

Geo 101

Physical Geology

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- **Ph.D. (2011) Geophysics, Missouri University of Science & Technology (MST), Rolla, Missouri, USA.**
- **M.S. (2003) Marine Physics, King Abdulaziz University, Jeddah.**
- **B.S. (1999) Marine Physics, King Abdulaziz University, Jeddah.**

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Meeting Time:

Sun Tue Thu 10:00 – 10:50 am

Credits:

4 hours (3+1)

Reference Book:

**Earth An Introduction to Physical Geology. 8th
Edition by Edward J. Tarbuck and Frederick K.
Lutgens.**

Course Description:

Introduction to physical geology and minerals, volcanism and intrusive igneous rocks, weathering, soil, sediments and sedimentary rocks, metamorphism and metamorphic rocks, water courses and groundwater, glaciers and glaciations, deserts and coasts, geological structures, earthquakes, plate tectonics, mountain belts and continental growth, earth resources.

Learning Goals:

By the end of this course, students will:

- o The physical and chemical processes that occur on and within the Earth.**
- o The source of energy that drive these processes.**
- o How these processes have given rise to present of Earth through time.**
- o How they continue to act to affect our everyday lives.**

Grades:

Based on examinations and class participation as follows:

- | | |
|---------------------------------------|-----|
| ■ Exam 1 [Tuesday 29-October 2013] | 20% |
| ■ In-class quizzes | 5% |
| ■ Field trip and homework assignments | 5% |
| ■ Lab assignments | 30% |
| ■ Final Exam | 40% |

Course Topics:

- **Introduction to Geology**
- **Minerals**
- **Igneous Rocks**
- **Sedimentary Rocks**
- **Metamorphic Rocks**
- **Plate Tectonics**
- **Volcanic Activity**
- **Geologic Time**
- **Mountain Building**

What I need from you:

- **Your attendance:**
 - Never to be late more than 10 minutes before lecture
 - Never play with your cell phone while giving lecture.
 - Never talk to your friend while giving lecture.
 - Never miss more 25% of the total lectures.
- **Your participation:**
 - Involve in all group discussions and activities.
 - Write down all important information in your notebook.
- **Homework assignments:**
 - Answer all your homework assignments on-time.
 - Never cheat from others.

My advice to you:

- **Group study**
- **Ask questions**
- **Don't copy**
- **Arrange your time**
- **Always prepare a plan to achieve your targets**

Any questions?

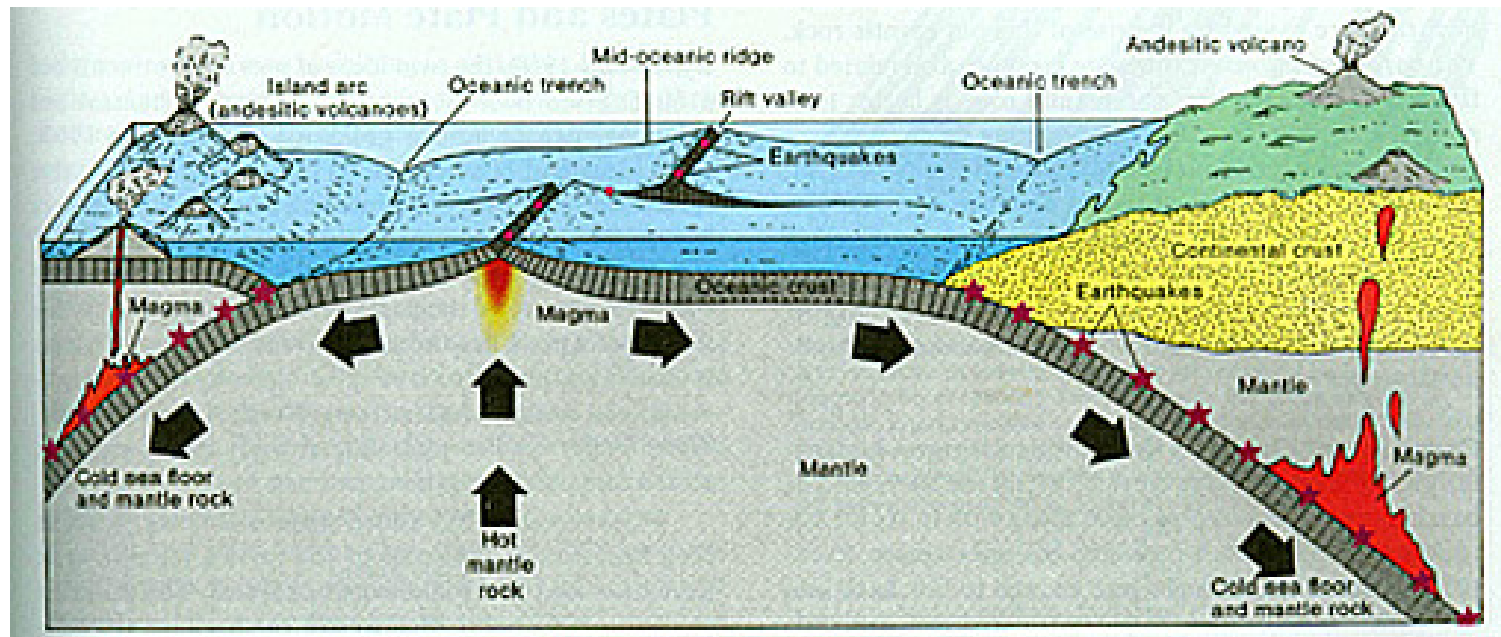
Introduction to Geology:

