

HOW DID IT ALL BEGIN? (THEORY)

A.) 13 BILLION YEARS AGO, A TINY DENSE (HEAVY) FIREBALL EXPLODED.

B.) THE GAS FROM THE EXPLOSION (HYDROGEN AND HELIUM) AND THE PARTICLES LEFT BEHIND WERE PULLED TOGETHER BY GRAVITY.

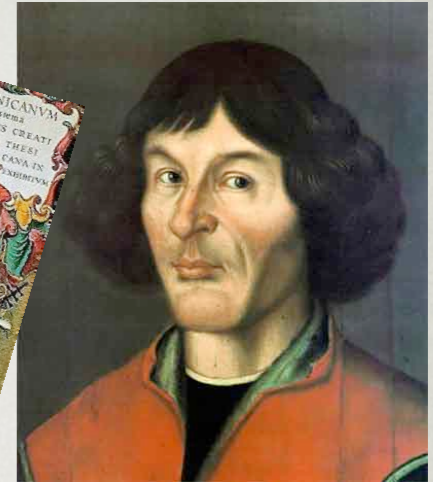
C.) WITH THE STRENGTH OF GRAVITY THE GASSES AND PARTICLES FORMED PLANETS, GALAXIES AND US.

D.) THIS IDEA IS CALLED THE “BIG BANG THEORY.”

A STUDENT IS CONSTRUCTING A PROJECT ON PLANETS IN OTHER SOLAR SYSTEMS. SHE LEARNS ABOUT A PLANET CALLED PLANET Z. THIS PLANET IS VERY LARGE AND HAS A THICK ATMOSPHERE. IN ADDITION, PLANET Z HAS A LOW DENSITY. WHICH PLANET IS PLANET Z MOST SIMILAR TO AND WHY ?

A. EARTH B. MARS C. MERCURY D. SATURN

MORE SCIENTIFIC THEORIES



- A.) **Geo**centric: - (*Geo = Earth*) In this model the Earth is at the center of the solar system with the Sun and planets revolving around it.
- B.) This model was developed by Ptolemy who lived in Egypt in 145A.D.
- C.) **Helio**centric - (*Helio = Sun*) In this model the Sun is at the center of the solar system with all the planets revolving (*orbit = path*) around it.
- D.) This model was developed by Nicolaus Copernicus in 1543 A.D.
- *Interesting Fact: Our solar system is 7 billion miles wide. Even in the fastest transportation, it would take 10 years to cross.*

GRAVITY

- a.) Gravity-- the force that keeps all planets in orbit and you on the ground.
- b.) The bigger the object and the closer two objects are, the greater the gravitational attraction between them.

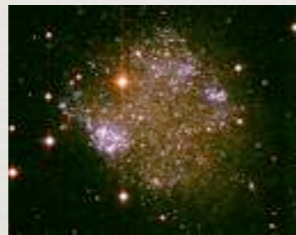
GALAXIES

- a.) Possibly up to 100 billion galaxies exist in the Universe.

- b.) Types of galaxies include:



- Spiral
- Elliptical
- Irregular



c.) Our galaxy is known as the Milky Way.

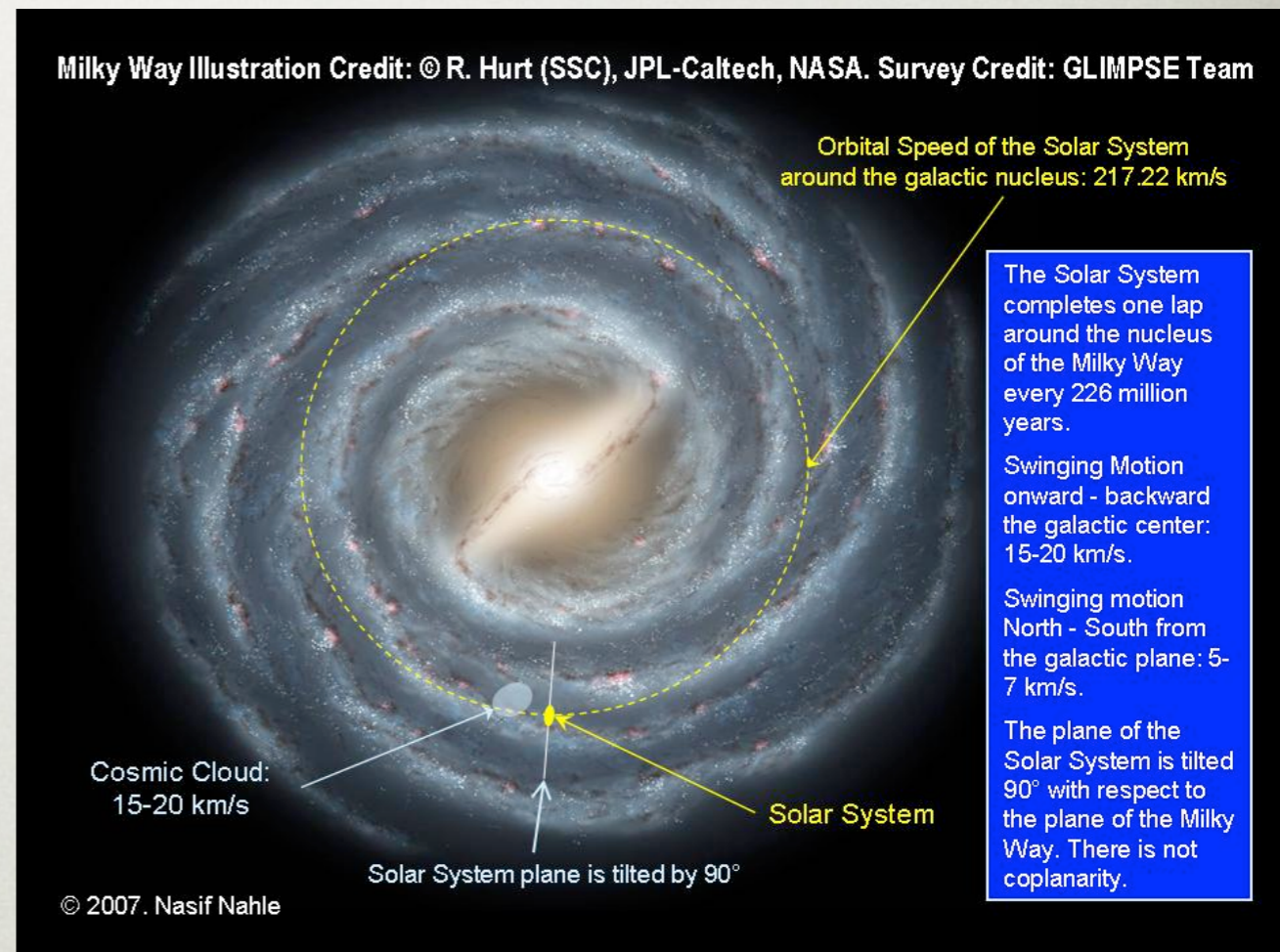
d.) The Milky Way consists of 200 billion stars.

e.) Our solar system exists at the edge of our spiral galaxy.

f.) Our solar system is thirty-thousand light years from the center of our galaxy.

g.) Traveling 500 miles per hour, it would take 1 million years to travel 1 light year.

h.) The Sun travels at 600 thousand miles per hour. It takes the Sun 225 million years to complete one revolution around our galaxy.



