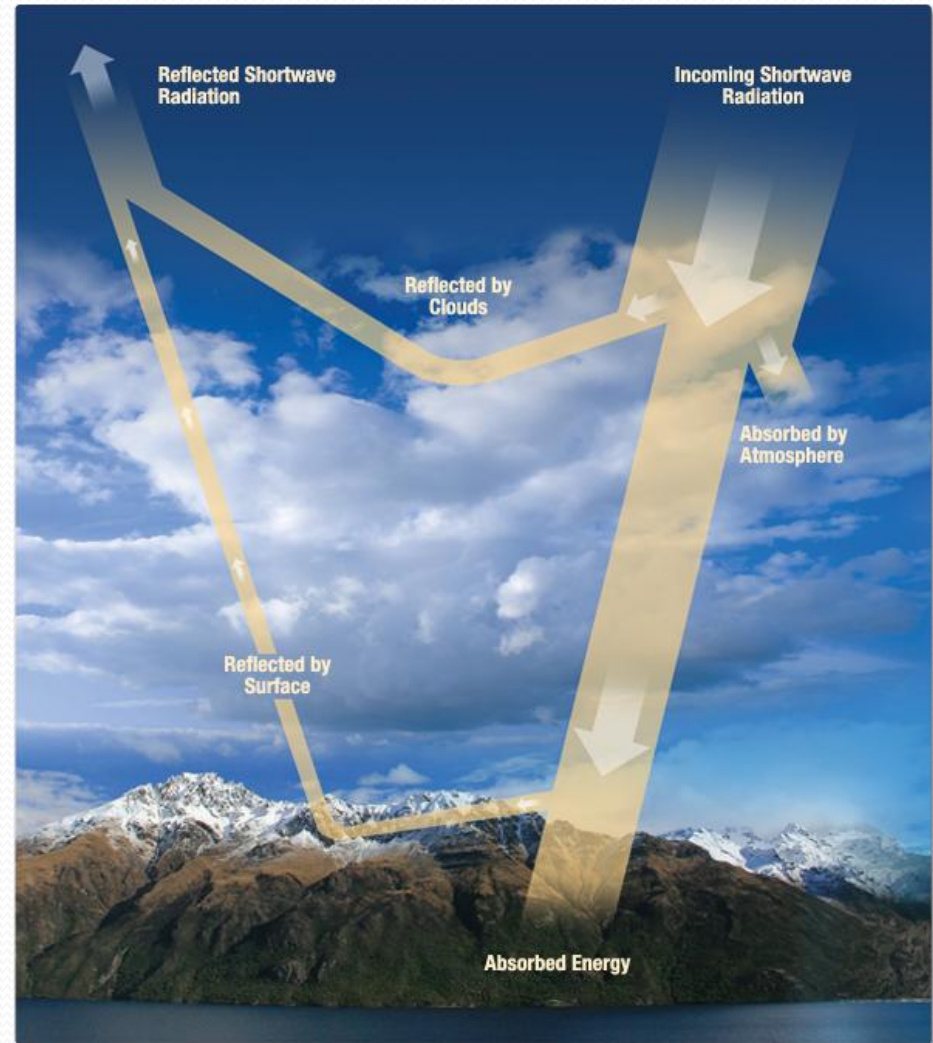
Which heats up and cools down more slowly – water or land?

- Water
- This is called differential heating.
(Highlight this term in your notes!)
- This is what moderates the climate in coastal areas.