- What is Geology.
- Branches of Geology.
- Geology in our lives.
- What does a geologist do.
- Where do geologist work.
- Processes acting on the Earth.
- Uniformitarianism and Catastrophism.
- Rock Cycle.
- Formation of the solar system.
- Formation of the Earth.
- Structure of the Earth.
- Geologic time.

Q. What is Geology?

Geology is the study of Earth, including:

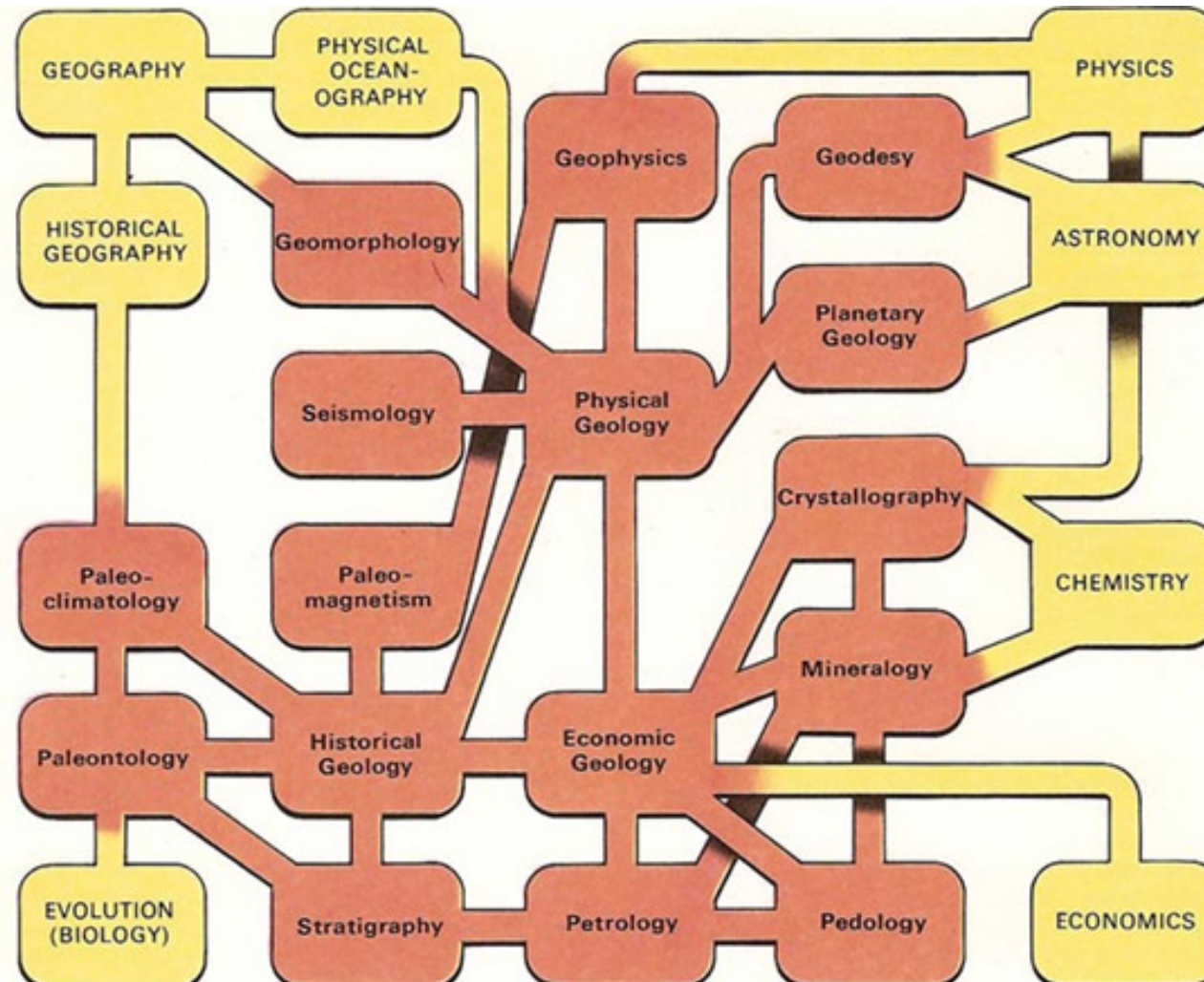
- **The materials that it is made of.**
- **The physical and chemical changes that take place on its surface and in its inner.**
- **The history of the planet and its life from.**



