

List of Topics

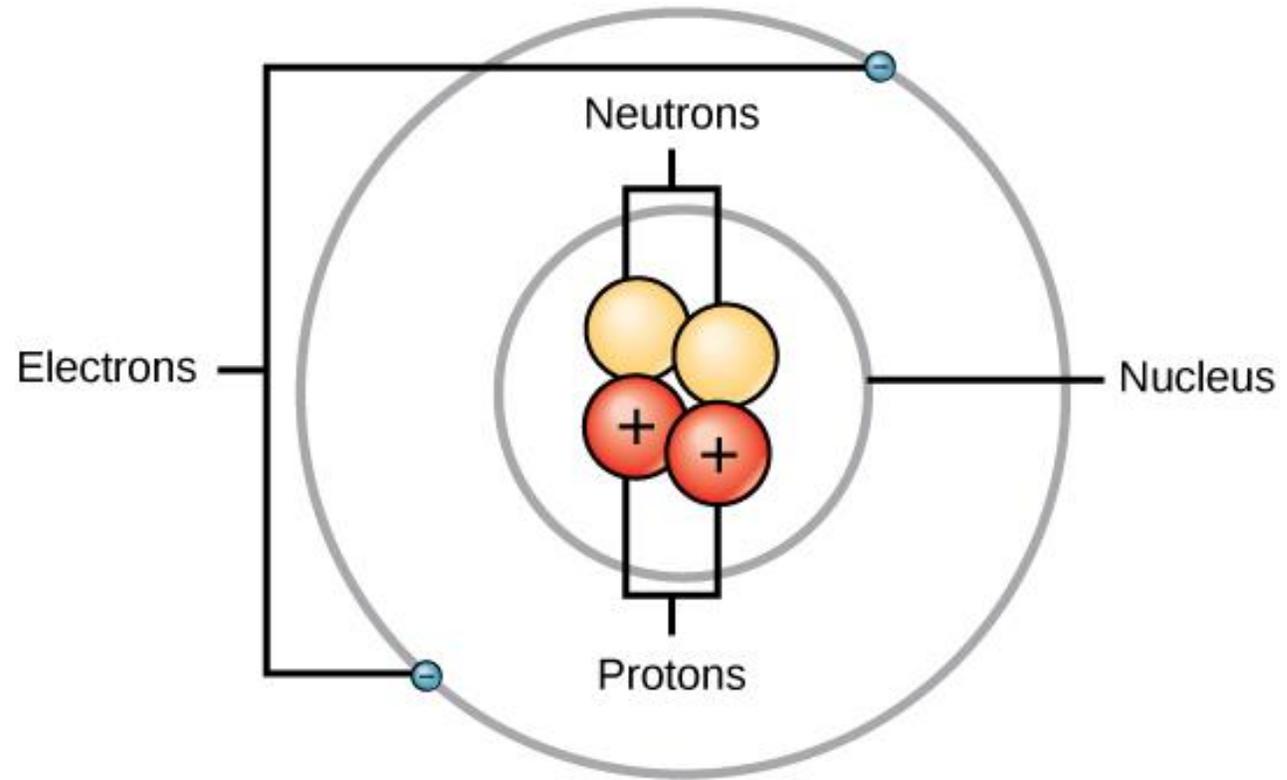
PART ONE

- Atoms, molecules, elements, mixtures, compounds
- Density
- Physical vs chemical changes
- Weathering, Erosion, Deposition (include rust)
- The Rock Cycle
- Tectonic plates, boundaries, and landform formation
- Fossil formation
- Energy (including electromagnetic waves)
- Layers of Earth
- Spheres of Earth
- Wind Patterns

PART TWO

- Effect of planetary rotation, orbit, and axial tilt
- Star types and stages
- Star characteristics
- Moon Phases
- Planet characteristics (importance of atmosphere)
- Eclipses
- Hierarchy in space and structure of the Solar System
- Gravity

Structure of the Atom



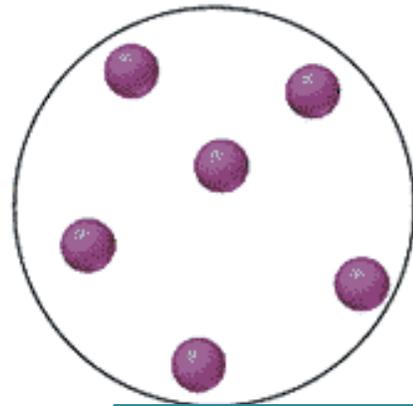
Atoms are the building blocks of all matter.

Creating Matter and Life

- Atoms combine to form **molecules**.
- There are types of atoms that are found naturally in Earth. These types of atoms are called **elements**. The different types of elements can be found on the Periodic Table of Elements.
 - Note: it is still called an element if there are two or more of the same type of atom bonded together
- When two or more different elements bond together, it is called a **compound**.
- A **mixture** is a solution that has different types of atoms and molecules in the same space: elements, single atoms, and compounds hanging out next to each other

Try it out!

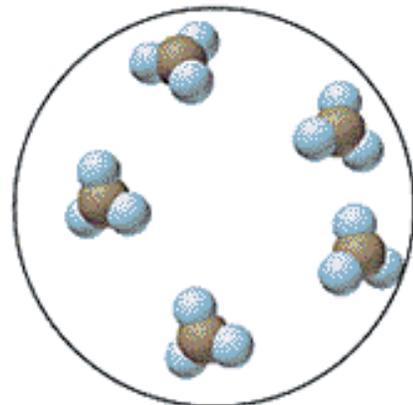
- Directions: Identify if the picture is showing an atom, a molecule of an element, a compound, or a mixture