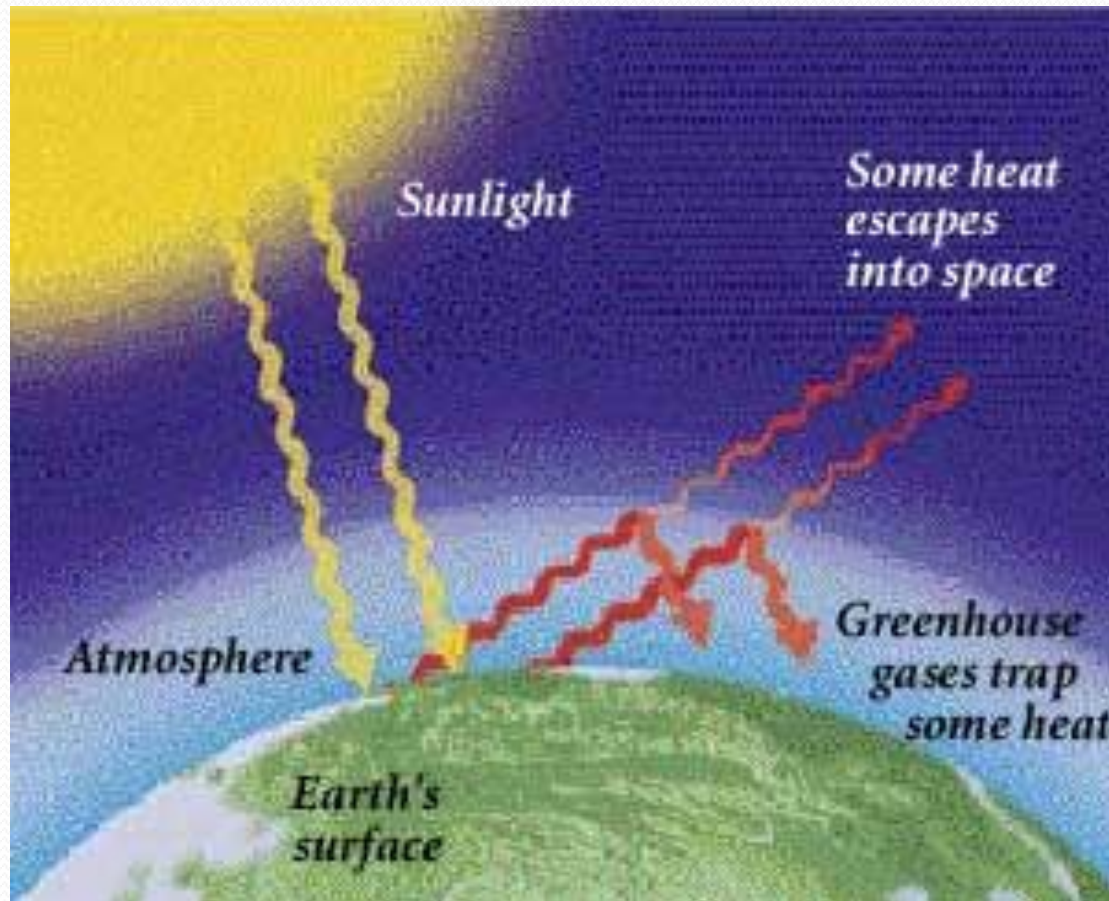
Energy for Earth...

Radiation

- the transfer of energy through space by visible light, ultraviolet radiation, and other electromagnetic waves
- Earth's surface is warmed by the sun's rays