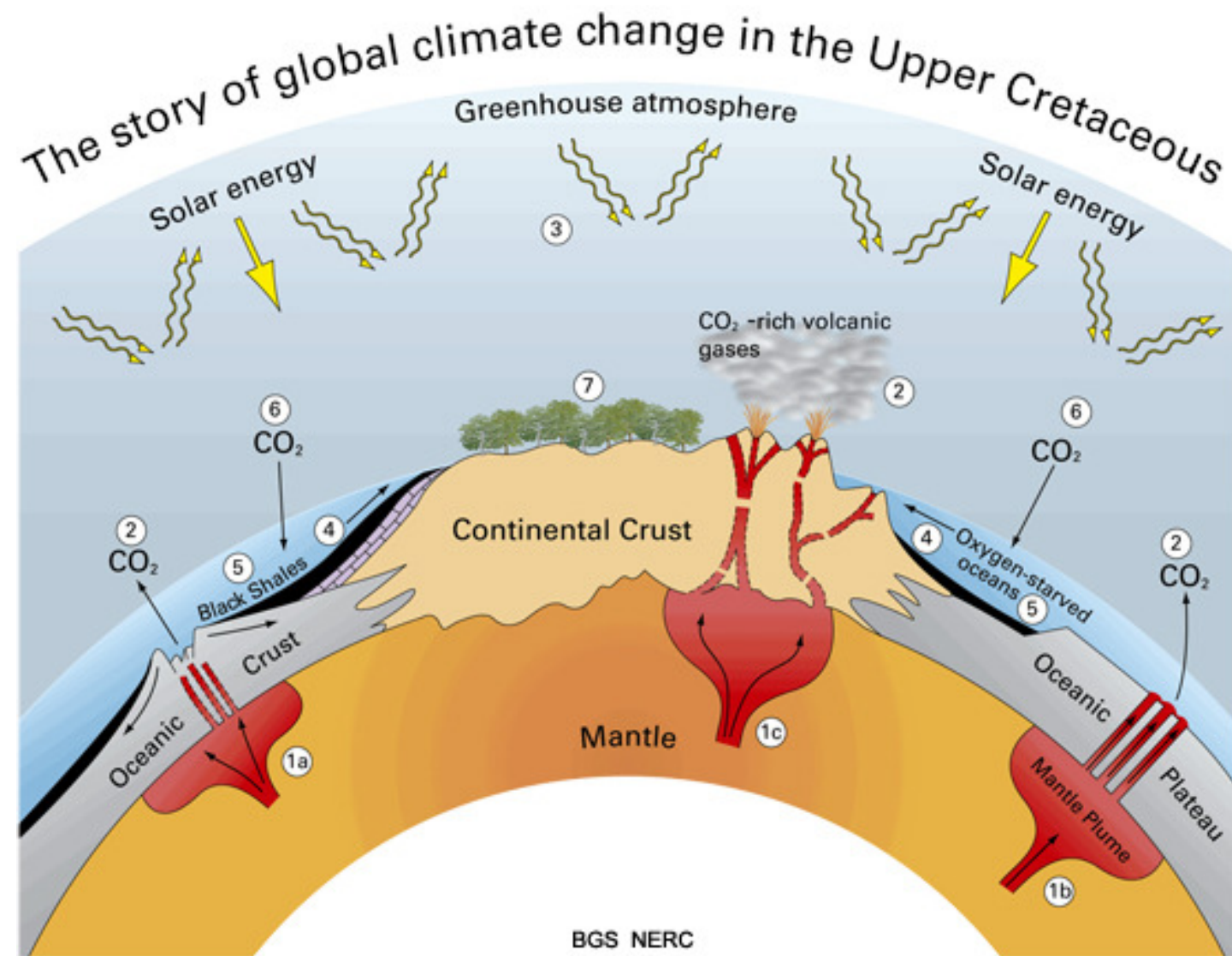
Geology divided into:

1. **Physical Geology:** is concerned with the materials and processes which composed and operate on the surface and within the Earth.
2. **Historical Geology:** is concerned with the origin and evolution of Earth's continents, oceans, atmosphere, and life.

Branches of Geology:



Q. Does Geology affect our lives?



Geology in our lives:

- Energy sources (coal and petroleum), are geologic products that build and power modern society.
- Water, is also a geologic product.
- Natural hazard (tsunamis, landslides, earthquakes and volcanic eruptions) are also related to geology.



Q. What does a Geology do?



What does a geologist do:

- Geologists work to understand the history of our planet.
- Geologists study the earth processes such as: landslides, earthquakes, floods and volcanic eruptions and their impact on people.
- Geologists study earth materials such as: oil and metals and locate them and produce them.
- Geologists study earth history and linked it with climate change (the past is the key to the future).