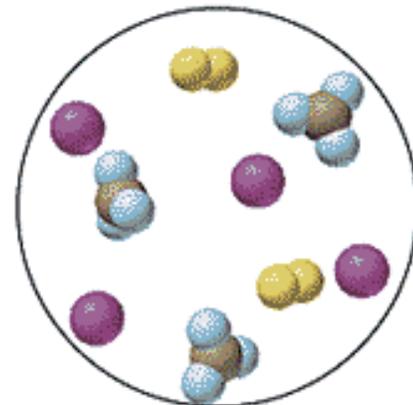
A



B

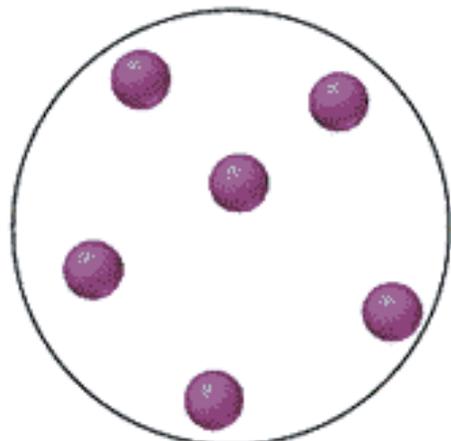


C



D

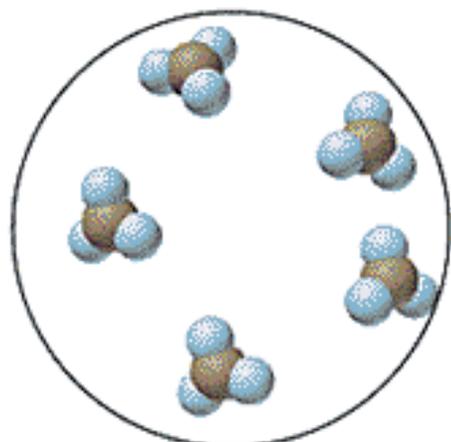
Answers



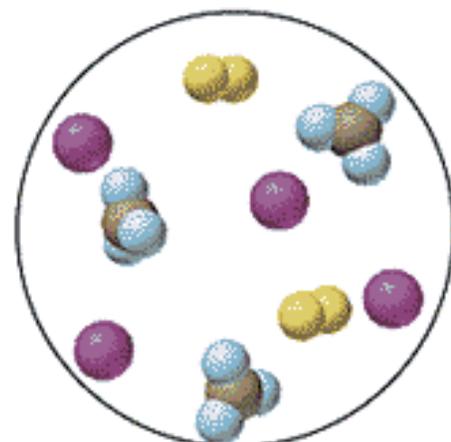
A Atoms of an element



B Molecules of an element



C Molecules of a compound



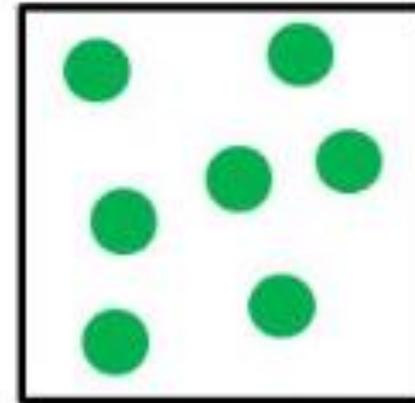
D Mixture of two elements
and a compound

Density

- **Density** a measure of how many atoms and molecules are squished into a given space.
- **Density** = $\frac{\textit{mass}}{\textit{volume}}$
- The SI unit for density is $\frac{\textit{grams}}{\textit{cm}^3}$
- Density is the principle that determines how materials move around in the Earth
 - Why does hot air rise?
 - Why does oil float on water

Try it out!

Which image shows a material with the greatest density?



Physical vs Chemical Changes

- **Physical change:** no change to how the atoms/molecules are bonded and arranged
- **Chemical change:** changes how the atoms/ molecules are bonded and arranged

EXAMPLES:

Cutting pizza into slices

Digesting food

Physical Change Examples

Physical Changes



Crushing a can



Melting an ice cube



Boiling water



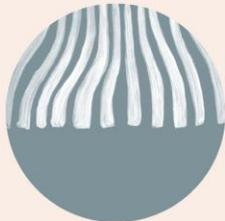
Mixing sand with water



Breaking glass



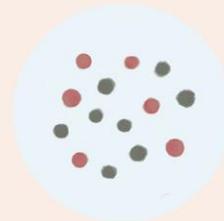
Dissolving sugar in water



Shredding paper



Chopping wood



Mixing green and red marbles



Sublimation of dry ice

ThoughtCo.

Chemical Change Examples

Chemical Changes



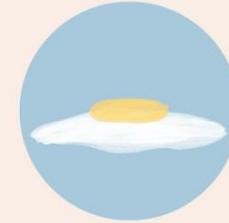
Iron Rusting



Burning Wood



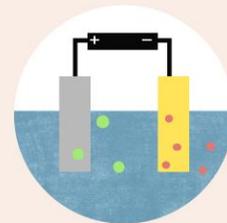
Metabolism



Cooking an Egg



Baking a Cake



Electroplating



Rotting Banana



Vinegar and Baking Soda Mixture



Fireworks



Chemical Battery

ThoughtCo.

Changes to Earth

Two main drivers of change on Earth:

- Weathering, Erosion, Deposition
- Tectonic Plate Movement

Weathering

- **Weathering**: When pieces break off (of rock, minerals, etc)
- Two types of weathering:
 - **Physical/ Mechanical Weathering**: Ice wedging, wind, moving water, animals, plants, abrasion
 - **Chemical Weathering**: acid rain, rust (oxidation of metals)

Erosion

- **Erosion**: When pieces are in the process of being moved
 - The same agents that cause weathering can also cause erosion. Make sure you read what the question is asking you!!

Deposition

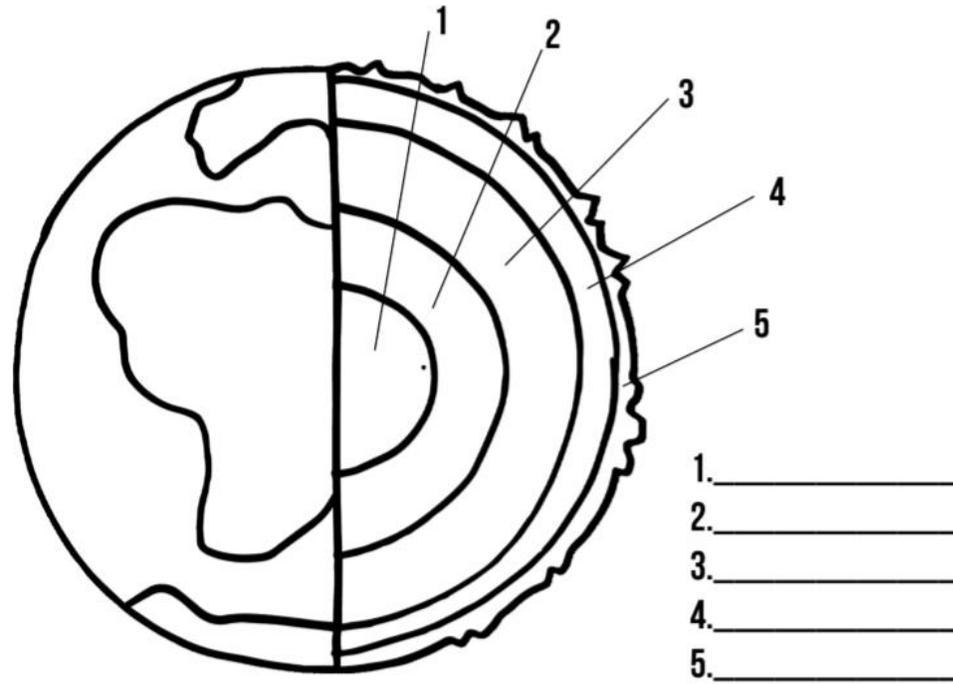
- Deposition: Pieces land in new location
 - Sediment is formed (but not sedimentary rock . . . Yet!)

Try it out!

Directions: Identify if the following examples are mechanical weathering, chemical weathering, erosion, or deposition

1. One rock falls and hits another rock which causes the rock to break
2. New pieces of shell land at the beach making more sand
3. Pebbles are carried away by a river
4. The chain of a bicycle gets stuck due to rust buildup

Layers of Earth



Where does magma come from?
What are the two types of crust?
Which crust is thicker?
Which crust is more dense?