Radiant Energy Electromagnetic energy that travels in transverse waves

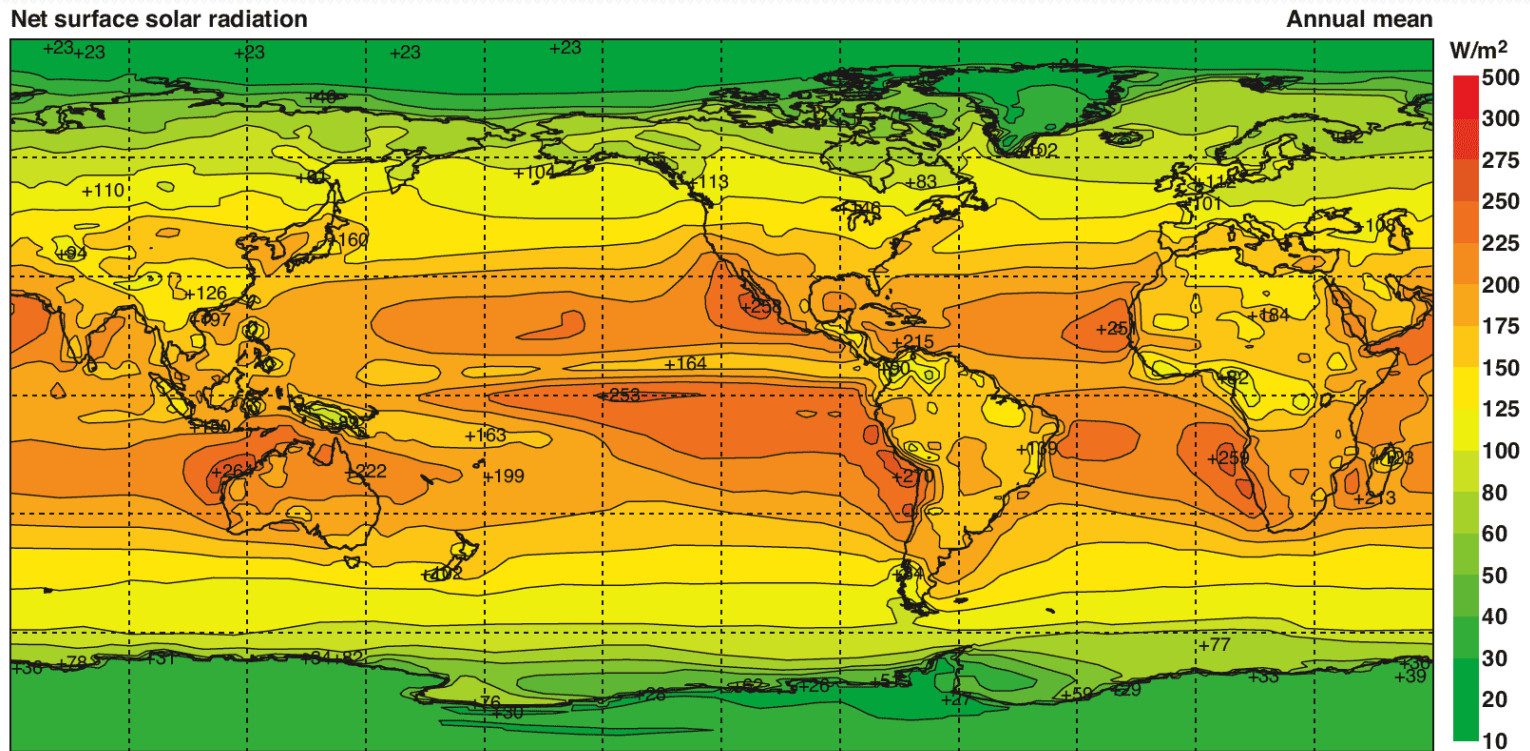


Radiant Energy from the Sun

- **Radiant energy** is also called electromagnetic energy.
- Almost every reaction that happens on the surface of the Earth is the result of energy coming to the Earth from the Sun.
- Radiant energy is also called electromagnetic energy because it is made up of two combined fields.
- One of the fields is electrical and the other is magnetic.

What is “Insolation?”

Insolation = Incoming Solar Radiation



Earth's Atmosphere and Insolation

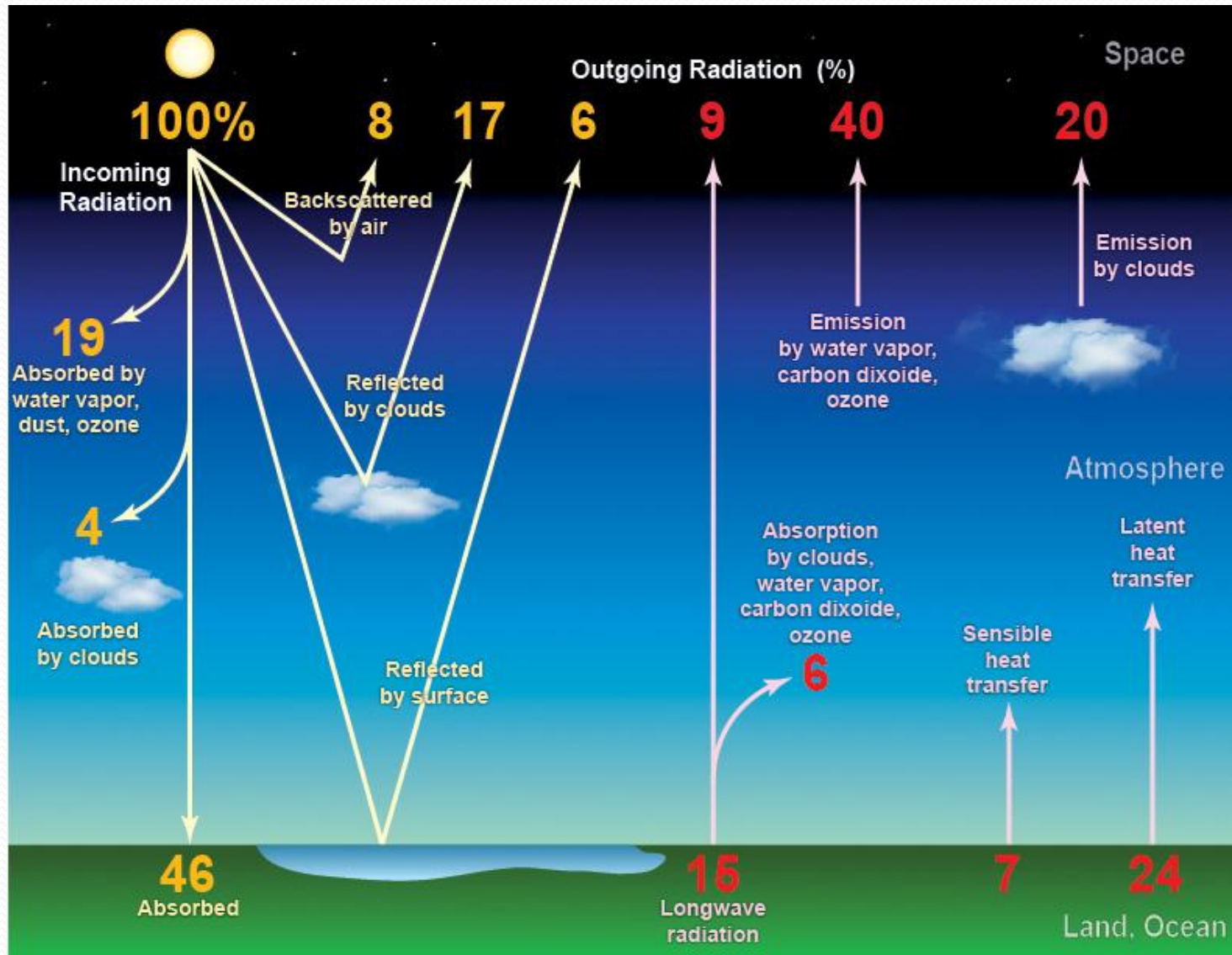
Brainstorm

Does Earth's atmosphere influence the amount of insolation?