WHAT DO WE SEE IN THE NIGHT SKY?

a.) Stars:

- These huge globes of hot gasses create their own light. As a result, they appear to twinkle.

b.) Planets:

- These large objects circle a star and reflect the light **produced by the star. As a result, they shine steadily.**



c.) Comet:

- An object made of ice, dust, gas and rock that orbits a star.

d.) Asteroid:

- A rock that orbits space. (*If it enters the Earth's atmosphere, it is called a meteor.*)





THE MOON

A.) **Also known as a satellite of Earth.**

B.) **Produces no light of its own. (The moon is made of 60% glass particles; giving it the ability to reflect sunlight very well.)**

C.) The distance from the center of Earth to the center of the Moon is approximately 240,000 miles.

(This distance grows about one and a half inches per year.)

D.) The Moon rotates once every twenty-nine and a half days.

E.) The Moon revolves around Earth once every twenty - seven and one third days.

F.) The Moon's tilt is so minor that it does not have any seasons.

G.) The gravitational force from the Moon is responsible for tides, length of day and seasons on Earth.

H.) The Moon has a very small atmosphere called an exosphere. (small particles of gas.)

I.) Due to the Moon's slow rotation, the only hemisphere we can see from Earth is called the near side. (The far side is always turned away from Earth.)

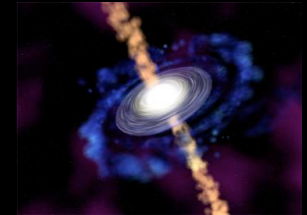
J.) It is believed the Moon formed from a “ Great Impact” with the newly formed Earth.

(4 billion years ago)

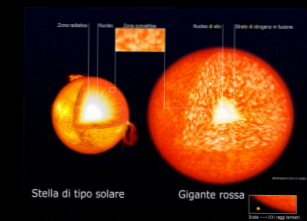
The Life Cycle of a Star



- Gas and particles in Nebulas clump together.
- Gravity causes the clumps to condense to form a Protostar.
- As the Protostar condenses it becomes very hot.
- When it reaches 15,000,000 degrees celsius it releases energy and begins to shine.



- It is now a star.



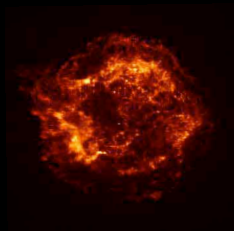
- As a star ages it expands and gives off less energy. (Red Giant)

- Quick Facts:

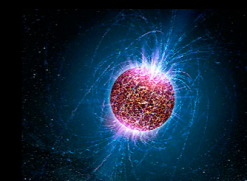
- *The strongest star will have a blue color.*



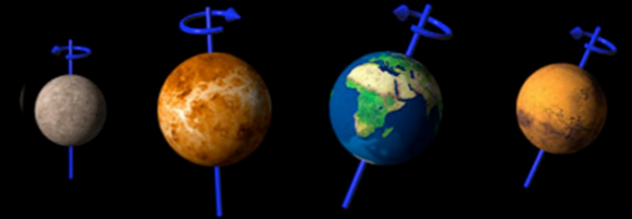
- *Supernova: an explosion of a massive star which can result in a neutron star or a black hole.*



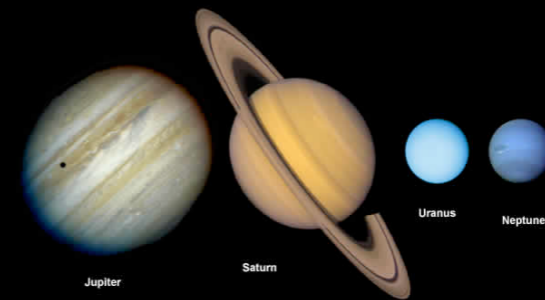
- *The fuel in a star is hydrogen.*



The Planets



- a.) The inner planets consist of Mercury, Venus, Earth and Mars.
- b.) These planets are also known as *terrestrial planets*. (**Terrestrial = land**)
- c.) The Outer Planets consist of Jupiter, Saturn, Uranus and Neptune.
- d.) These planets are called *Gas Giants* because of their large atmosphere and small amounts of land.



- e.) IN OUR SOLAR SYSTEM THERE IS ONLY **ONE** STAR KNOWN AS THE **SUN**.

Planets and Their Names

- *All planets, except for Earth, are named after Greek and Roman gods.*
- a.) Mercury - Messenger to the gods. (*Speedy Revolution.*) (*Son of Jupiter.*)
- b.) Venus - Goddess of beauty. (*Bright*)
- c.) Earth - Comes from the German word “erde” which means ground.
- d.) Mars - God of war. (*Red = Blood*)
- e.) Jupiter - Ruler of all gods. (*Size*) (*Son of Saturn.*)
- f.) Saturn - God of agriculture and harvest. (*Slow Revolution*)
- g.) Uranus - God of the heavens.
- h.) Neptune - God of the sea. (*color*)

Optional Challenge: Your Weight in Our Solar System

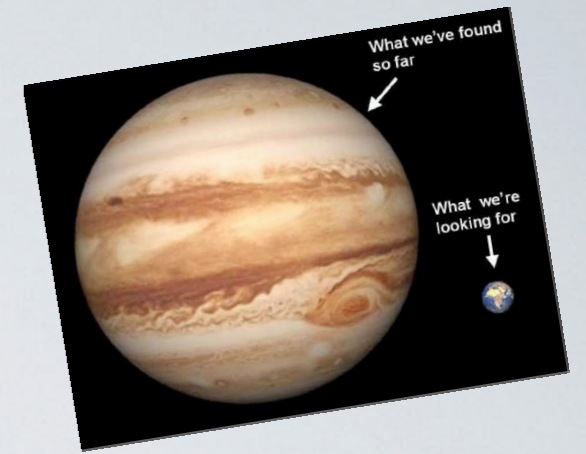
Multiply your weight by the gravitational force of the object.

▶ <i>Object</i>	<i>Gravitational Force</i>
▶ Mercury	0.4
▶ Venus	0.9
▶ Moon	0.17
▶ Mars	0.4
▶ Jupiter	2.5
▶ Saturn	1.1
▶ Uranus	0.8
▶ Neptune	1.2
▶ Pluto	.01
▶ Sun	28

INNER PLANET FACTS

- a.) Sun - 870,000 miles in diameter. / Earth - 7,926 miles in diameter.
- b.) In six billion years the Sun will use up all of its energy (hydrogen).
- c.) Mercury - smaller than Jupiter's largest moon.
 - 1 year = 88 days (revolution)
 - 59 Earth days = 1 day on Mercury (rotation)
 - Temperature : 806 degrees F during the day ; - 297 degrees F at night.
- d.) Venus - 80% of this planet is covered in lava flows. (*430 volcanoes that are 12 miles or bigger / thousands of smaller ones.*)
- e.) Mars - this planet is half the size of Earth. (687 days to revolve ; 24.6 hours to rotate)
- f.) Earth - rotation = 24 hours revolution/orbit = 365 days

Outer Planet Facts



a.) **Jupiter** - 11.86 years to revolve and 9.9 hours to rotate.

-- 1,500 Earths could fit in this planet.

-- at least 16 moons.

-- 1 very large storm known as the Great Red Spot. (larger across than Earth.)

b.) **Saturn** - 10.5 hours to rotate and 29.5 years to revolve.

-- this planet is less dense than water. (It would float!)

-- at least 18 satellites (*moons*).

c.) **Uranus** - 17.2 hours to rotate and 84 years to revolve.

-- rotates on its side because of a collision with another object early in its existence.

d.) **Neptune** - 17.2 hours to rotate and 164 years to revolve.

-- storm called the Great Dark Spot; winds = 1,200 mph.

e.) ? **Pluto** - 248 years to revolve and 6.4 days to rotate.

-- smaller than 7 moons.