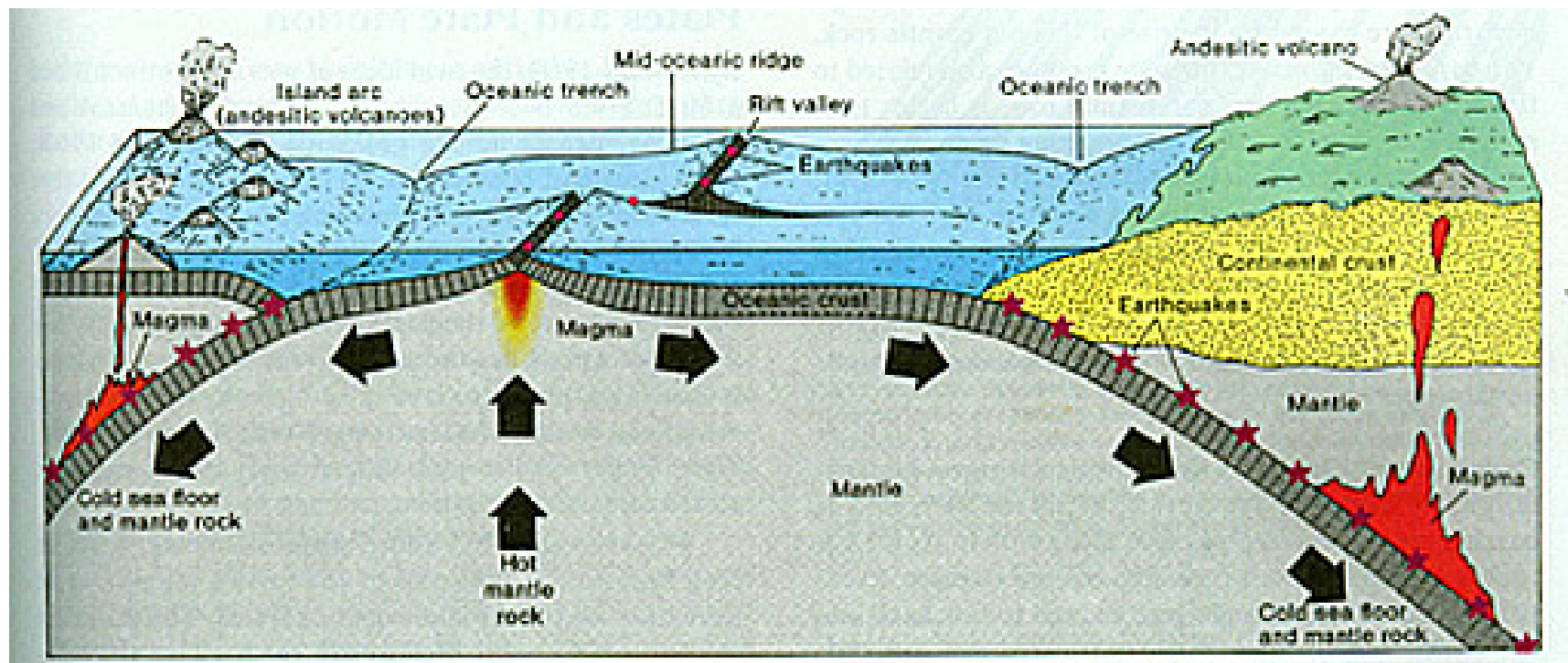
Where do a geologist work:

- **Government agencies:** investigate natural disaster, construction sites, and natural resources.
- **Private companies:** help located natural resources (minerals, oil, and natural gas)
- **Academic institutions:** schools, colleges, universities and museums.



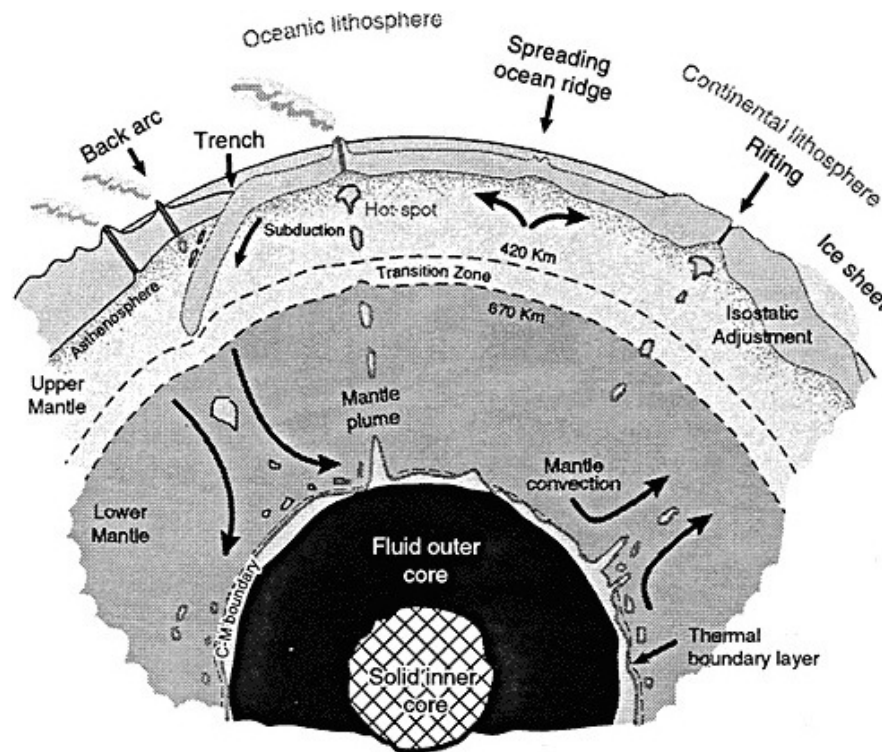
Processes acting on the earth:

- The Earth is a dynamic system that undergoes constant changes with time both internally and on its surface.