YES!

- Insolation may be transmitted, absorbed, reflected or scattered before reaching Earth's surface
- Let's take a closer look...

Earth's Atmosphere and Insolation



Incoming Solar Radiation = Outgoing Terrestrial (Earth) Radiation

What Influences the Absorption and Reflection of Insolation?

4 Main Factors

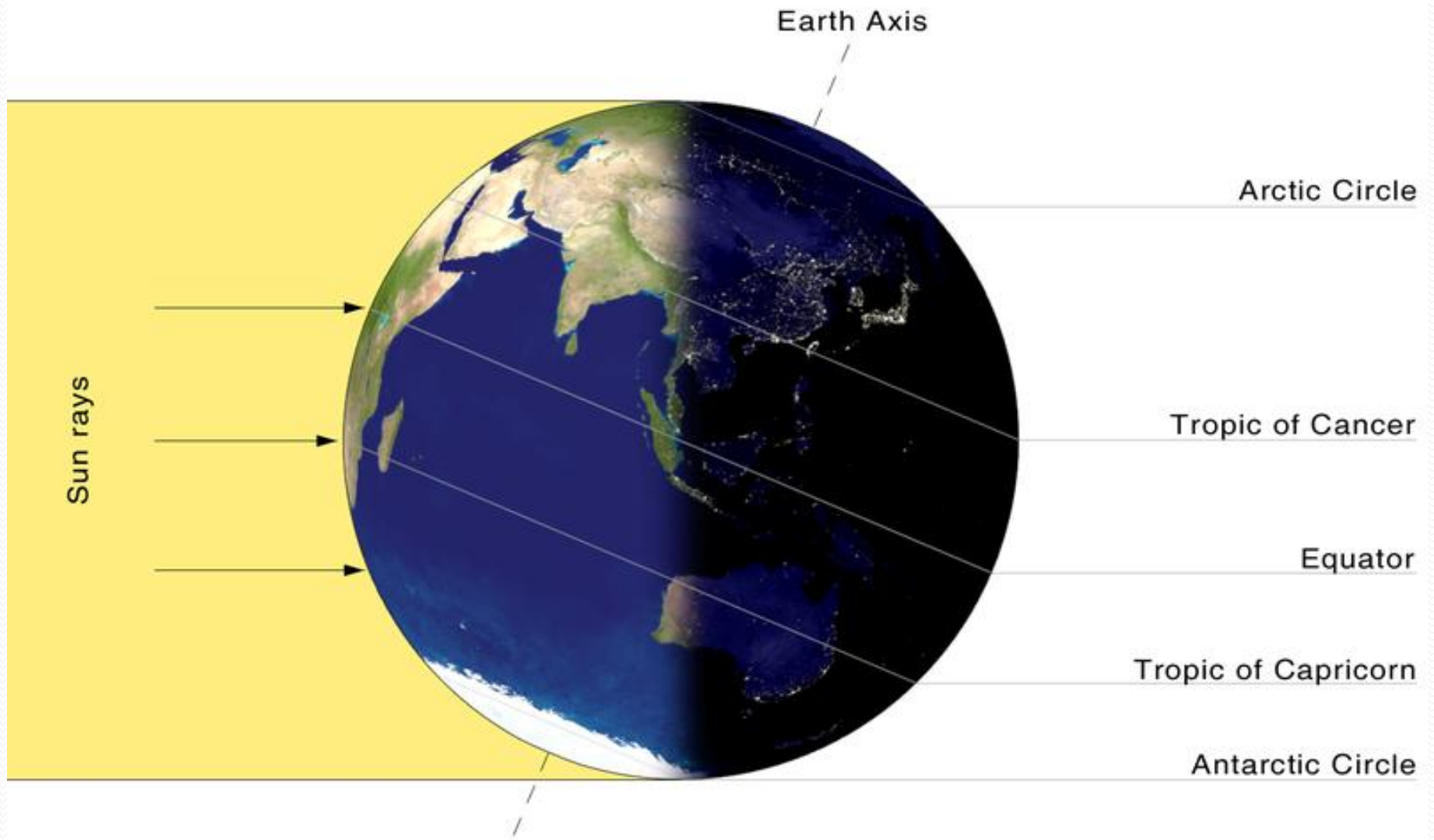
- **Factor 1. Angle of Incidence**
 - Angle at which insolation hits Earth's surface
 - Determined by the altitude of the Sun
 - Higher altitude = higher angle of incidence = more insolation absorbed
 - Lower altitude = lower angle of incidence = less insolation absorbed

Challenge Question

In North Carolina, which season has the highest angle of incidence?