***** Remember :**

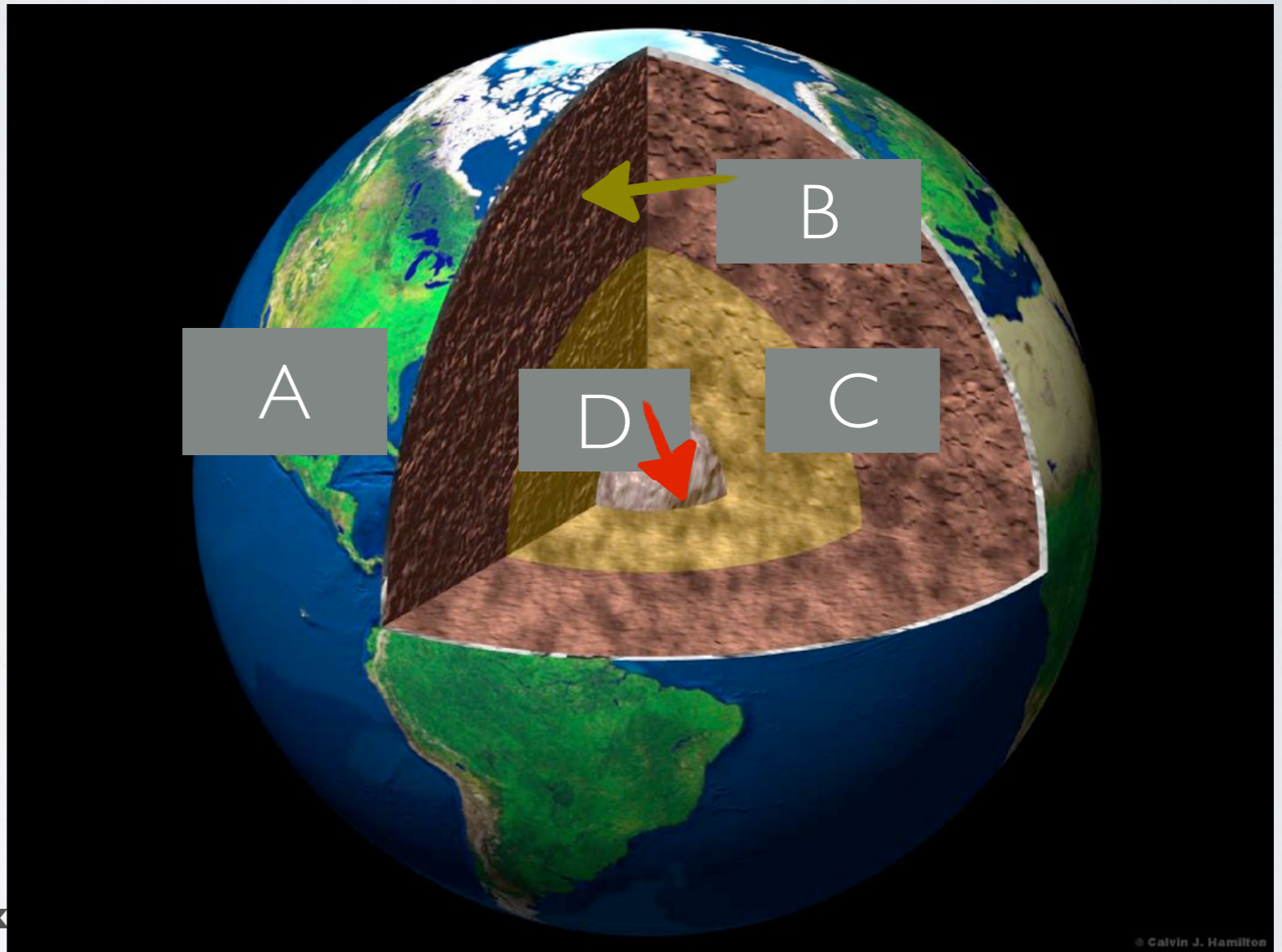
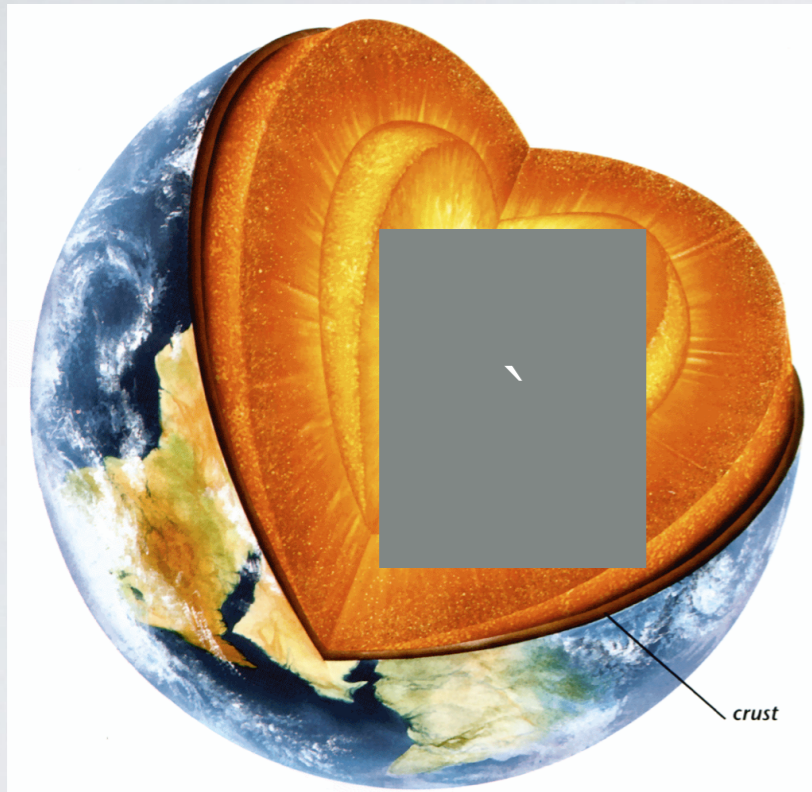
100 billion galaxies exist in our Universe.

In the Milky Way - 200 billion stars

In our solar system - 1 star known as the Sun.

Orbit: path of revolution

DISSECTING EARTH



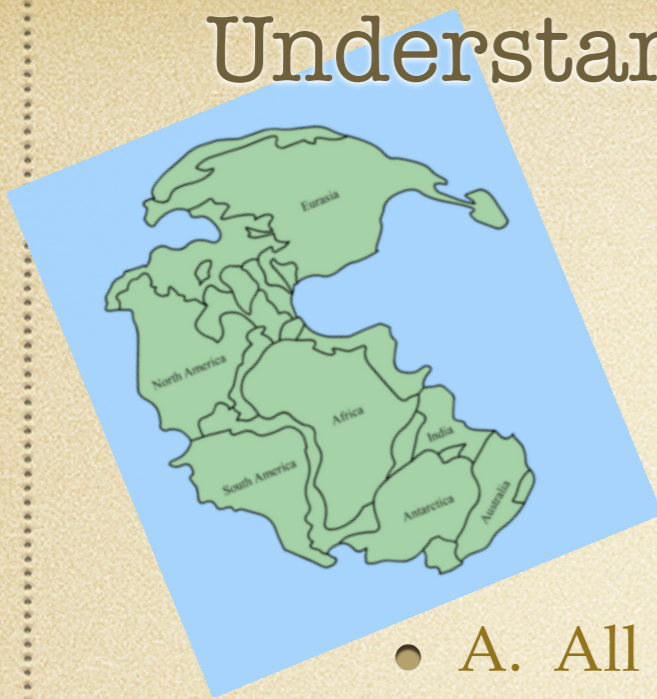
- **A.) Crust-- made of rock.**
- **B.) Mantle -- made of molten rock**
- **C.) Outer Core -- made of liquid nickel and iron.**
- **D.) Inner Core -- made of solid nickel and iron.**