Processes acting on the earth:

1. **Internal Processes:** processes that originate deep within the Earth. (mountain building, earthquakes, and volcanic eruptions.)



Processes acting on the earth:

2. **Surface Processes:** processes which take place on the earth's surface. Most of them are driven by water, wind, ice, and gravity.



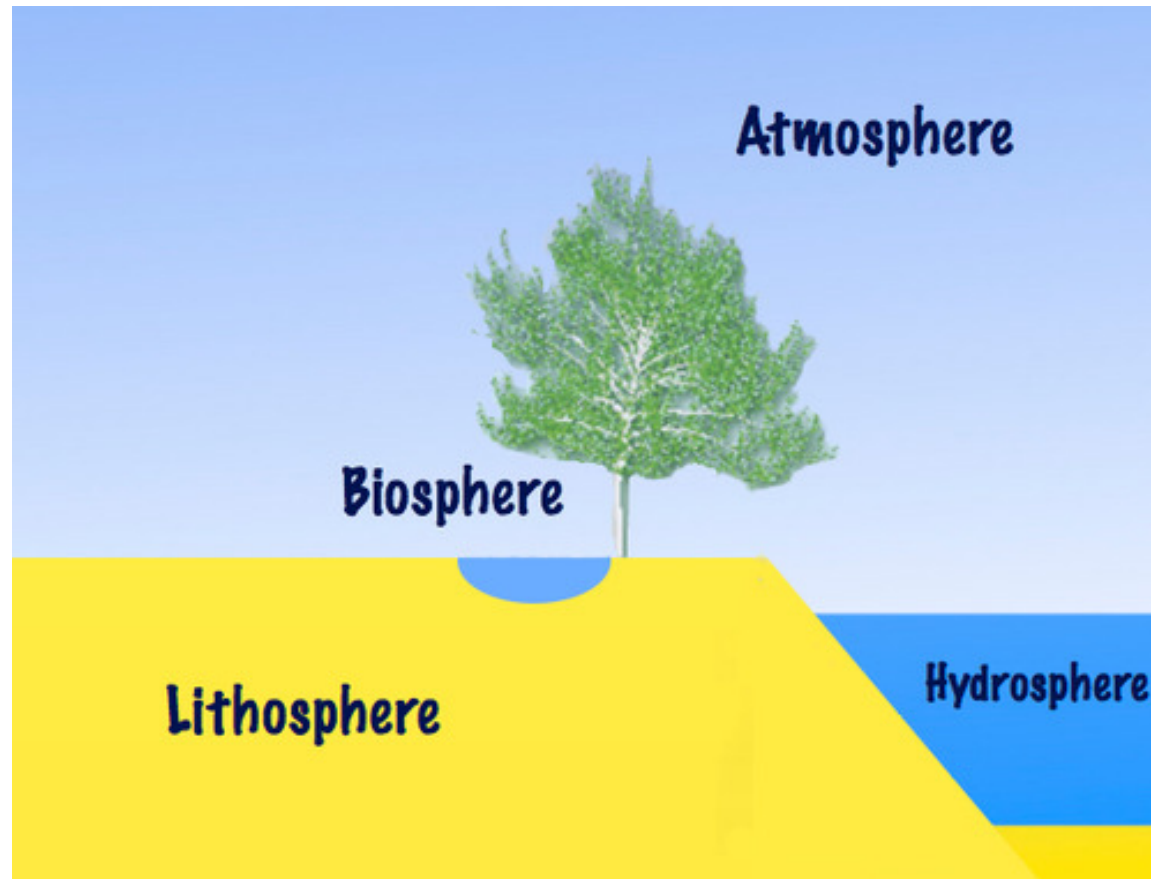
Q. Is Earth expanding ?

Answer:

The Earth is maintaining a constant diameter.