3 Rock Types

- **Igneous:** Forms when magma cools and hardens
- **Metamorphic:** Forms from heat and pressure
- **Sedimentary:** Forms from weathering, erosion, deposition, compaction, and cementation

Igneous Rock

- Igneous rock can be classified based on where it formed, its texture, and its mineral composition
 - Intrusive Igneous rock: forms deep inside the crust (usually continental crust), which allows it to cool slowly and form big crystals, giving it a coarse-grained texture. Example: Granite
 - Extrusive Igneous rock: towards the surface of the crust (usually oceanic crust), which makes it cool quickly and form small crystals, giving it a fine-grained texture. Example: Basalt
 - Minerals give rock their color!
 - Ex. Granite is made up of lighter minerals
 - Ex. Basalt is made up of darker minerals



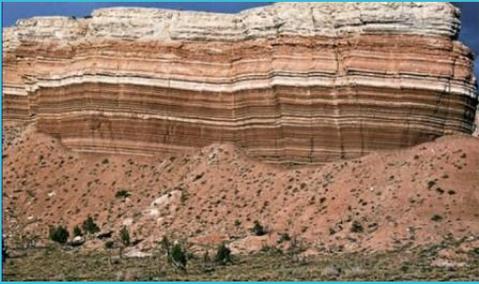
Metamorphic Rock

- Forms under extreme heat and pressure. Common example: marble
- Classified based on visible stripes called foliation
 - Foliated rock has visible layers that are created when air/space gets trapped during formation. These layers can be peeled away in big sheets by weathering and erosion. (See Gneiss, shown below on left)
 - Un-foliated has no visible layering due to no air getting trapped (See Sandstone, shown below on right)



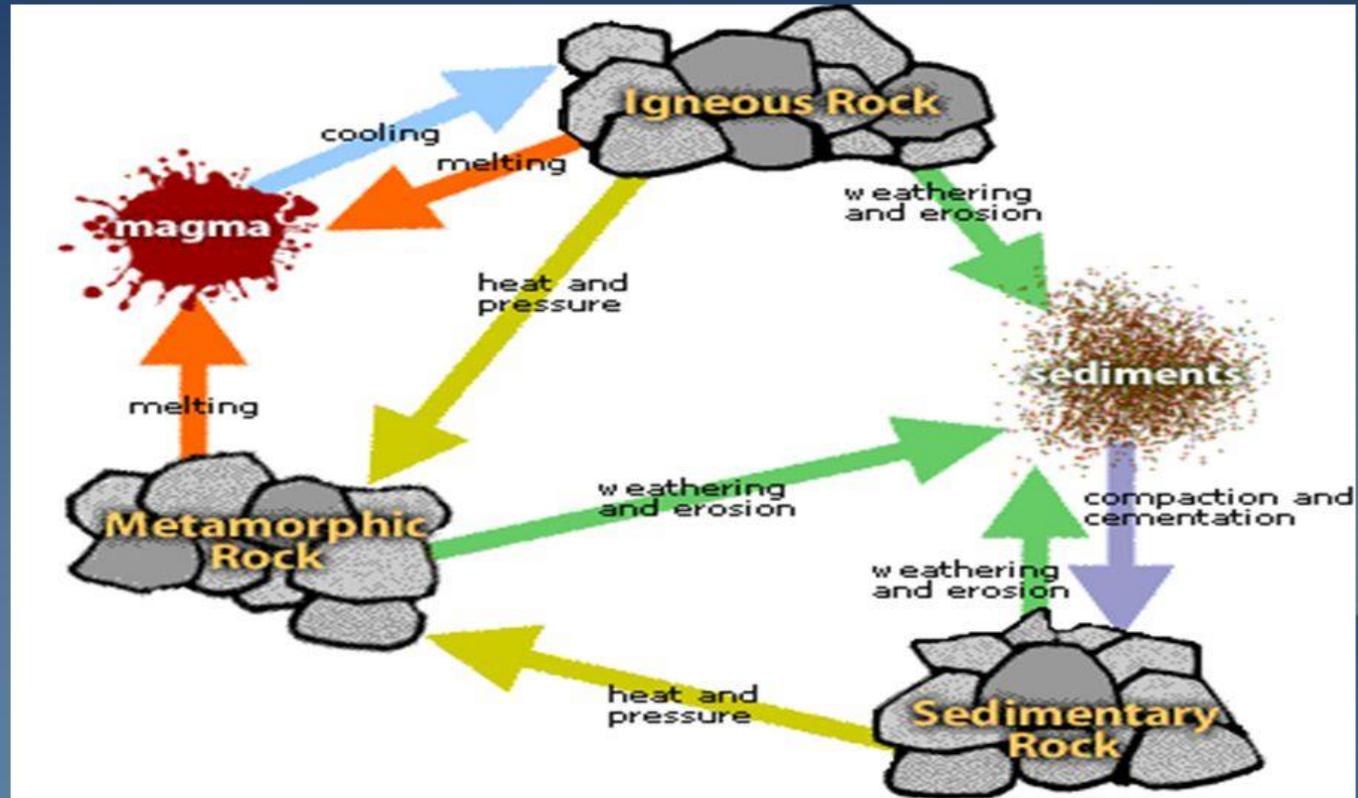
Sedimentary Rock

- Formed when sediment is compacted and cemented together (weathering, erosion, deposition -> sediment -> compaction, cementation -> sedimentary rock)
- Sedimentary rock can give the following features:
 - Stratification: layering used to tell age
 - Mud-Cracks: cracks form when water evaporates
 - Ripple marks: wind or water run over rock as it is forming
 - Concretion: one rock forms on top of another rock
 - Fossils: preserved remains of organisms



The Rock Cycle

The Rock Cycle



Try it Out!

- How does igneous rock turn into metamorphic rock?
- How does metamorphic rock turn into sedimentary rock?
- How does metamorphic rock turn into igneous rock?

Heat Transfer

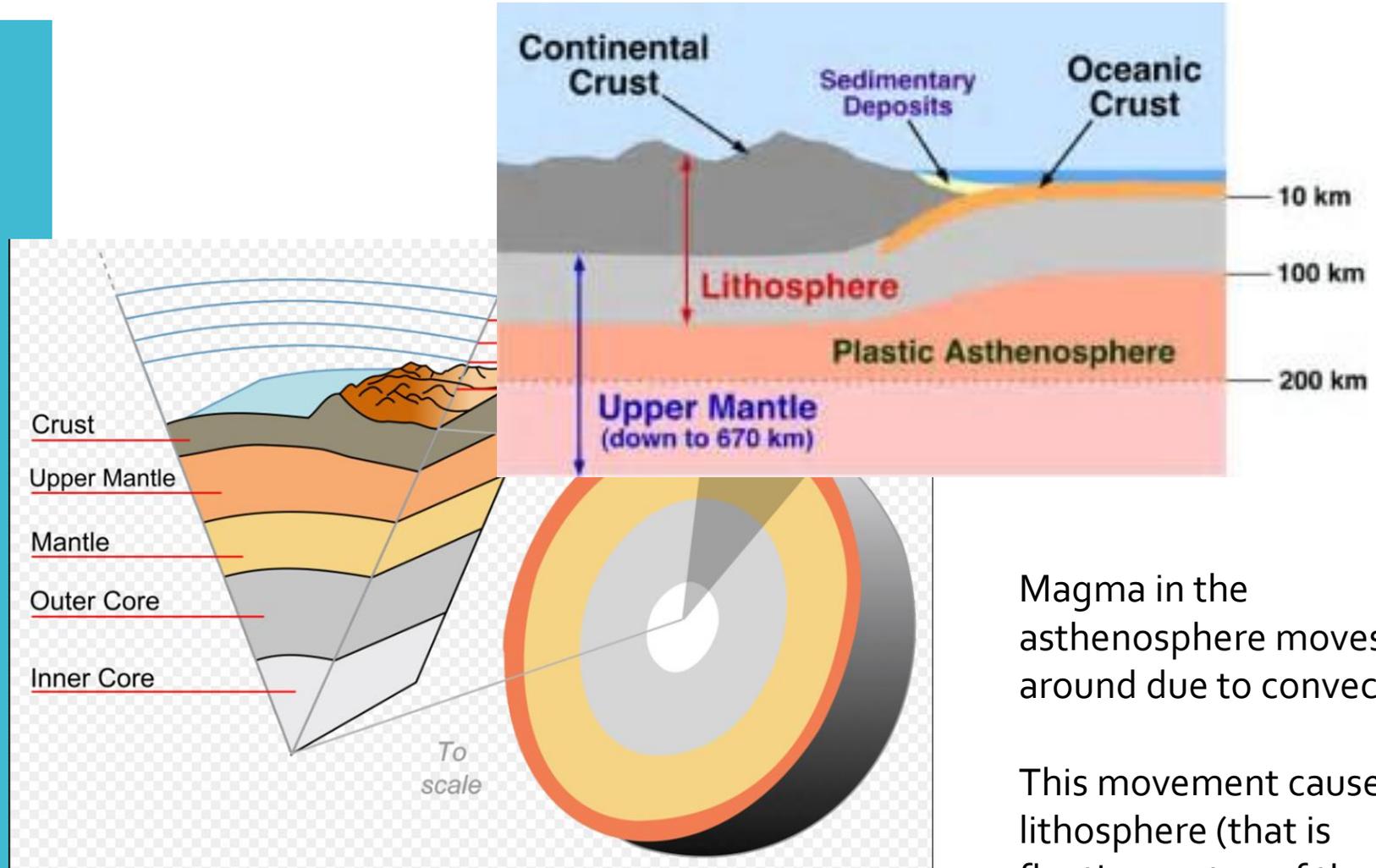
There are 3 main ways heat is transferred on Earth:

1. Radiation: heat is transferred through space
2. Convection: heat is transferred through the movement of a material (such as air or water)
3. Conduction: heat is transferred when two objects touch

Examples:

- Heaters are installed on the floor, so that as the hot air rises it warms the room
- You get a sunburn from heat from the sun
- A spoon is placed in hot coffee, and the spoon gets hot

Layers of Earth: A closer look



Magma in the asthenosphere moves around due to convection

This movement causes the lithosphere (that is floating on top of the asthenosphere) to move also

Tectonic Plates

The lithosphere is broken up into pieces called **Tectonic Plates**.

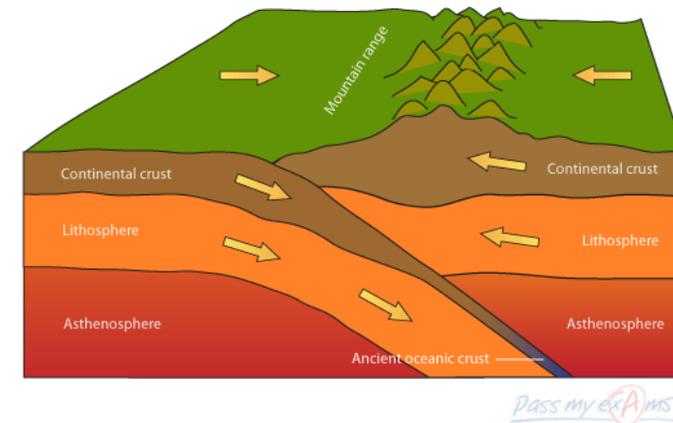
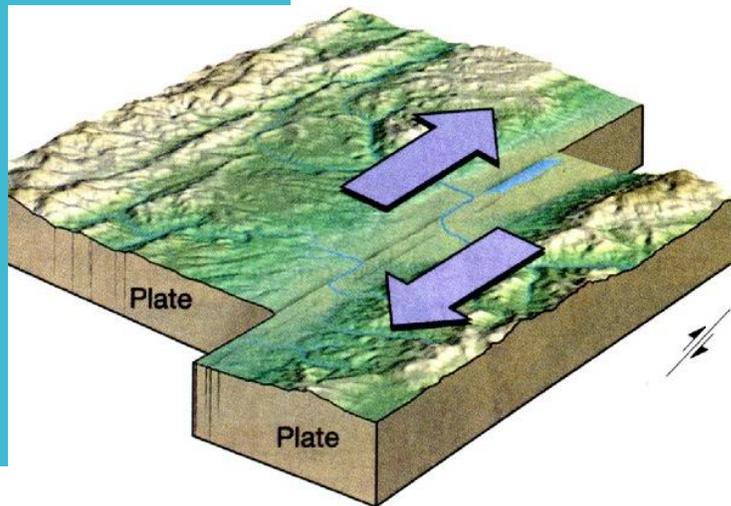
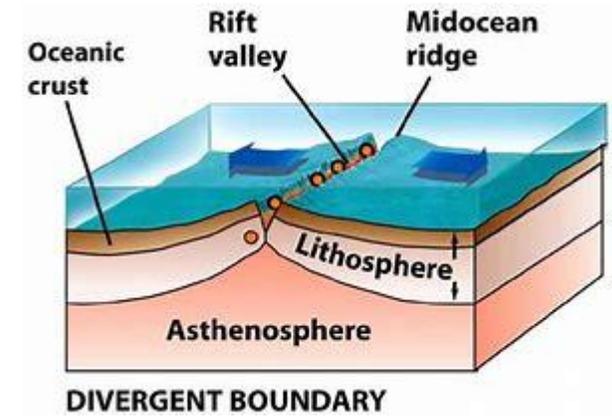
As the convection of magma in the asthenosphere causes these tectonic plates to move, they can:

- 1. Convergent boundary:** collide/ run into each other (Mountains / volcanoes / deep sea trenches)
- 2. Divergent boundary:** move away from each other (rift-valleys/ new crust/ mid-ocean ridges)
- 3. Transform boundary:** slide past each other in opposite directions (earthquakes)

The movement of the tectonic plates create many of the landforms we have on earth today.

Try it out!

Label each picture which the type of tectonic plate boundary it is representing:



Spheres of Earth

- Biosphere: all living organisms
- Geosphere: all non-living solid matter of Earth
- Hydrosphere: all water on Earth
- Atmosphere: all gases surrounding Earth

Provide examples for each sphere. Then, discuss how the spheres may interact with one another.

Wind and breezes

Wind is created by a pressure difference in air: gases that make up the air will always move from higher pressure to lower pressure areas.

- **Cold air is higher pressure:** the gas molecules are closer together
- **Hot air is lower pressure:** the gas molecules are moving faster and farther apart

Sea Breeze: air moving from ocean to land which cools off the land. Where is there the colder/ higher pressure air? Where is there the hotter/ lower pressure air?