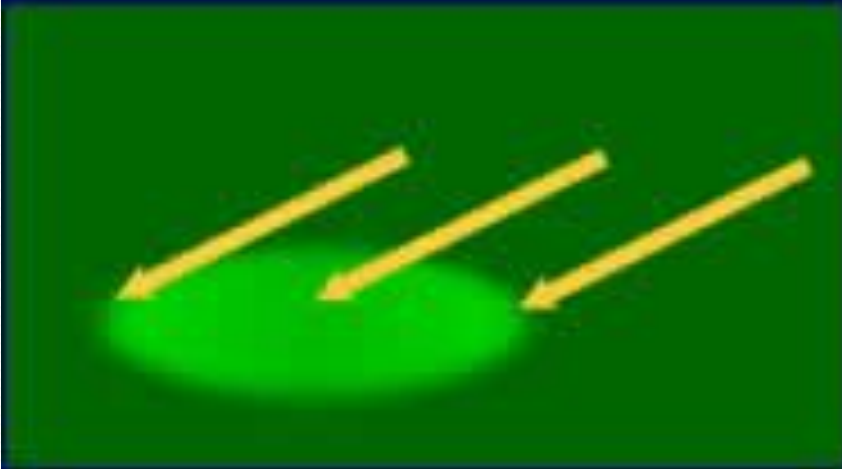
Summer!