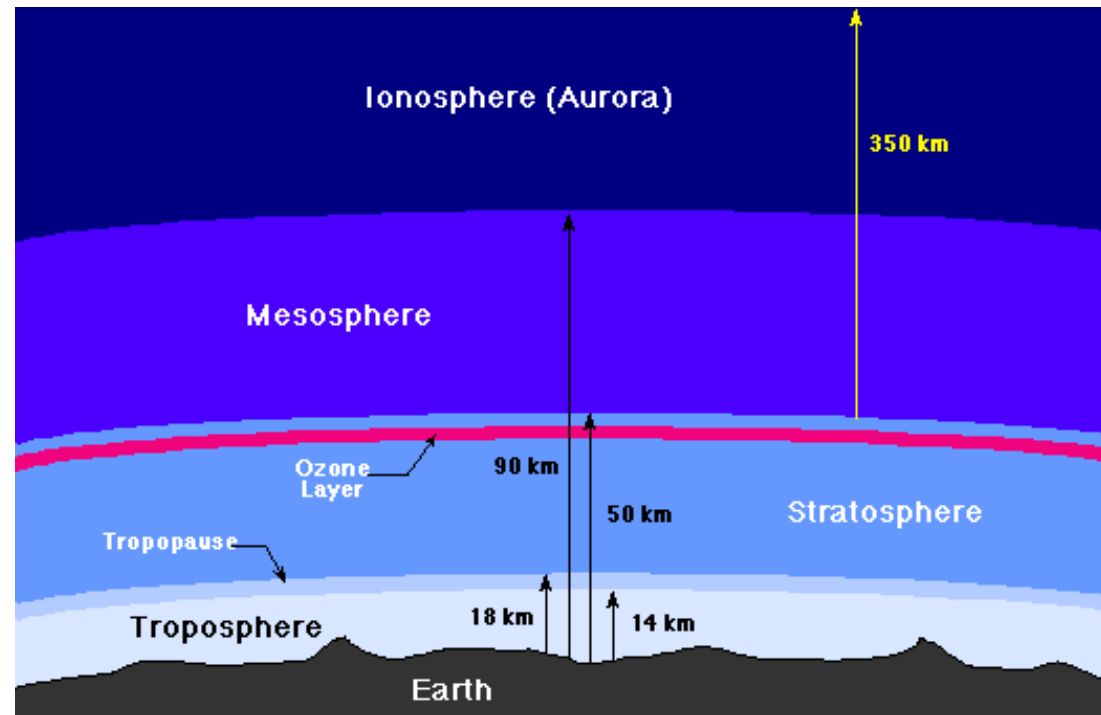
Geo-Spheres:

The area near the surface of the earth can be divided into four inter-connected “geo-spheres”:



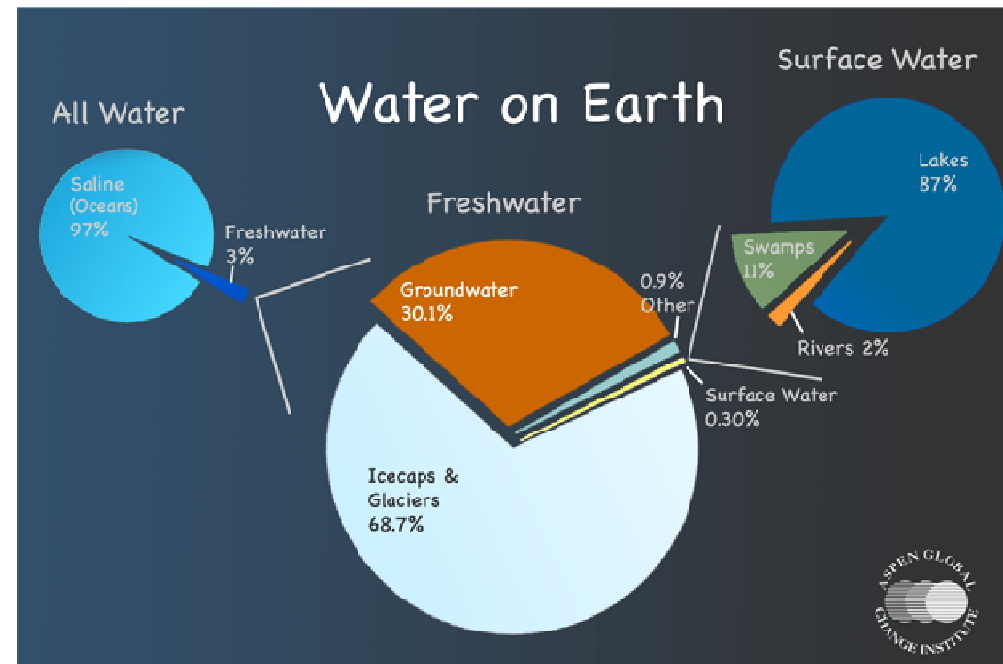
Atmosphere

- Is the body of air which surrounds our planet.
- Located near the earth's surface.
- Provide air and protect us from the Sun's intense heat and dangerous ultraviolet radiations.