I. Let's Get to Know the Earth Better.



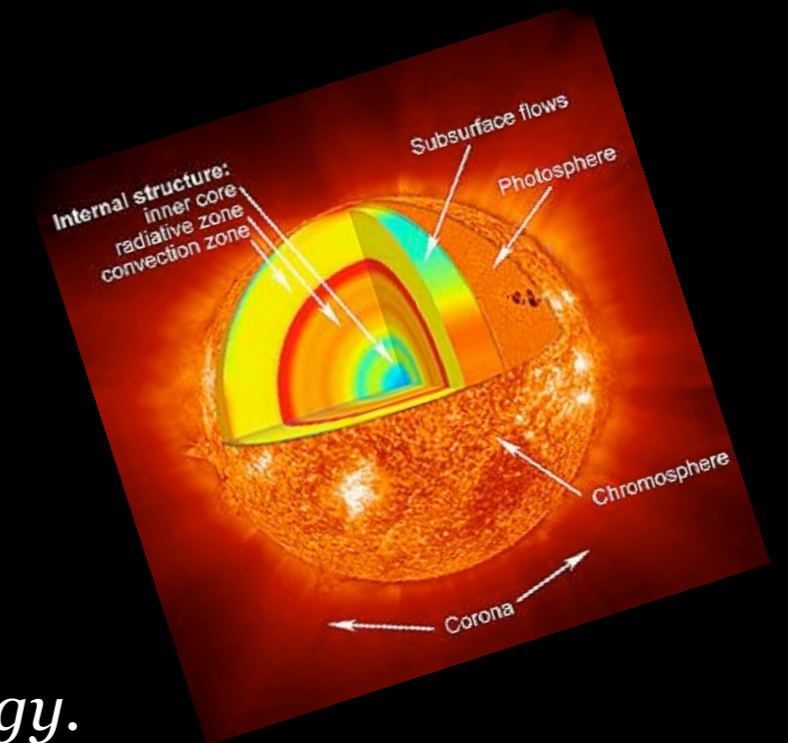
- A. The Earth is made of four different spheres.
- B. Each sphere has its own role and function.
- C. Each sphere has an impact on one another.
- D. The four different spheres consist of the following:
 - Atmosphere -- Air
 - Biosphere -- Life
 - Hydrosphere -- Water
 - Lithosphere -- Land

Understanding the History of the Lithosphere



- A. All the continents sit on plates, or *molten rock*, which move each year; this movement is called Plate Tectonics.
- B. Pangaea- the term given to the point in Earth's history when all the continents were one giant landmass.
- C. Converging Plates - when plates move towards one another.
- D. Diverging Plates - when plates move away from one another.
- E. Subduction Zones - a region where two plates converge. The heavier plate slides below a lighter plate and moves further into the Earth's mantle.
- F. Depending on who you speak to; there are between 8 - 14 major plates and many smaller plates that divide the lithosphere.

The Sun



A. **Corona** : *The upper atmosphere.*

B. **Radiative Zone**: **9,000,000°F.**

Where gamma rays are converted to less harmful forms of energy.

It takes millions of years for this energy to rise to the surface; the energy we feel today, was created when Homo Erectus (Early Humans) roamed the Earth.

C. **Core**: **18,000,000 ° F.**

Extremely hot gasses explode turning hydrogen to helium.

Gamma Rays are formed and rise to the Radiative Zone.

D. **Photosphere**: *The surface of the Sun; from here energy spreads through space.*

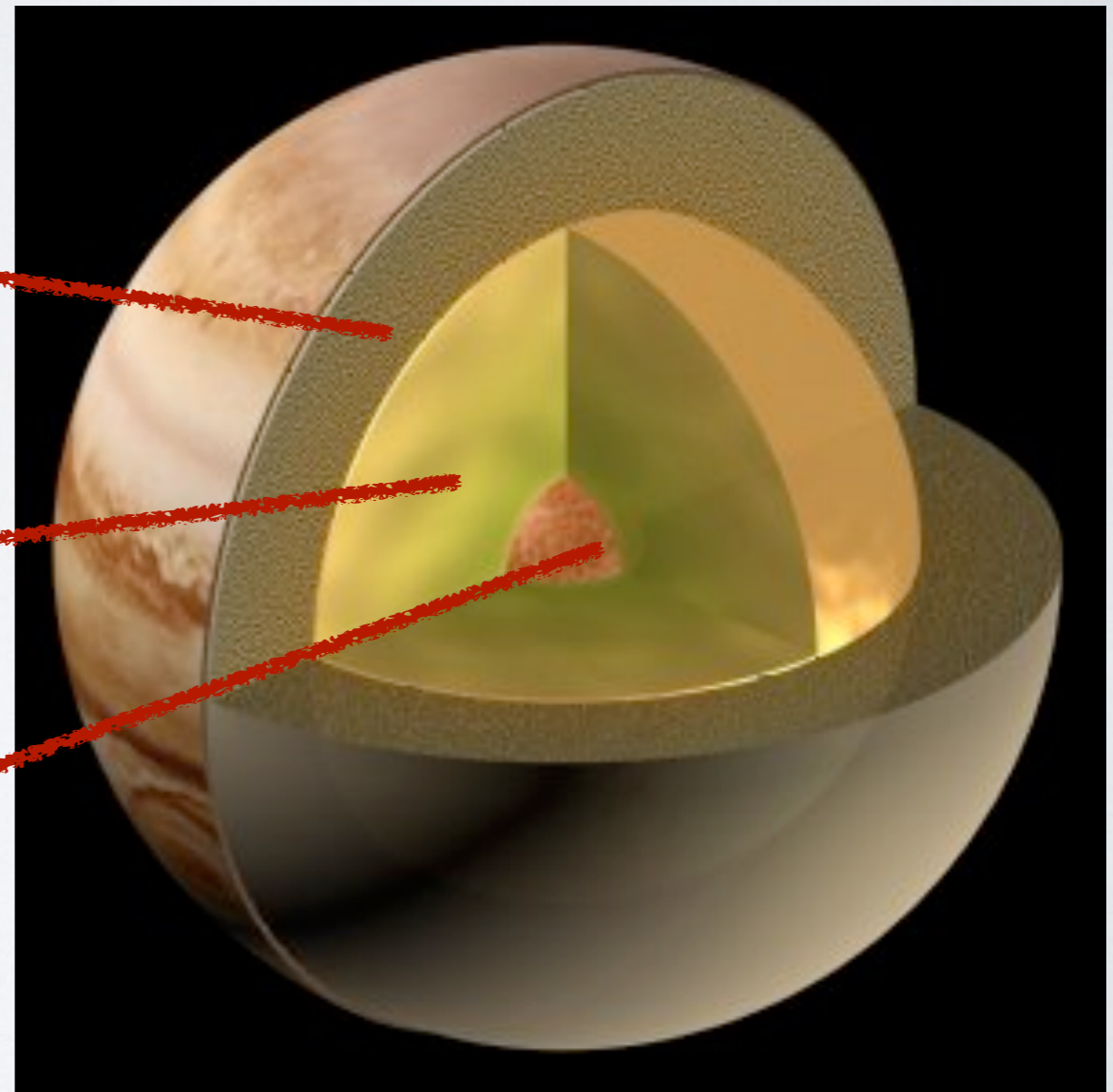
E. **Chromosphere**: *The Sun's atmosphere.*

F. **Solar Flares**: *Blasts of burning gas that shoot millions of miles into space.*

G. **Sunspots**: *Cooler portions of the Sun.*

DISSECTING JUPITER

- a.) **Liquid hydrogen** --
heat and pressure turn the gas into a liquid.
- b.) **Metallic hydrogen** --
the liquid is so thick it acts like molten metal.
- c.) **Core** -- *extremely tiny compared to the other layers.*



Solstice and Equinox

The Earth's axis tilt is 23.5 degrees.