Solar Resource

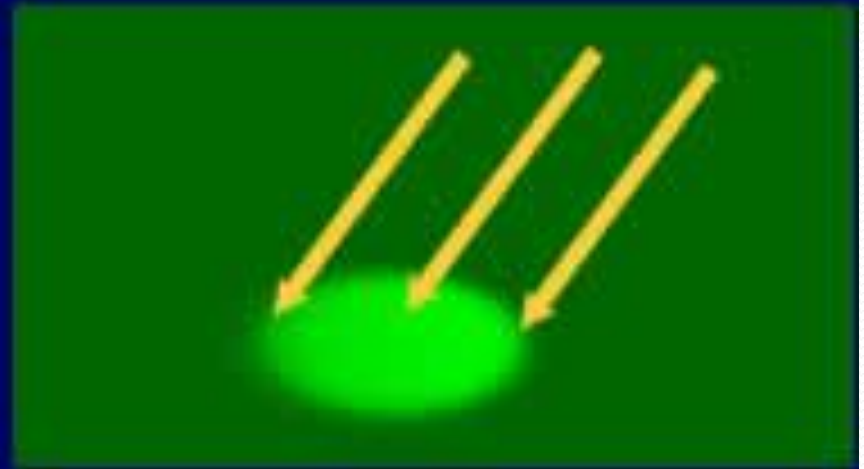


Incident angle

Winter

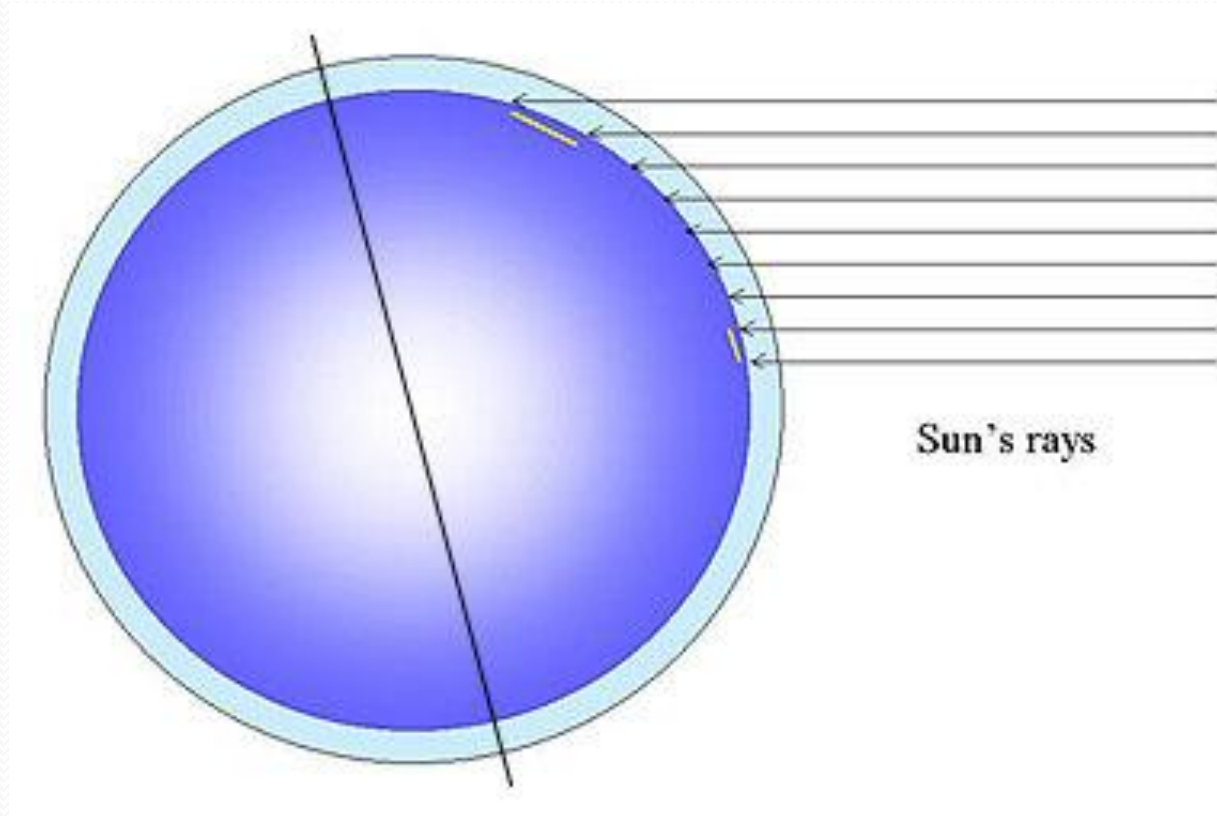


Summer



Effects of Atmosphere

- The lower the angle of the Sun in the sky, the more atmosphere the Sun's rays must pass through to reach earth and therefore the less energy those rays have when they reach earth.



What Influences the Absorption and Reflection of Insolation?

- **Factor 2. Earth's Surface Characteristics**

- Type of Material

- Specific heat is different for different materials (i.e. land heats up and cools down more quickly than water)

- Texture (how rough, uneven a surface is)

- More rough/uneven surface = more insolation absorbed (less reflected)
- Think: water!

- Color

- Darker colors = more insolation absorbed (i.e. dirt)
- Lighter colors = more insolation reflected (i.e. ice, snow)

What Influences the Absorption and Reflection of Insolation?

- **Factor 3. Interactions with Earth's Materials and Living Things**
 - When energy from insolation causes water to change state (i.e. melt, evaporate) OR affects plant growth, it is NOT available to raise the temperature of Earth's surface

What Influences the Absorption and Reflection of Insolation?

- **Factor 4. Duration**

- The amount of insolation received changes with the length of the day
 - Longer day = more insolation received
 - Shorter day = less insolation received

Challenge Question

In NYS, during which season is the length of the day the longest?

Summer!

Thermal Energy (a.k.a. Heat)

Internal energy of a substance due to the vibration of atoms and molecules making up the substance

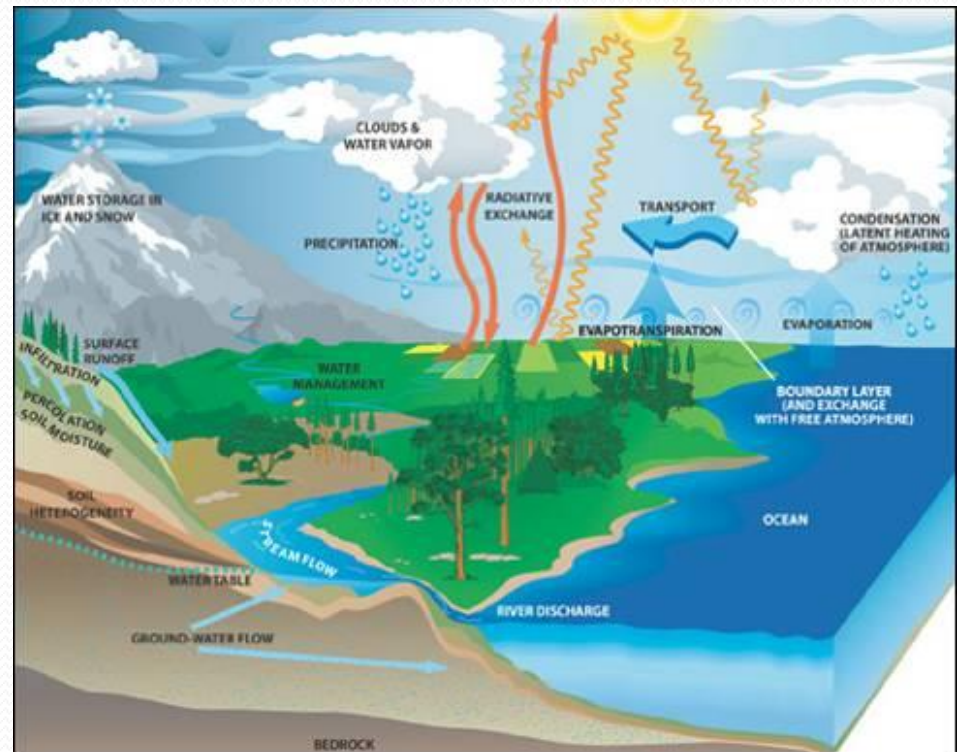
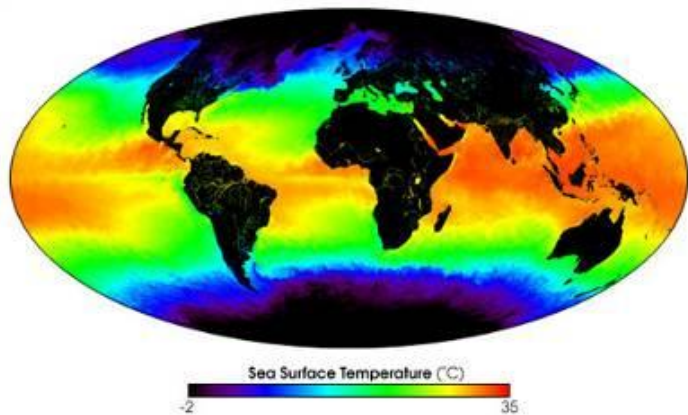