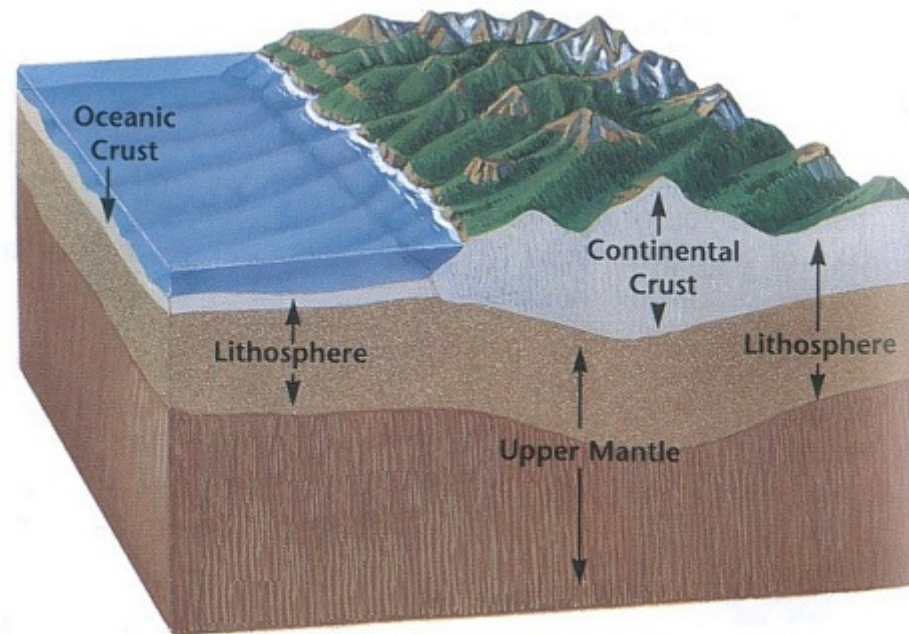
Hydrosphere

- Composed of all of the water on or near the earth. Includes oceans, rivers, lakes, and even moisture in the air.
- 97% in the oceans.
- 3% fresh water: 1/3 is solid and exists in ice sheets.



Lithosphere

- Beneath the atmosphere and the oceans is the solid Earth, or lithosphere.
- It is the solid, rocky crust covering entire planet.



Biosphere

- Composed of all living organisms.
- Plants, animals, and non-celled organisms are part of it.
- Most of the planet's life is found from 3 meters below the ground to 30 meters above it.
- And the top 200 m of the oceans and seas.



Grades:

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as follows:**

- Exam 1 10%
- Exam 2 10%
- In-class quizzes 5%
- Field trip and homework assignments 5%
- Lab assignments 30%
- Final Exam 40%

Review:

- Geology and its divisions.**
- Processes acting on Earth.**
- Geo-spheres.**

Uniformitarianism and Catastrophism

Uniformitarianism (James Hutton, Scottish geologists) means that the geological features were the result of a slow process that took billions of years.

"the present is the key to the past"

Slow process » » billions of years



Catastrophism (William Whewell, English scientist) means the geological features were the result of large scale of catastrophes



Q. What is a rock?

Rock is the most common material on Earth. It Consist of smaller crystal or grains called minerals.