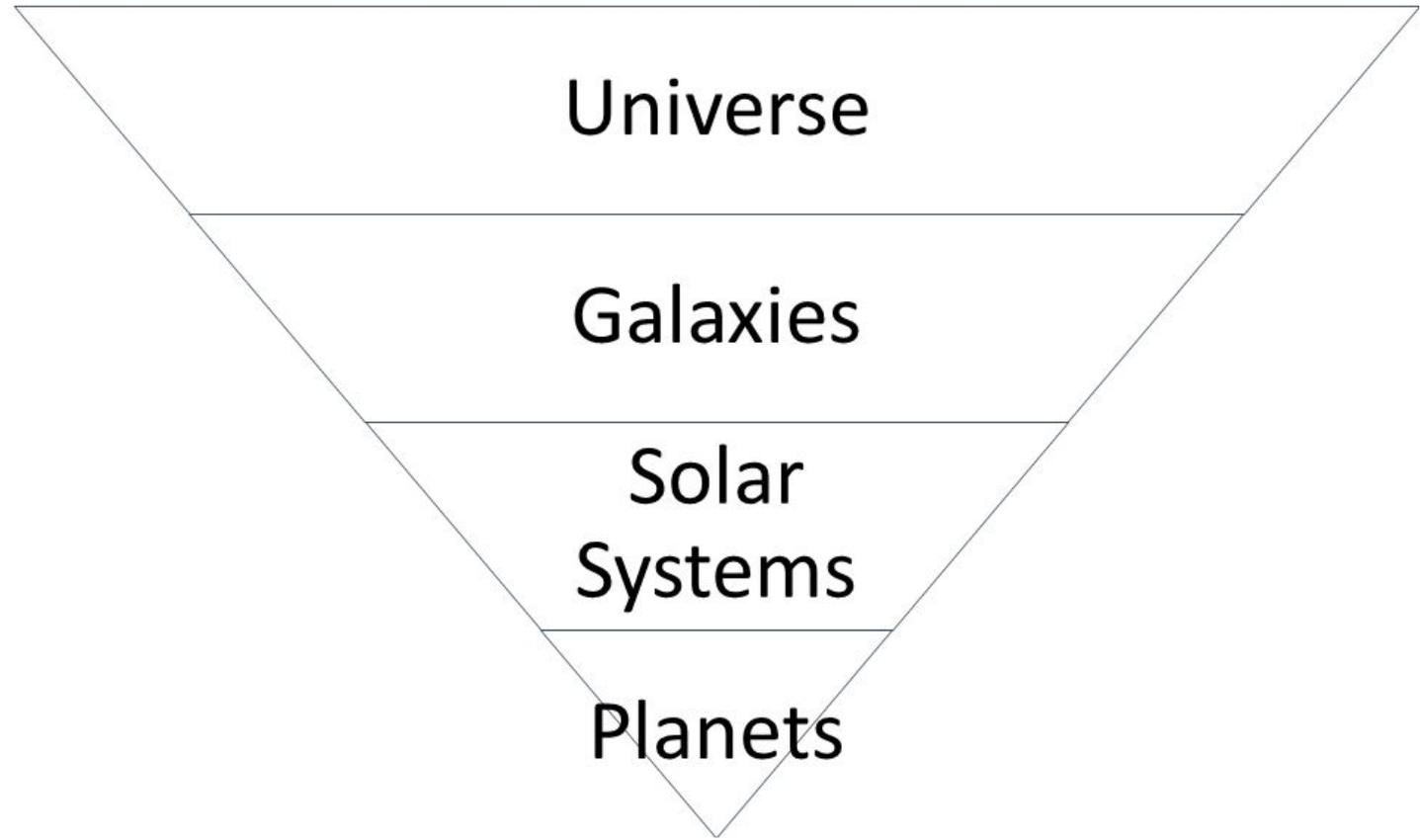
Land Breeze: air moving from land to ocean. Where is there the colder/ higher pressure air? Where is there the hotter/ lower pressure air?

Gravity

- Like density, gravity is another principle that determines relationships between objects
- Any two objects will have a gravitational attraction towards one another
- The greater the mass, the stronger the gravitational force
- The closer the objects are, the stronger the gravitational force.