Sunlight is absorbed by Earth

- The Sun does NOT send “heat rays” into space. Some of its light is infrared, but that is not the same thing as heat.
- The Sun’s light is absorbed by Earth (clouds, plants, oceans, rock...)
- By absorbing the light, we are transforming it into heat energy

Sun as a Source of Energy

- Light from the Sun is absorbed by the Earth, unevenly to:
 - drive wind bands – which drive surface currents
 - drive deep ocean currents
 - drive water cycle
 - drive weather

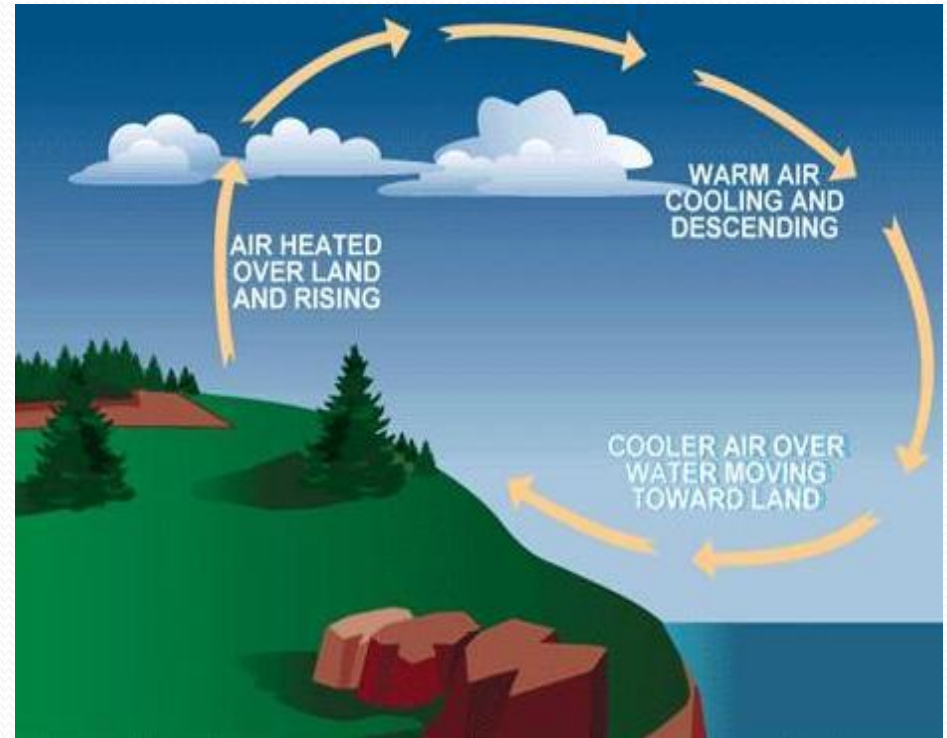


Energy for Earth...

Conduction is...

the transfer of energy that occurs when molecules collide

- i. The air molecules above Earth's surface are warmed by the process of **conduction**.
- ii. Energy moves from your hand to your desk. Why?