- **a.) Solstice :**

- **takes place twice a year; June 21st and December 21st.**

- **during these two days the Sun shines directly on either the Tropic of Cancer or the Tropic of Capricorn.**

- ***(determined by the tilt of the Earth's axis.)***

- **as a result, June 21st would be our longest amount of daylight, while December 21st would be our shortest amount of daylight.**

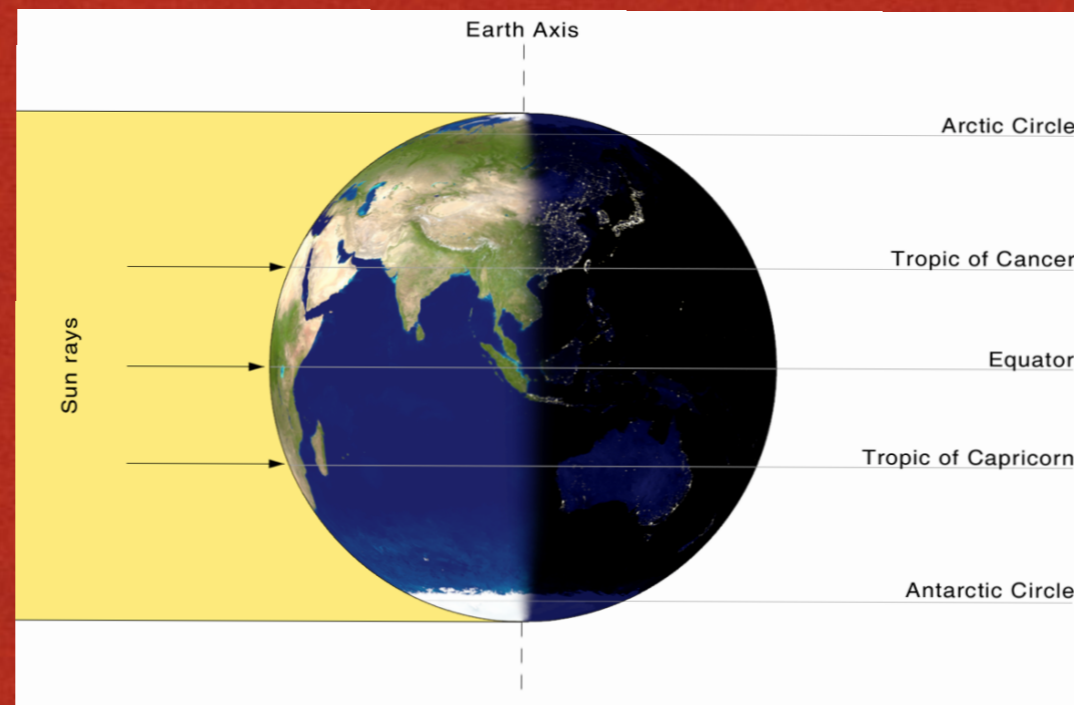
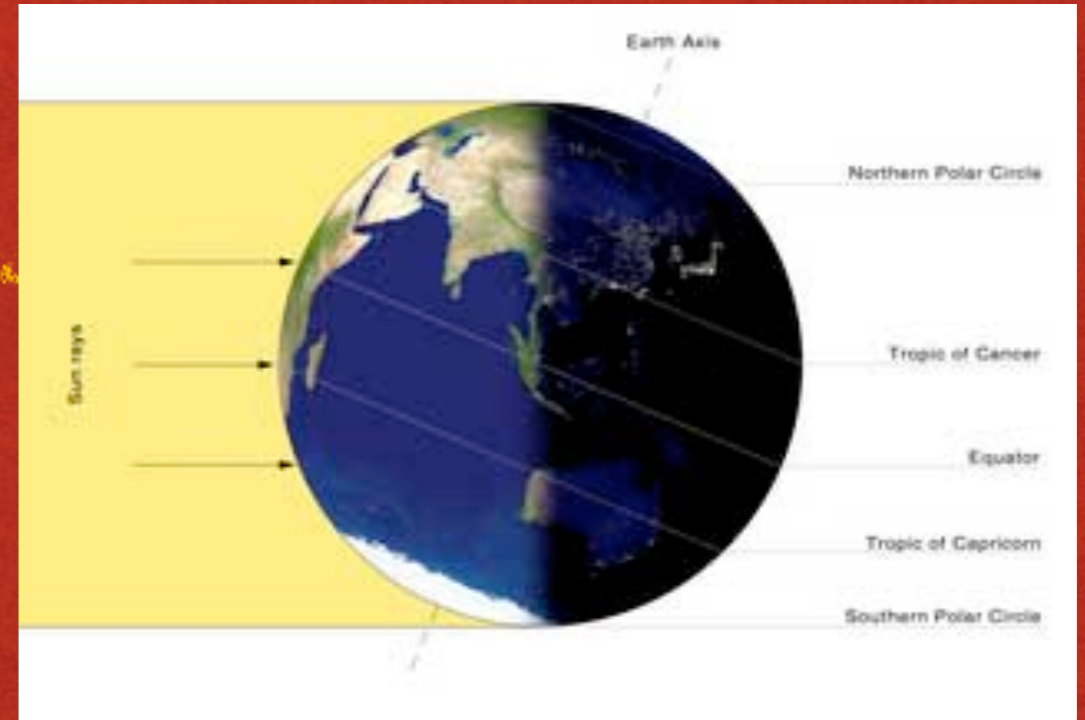
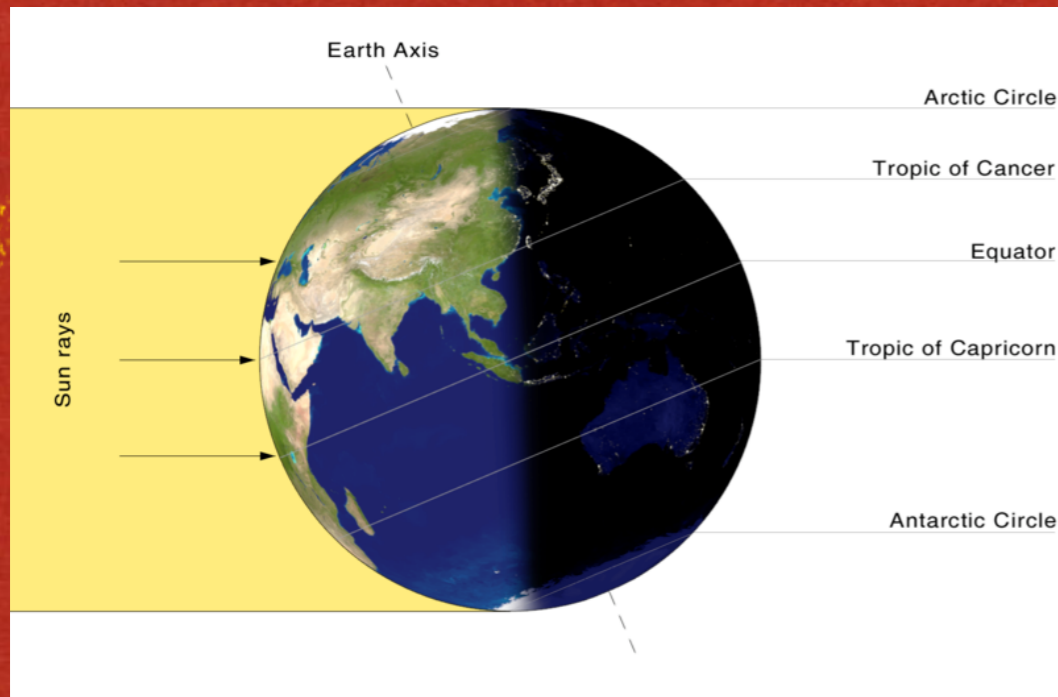
- **b.) Equinox :**