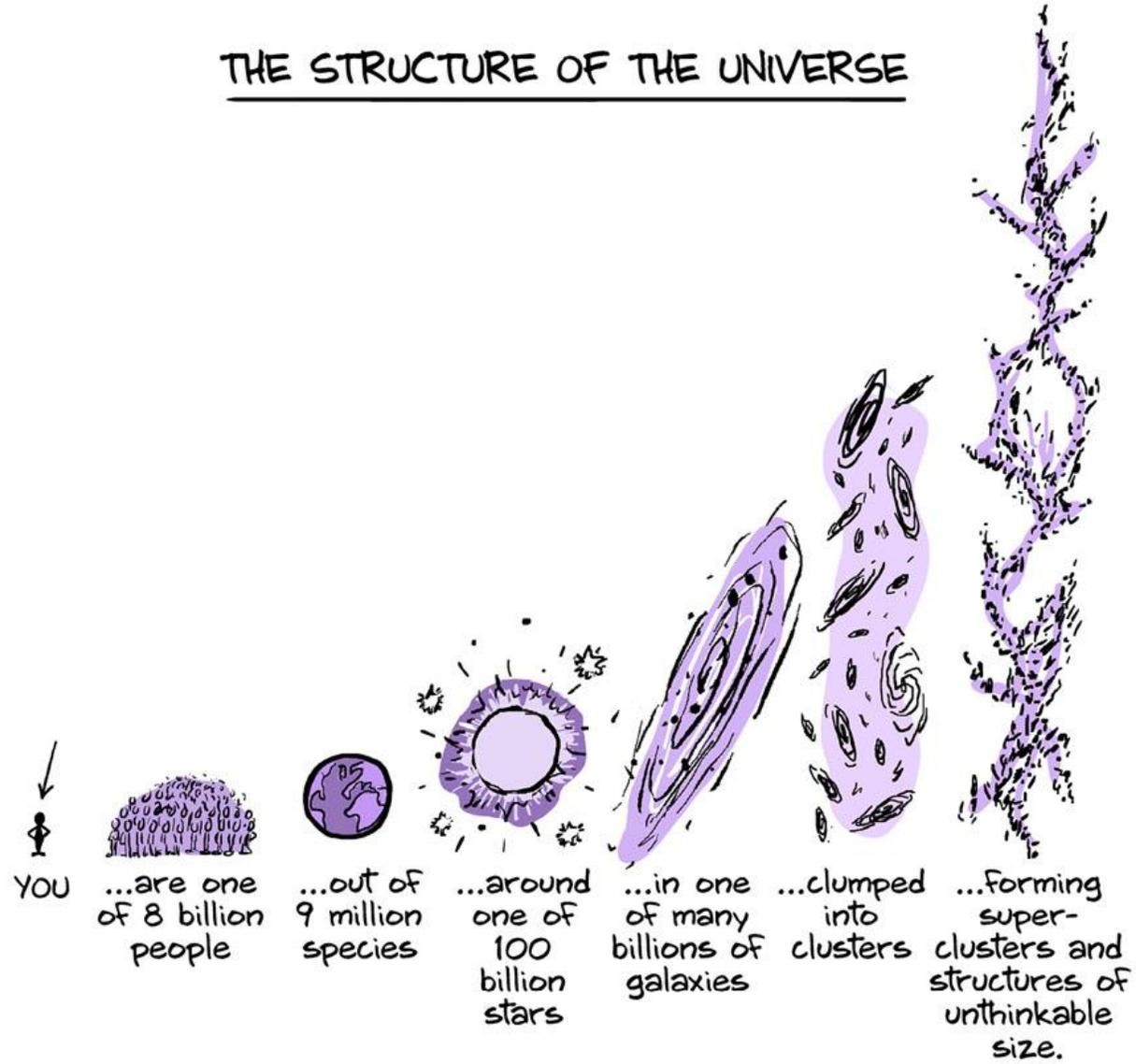
Universe Hierarchy

Astronomical Hierarchy



Universe Hierarchy

THE STRUCTURE OF THE UNIVERSE

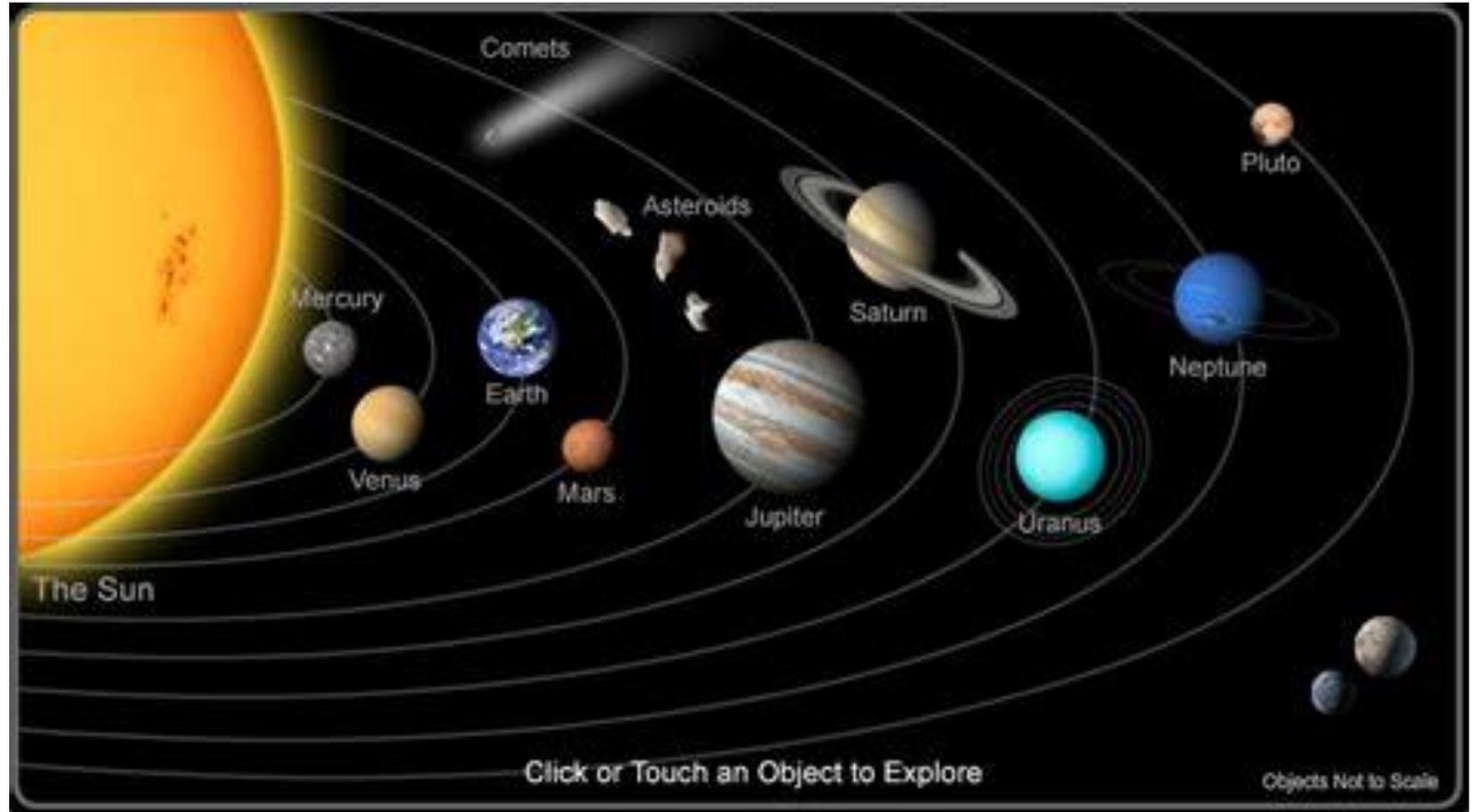


Try it out!

Which distance is the largest?

- a. From the sun to the next nearest star
- b. From Pluto to the sun
- c. From the sun to a star in the next galaxy
- d. From Earth to the moon

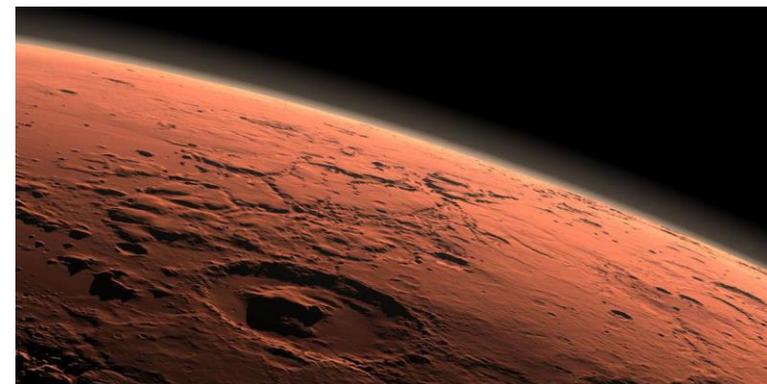
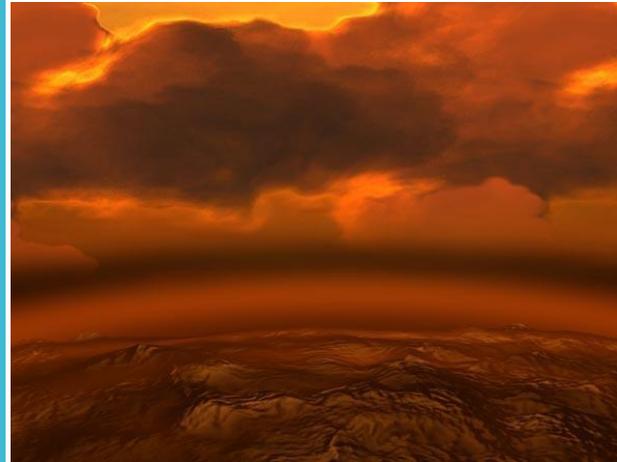
Structure of the Solar System



Rotation VS Orbit?

Planet Characteristics

- Interior: composition of the layers
- Atmosphere: influences temperature and ability of water and life to exist
- Moons



Star Characteristics

CHARACTERISTICS OF STARS

- Composition and temperature
- Motion
- Distance
- Magnitude- Brightness
- Luminosity- a measure of the energy released each second from the surface of a star

Stars that are further away will not APPEAR to move as much, and will not APPEAR as bright. But, that is just an illusion created since the star is so far away.

Star Classification

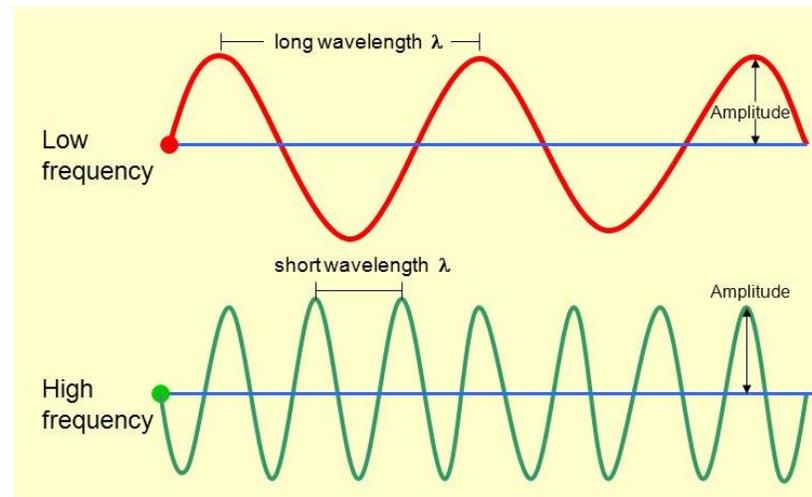
Spectral Type	Color	Temperature (K) [*]	Spectral Features
O		28,000-50,000	Ionized helium, especially helium
B		10,000-28,000	Helium, some hydrogen
A		7,500-10,000	Strong hydrogen, some ionized metals ^{**}
F		6,000-7,500	Hydrogen and ionized metals such as calcium and iron
G		5,000-6,000	Both metals and ionized metals, especially ionized calcium
K		3,500-5,000	Metals
M		2,500-3,500	Strong titanium oxide and some calcium

^{*} To convert approximately to Fahrenheit, multiply by 9/5.
^{**} Astronomers regard elements heavier than helium as metals.