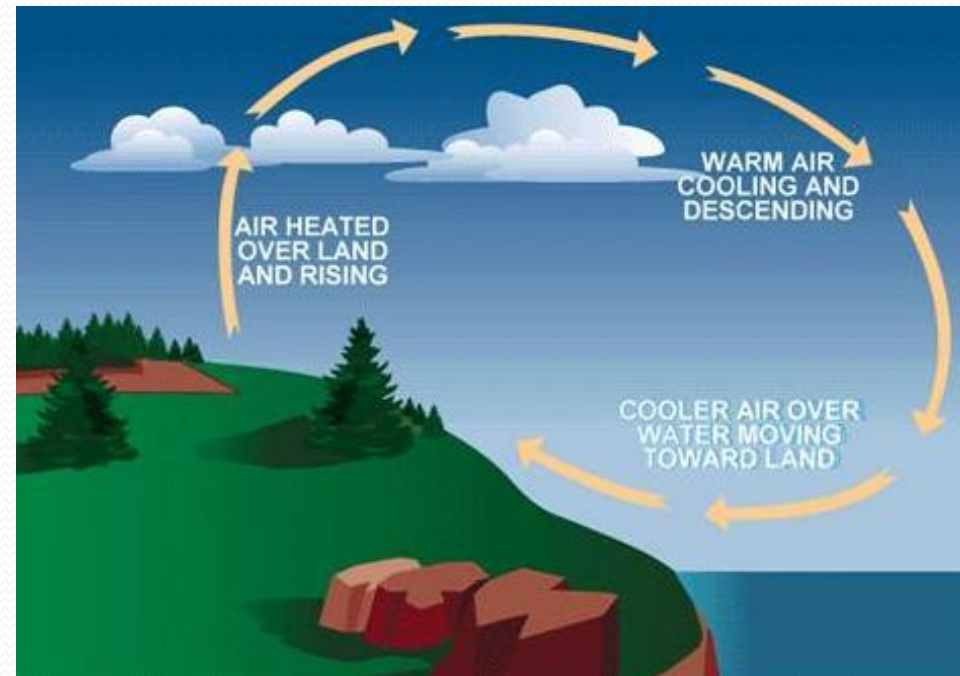


Energy for Earth...

Convection is...

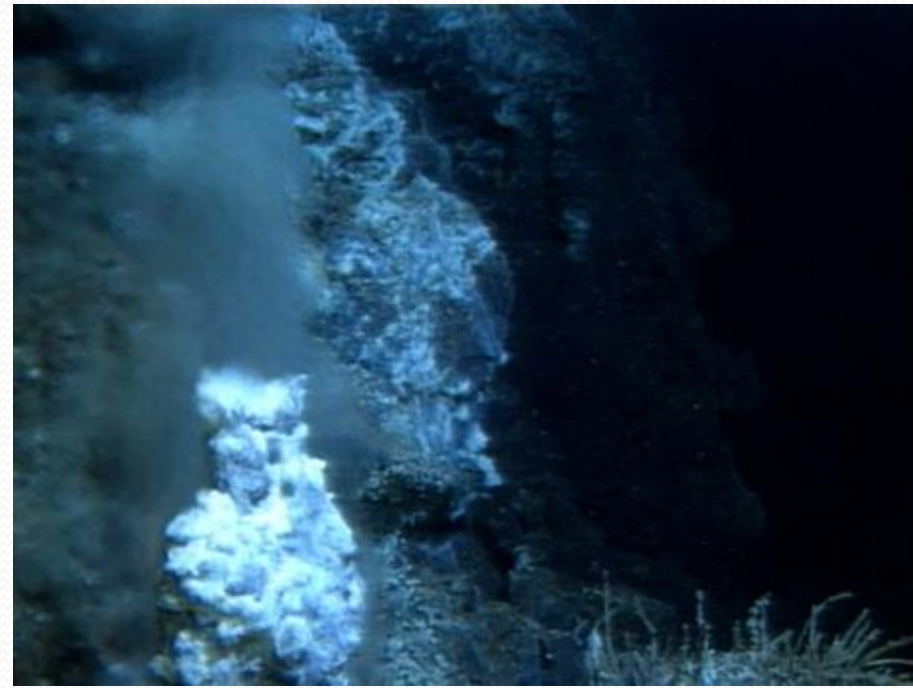
- the transfer of energy by the flow of a heated substance
 - i. Warm air rises.
 - ii. When the warm air gets high enough, it cools and sinks.
 - iii. This creates a convection current.

Draw this diagram in your notes ↓



Sun as a Source of Energy

- Plants need light for photosynthesis
- Without its heat, the only inhabitable areas on Earth would be near volcanic vents



Energy for Photosynthesis...

- a. During photosynthesis, solar energy is transformed into chemical energy.
- b. This occurs in plants, algae and some bacteria.
- c. For this to occur, there must be water, CO₂, and sunlight.
- d. In plants, this occurs in chloroplasts.