- **takes place twice a year; approximately March 20th and September 22nd.**

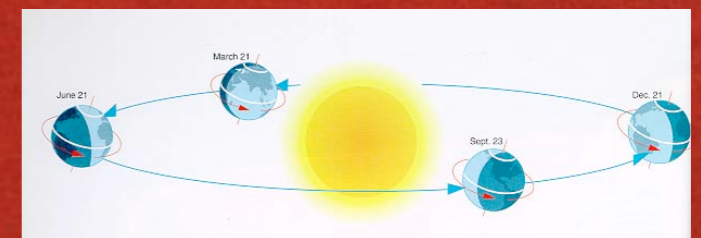
- **during these two days the Sun shines directly on the Equator.**

- ***(determined by the straight position of the Earth relative to the Sun.) Creating Spring and Fall.***

SOLSTICE AND EQUINOX



<http://www.brainpop.com/science/earthsystem/solsticeandequinox/>



Phases of the Moon



- A.) As the moon orbits Earth, we see different amounts of its sunlit side. This gives the appearance of the moon having different shapes.
- B.) There are eight general phases that we see as the moon orbits.
- C.) Key Terms:
 - *Waxing: becoming larger.*
 - *Waning: becoming smaller.*
 - *Gibbous: convex shape.*

Understanding Light and Sound to Understand the Biosphere

- a. Energy is the ability to do work or cause a change in matter.
- b. Matter is anything that takes up space.
- c. The Sun supplies almost all of the Earth's natural light energy.
- d. Electromagnetic Radiation: *energy from the Sun.*
- e. E-M Radiation travels to the Earth through the vacuum of space.
- f. A vacuum (space) is an area without matter. (no air)
- g. Types of E-M Radiation include: *(Most types are invisible.)*

Visible Light -- you can see.

Infrared -- makes you warm.

Ultraviolet -- known as U.V. rays can burn your skin.

E-M radiation can change matter and start chemical reactions:

example: warming the oceans and starting chemical reactions like photosynthesis.

Understanding Light Understand the Biosphere

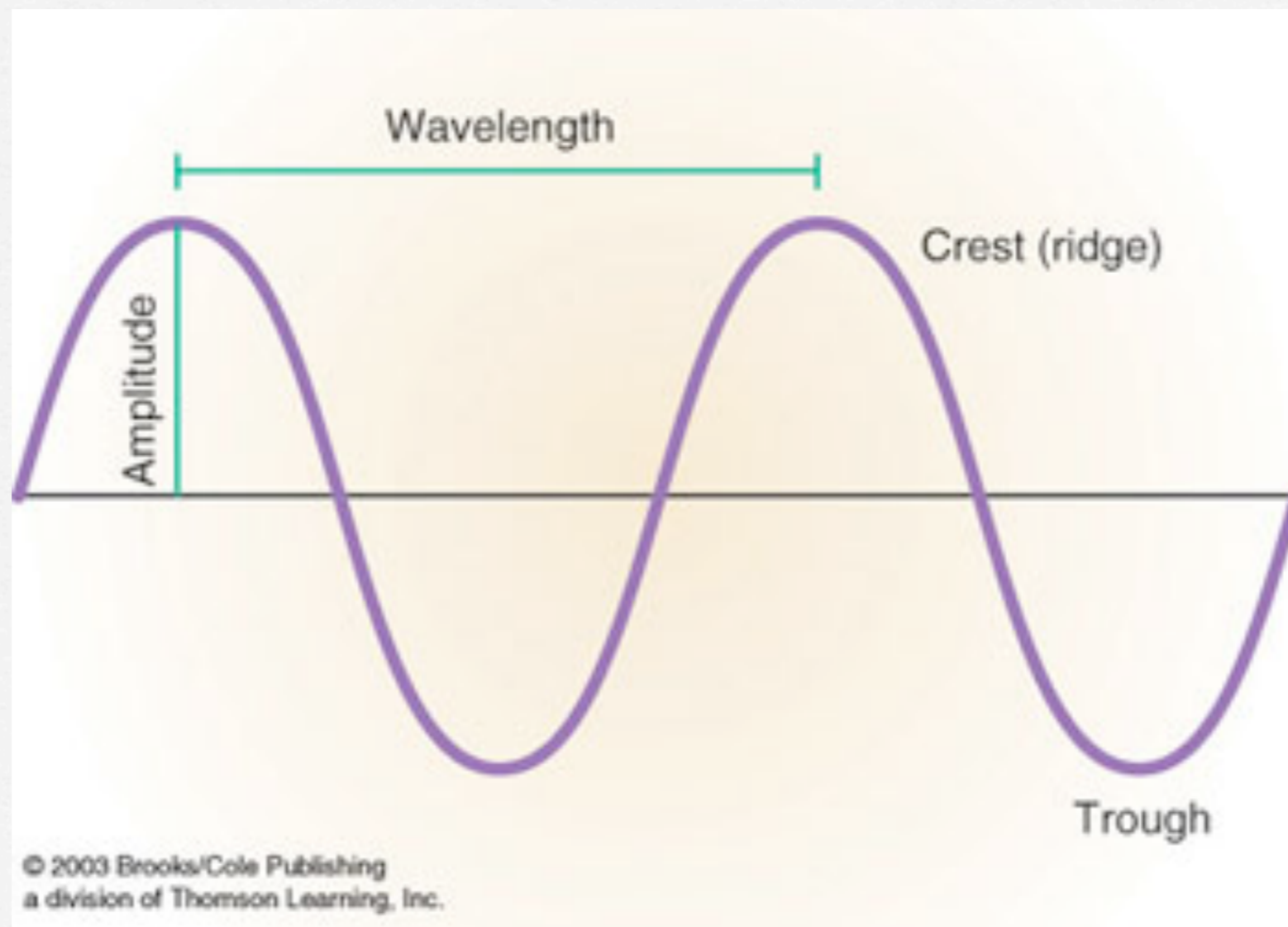
Light is the result of electrons moving between defined energy levels in an atom, called shells. When something excites an atom, such as a collision with another atom or a chemical electron, an electron may absorb the energy, boosting it up to a higher-level shell. The boost is short-lived, however, and the electron immediately falls back down to the lower level, emitting its extra energy in the form of an electromagnetic energy packet called a photon. The wavelength of the photon depends on the distance of the electron's fall. Some wavelengths, such as radio waves, are invisible. Photons with wavelengths in the visible spectrum form all the colors that we can see.

Excerpted from: <https://www.howitworksdaily.com/how-do-atoms-emit-light/>

Light as a Wave

- a. Wave - a disturbance that moves away from its starting point.
- b. Wavelength - the distance from one crest to the next.
 - color is determined by wavelength.
 - the shorter the wavelength the more powerful the wave.
- c. Frequency - the number of waves produced each second.
- d. Hertz - the unit used to measure frequency.
- e. Light waves belong to the electromagnetic spectrum.
- f. The visible light spectrum is defined by the color spectrum of R.O.Y.G. B.I.V.
- g. All light travels at 186,000 miles per second and vary in wavelength and frequency.

Structure of a Wave



Light, Eyes and Brain

When light hits our retina, it takes $1/10$ of a second for our brain to translate the image.

Types of Light

□ a. Artificial Light:

□ Incandescent Light Bulbs:

thin wire plus electricity = light

□ Fluorescent Light Bulbs:

gas plus electricity = light

□ Campfires and glow sticks use chemical reactions to produce light.