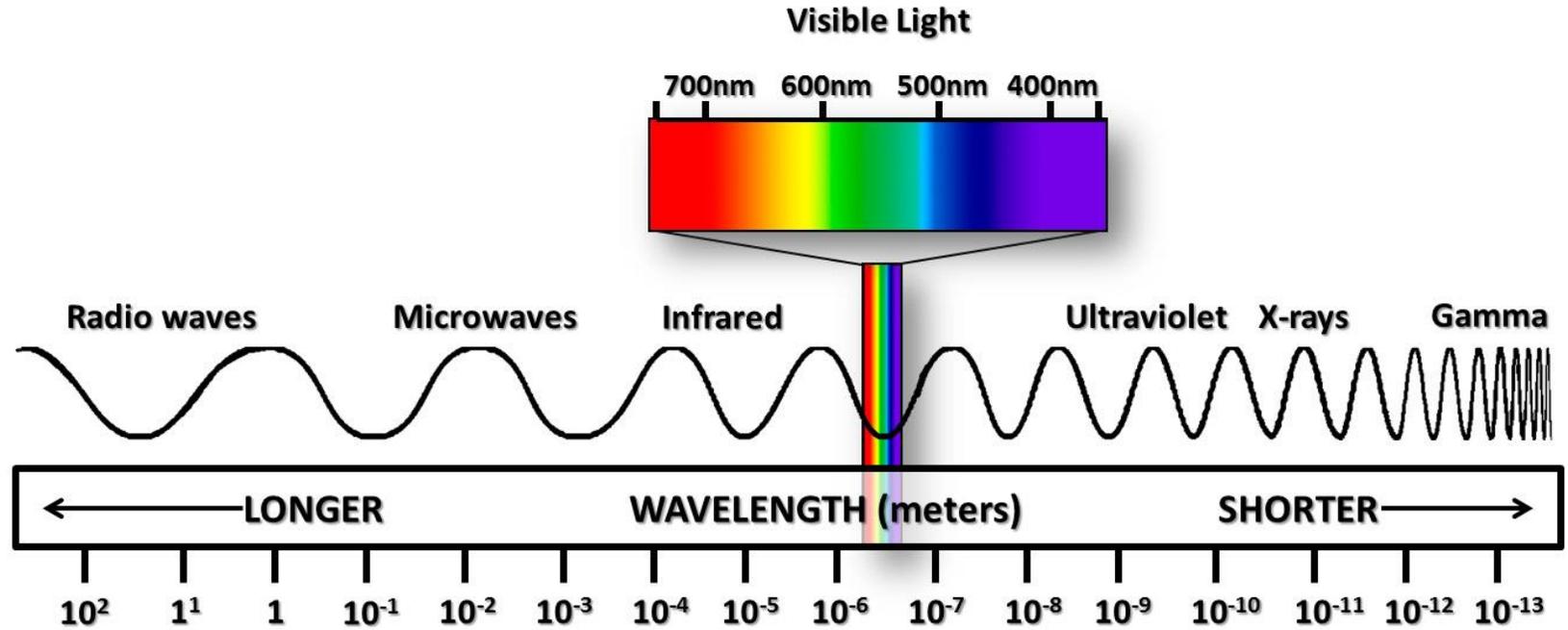
In order to remember the classification of stars, use ROYGBIV to remember the order of the colors. Blue = Hottest ; Red = Coldest

Light From Stars

- The light we see from stars is actually heat energy being transferred to Earth via radiation
- The different colors of stars are created from the different type of light/ radiation that the star is producing
- Radiation travels in the form of an **electromagnetic wave**
- Waves are told apart by their **wavelength** and **frequency**. Wavelength and frequency are mathematically related: long wavelength = low frequency (red); short wavelength = high frequency (blue). Two waves that have the same wavelength will also have the same frequency

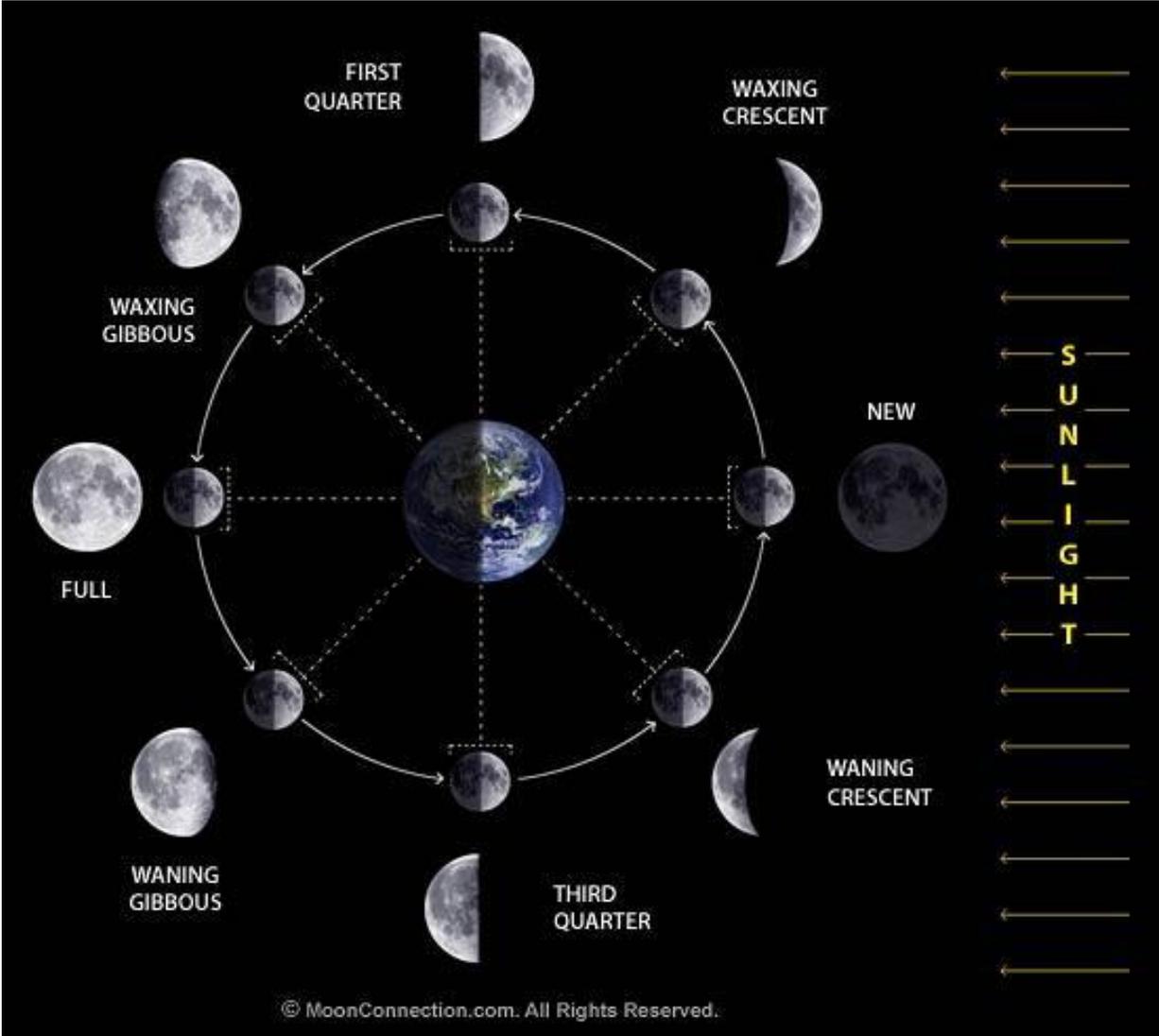


Electromagnetic Waves



Which type of electromagnetic wave has the lowest frequency?

Moon Phases



Try it out!