□ example: wood \longrightarrow Fire \longrightarrow light \longrightarrow warmth



Electromagnetic Spectrum

THE ELECTROMAGNETIC SPECTRUM

Penetrates
Earth
Atmosphere?



Wavelength
(meters)



10^3

10^{-2}

10^{-5}

$.5 \times 10^{-6}$

10^{-8}

10^{-10}

10^{-12}

About the size of...



Buildings



Humans



Honey Bee



Pinpoint



Protozoans



Molecules

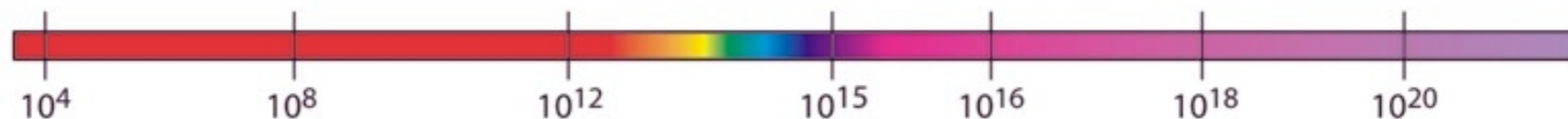


Atoms



Atomic Nuclei

Frequency
(Hz)



10^4

10^8

10^{12}

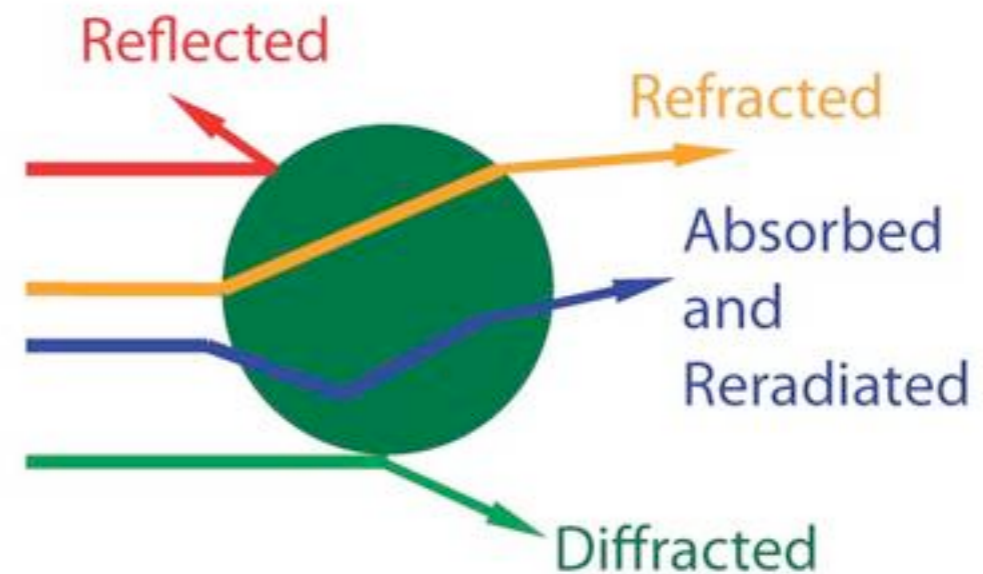
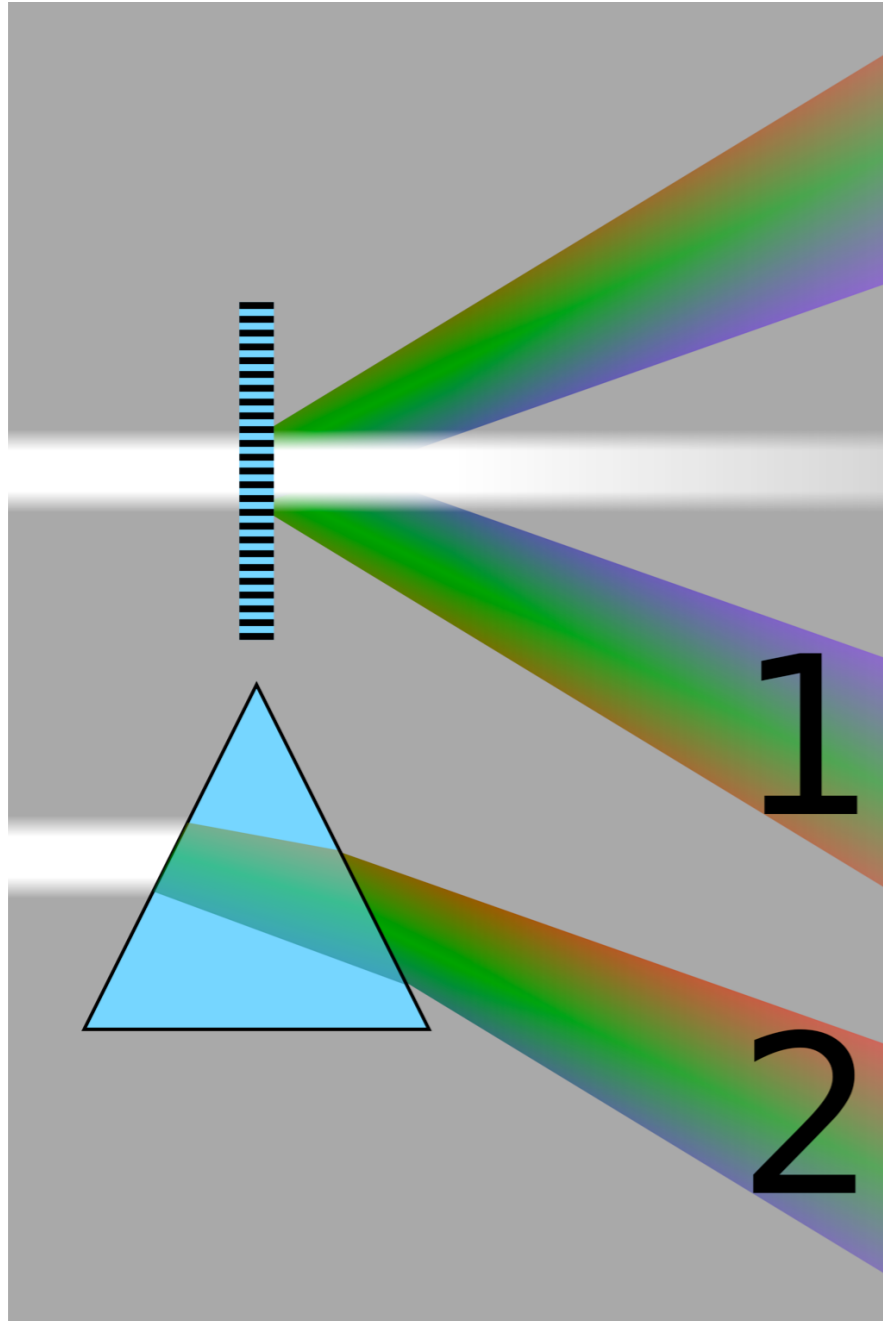
10^{15}