Name _____

Identifying Phases of the Moon



1

2

3

4



5

6

7

8



9

10

11

12

Which image shows First Quarter? _____ Full? _____ Last/Third Quarter? _____

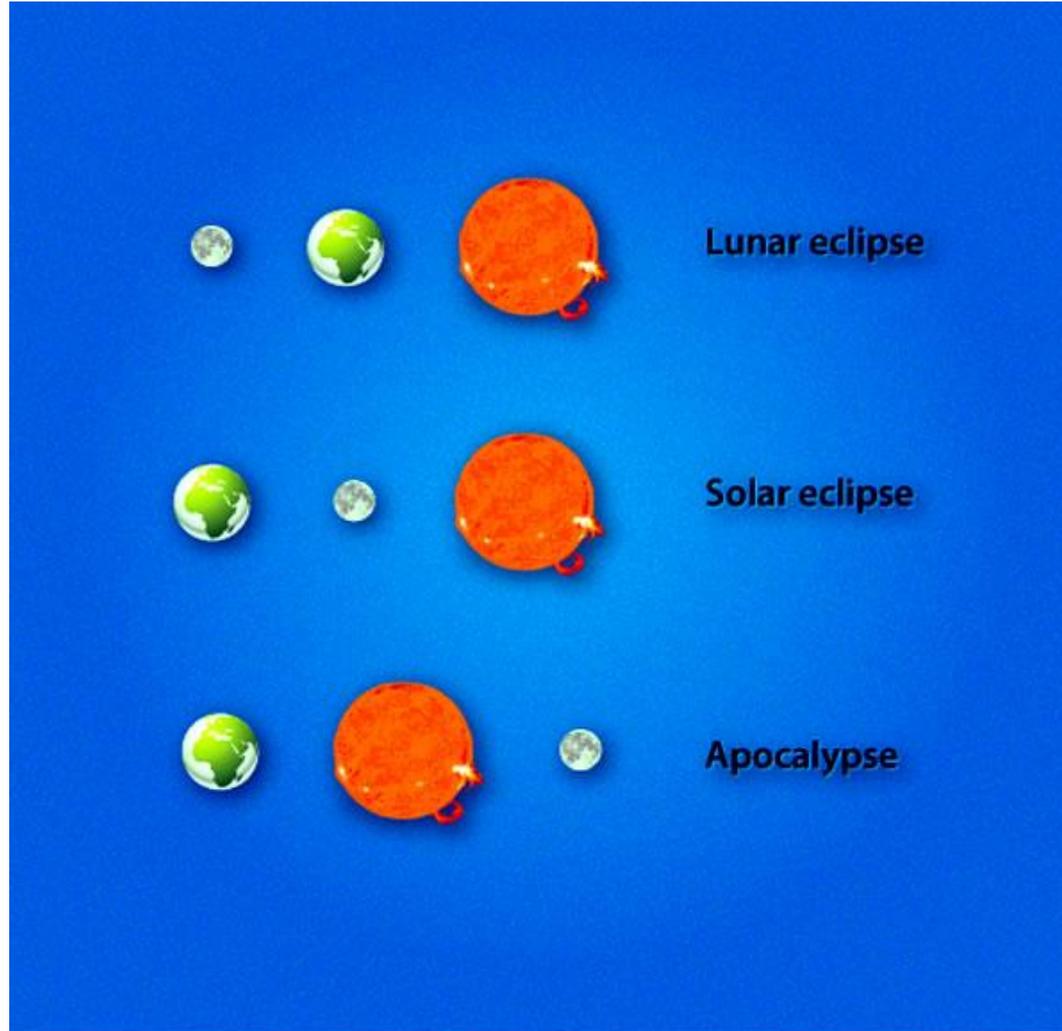
Which images are crescents? _____

Which images are gibbous? _____

Which images are waxing? _____ through _____

Which images are waning? _____ through _____

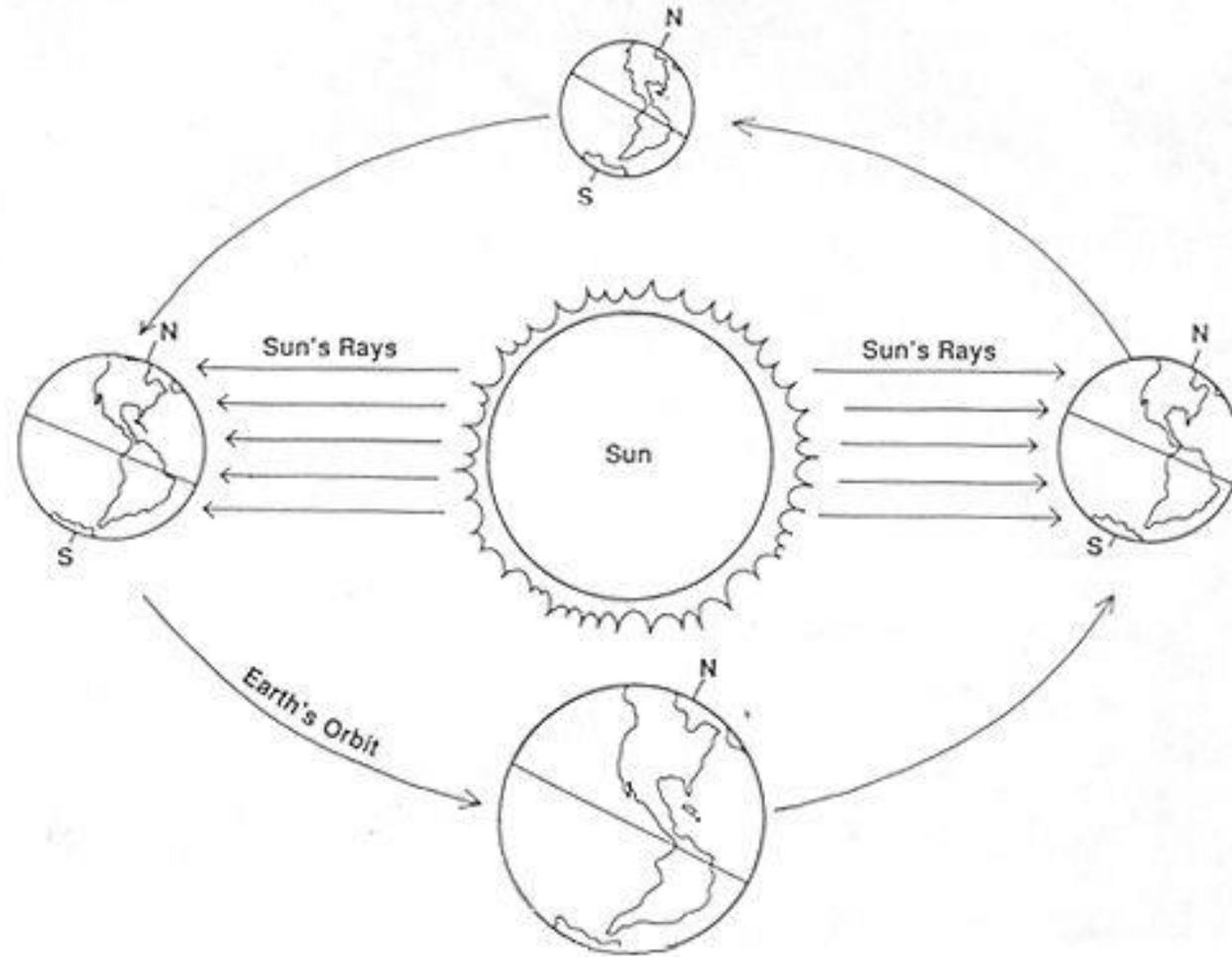
Eclipses



Try it out!



Seasons



- Tutoring in April: more in detail about layers of earth, river deposition (bends, deltas, alluvial fans), minerals, rock types, fossil formation, boundary types and landforms, wind patterns, water cycle
- Can sedimentary rock ever melt back into magma
- Can