10^{16}

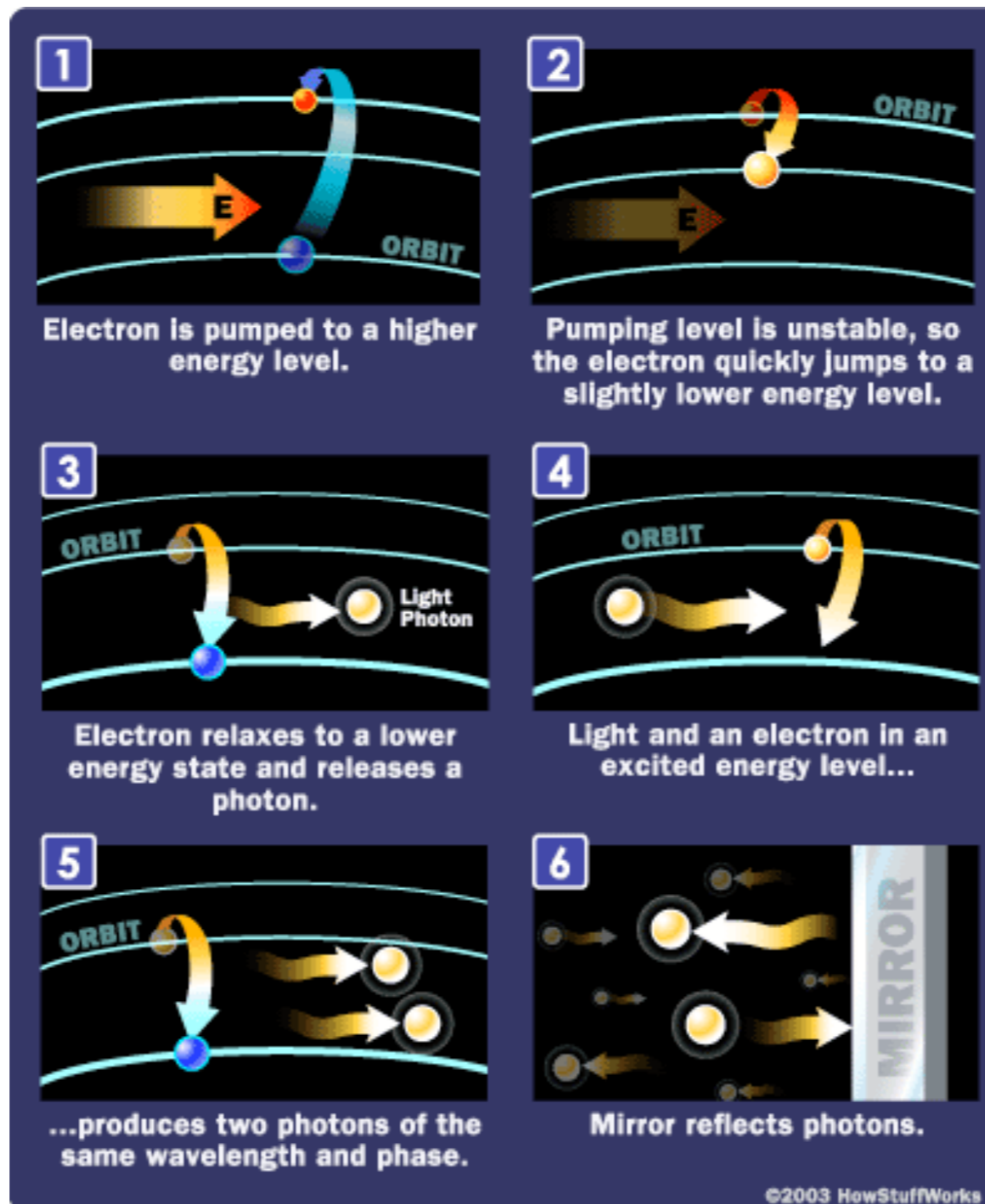
10^{18}

10^{20}

Reflection, Refraction, Diffraction



L.A.S.E.R.



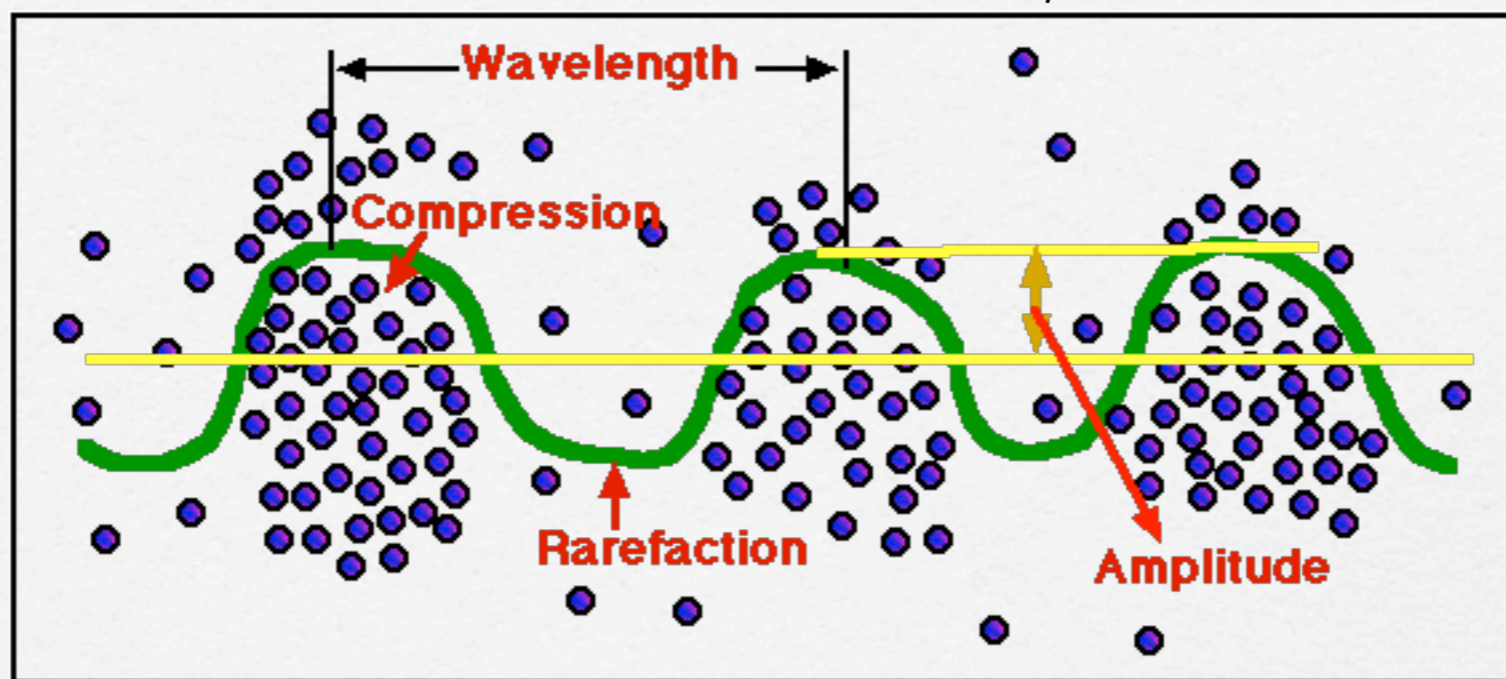
Bouncing and Bending Light

- A. Plane Mirror: flat surface.
- B. Concave : curves inward at middle.
(image larger than actual size.)
- C. Convex : curves outward at the middle. (image smaller than object.)
- D. L.A.S.E.R. (acronym)
 - Light Amplification Stimulated Emissions Radiation
 - Amplification : to make stronger
 - Emissions : release
 - Light made stronger by stimulating the molecules and releasing a form of radiation.

Sound

A form of energy that travels through matter as waves.

a. Vibrations -- the back and forth movement of matter (particles).



b. Compression -- particles have been pushed close together. (Found in the crest.)

c. Rarefaction -- area where fewer particles are located. (Found in the trough.)

Side Notes Regarding Sound

- Large Amplitude = Great amount of energy = Loud Sound
- Sound travels quicker through wood than air.
- Frequency-- the number of waves that pass through a certain point in a specific period of time.
 - Frequency is measured in Hertz.
 - Tasks:
 - Can sound travel through a vacuum ?
 - Through what material can sound travel the quickest ?
 - What spectrum can a spectroscope help you see ?
 - Find a concave and convex lens or mirror and be able to prove the items meet the definitions.