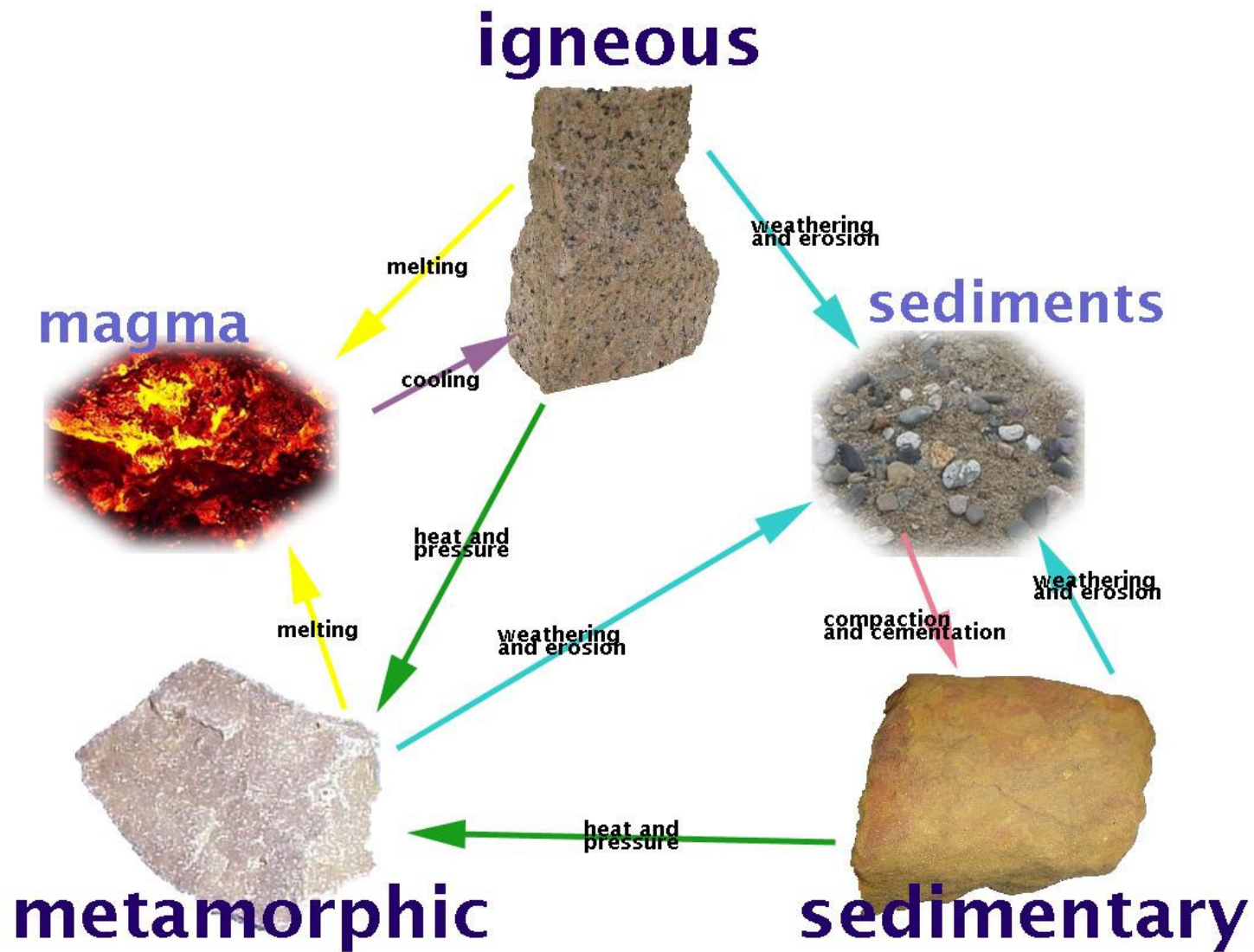


Q. What is rock cycle ?

The rock cycle is a fundamental concept in geology that describes the dynamic transitions through geologic time among the three main rock types: sedimentary, metamorphic, and igneous



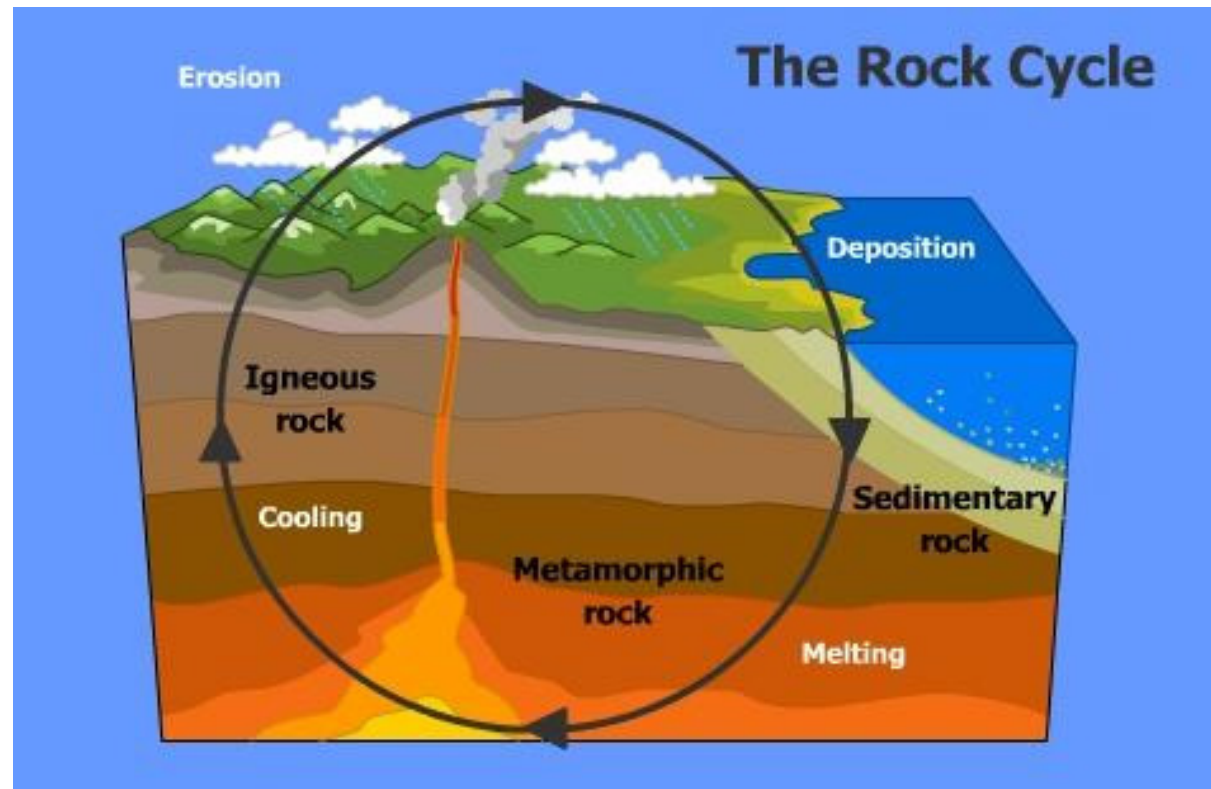
Q. What are rock types ?



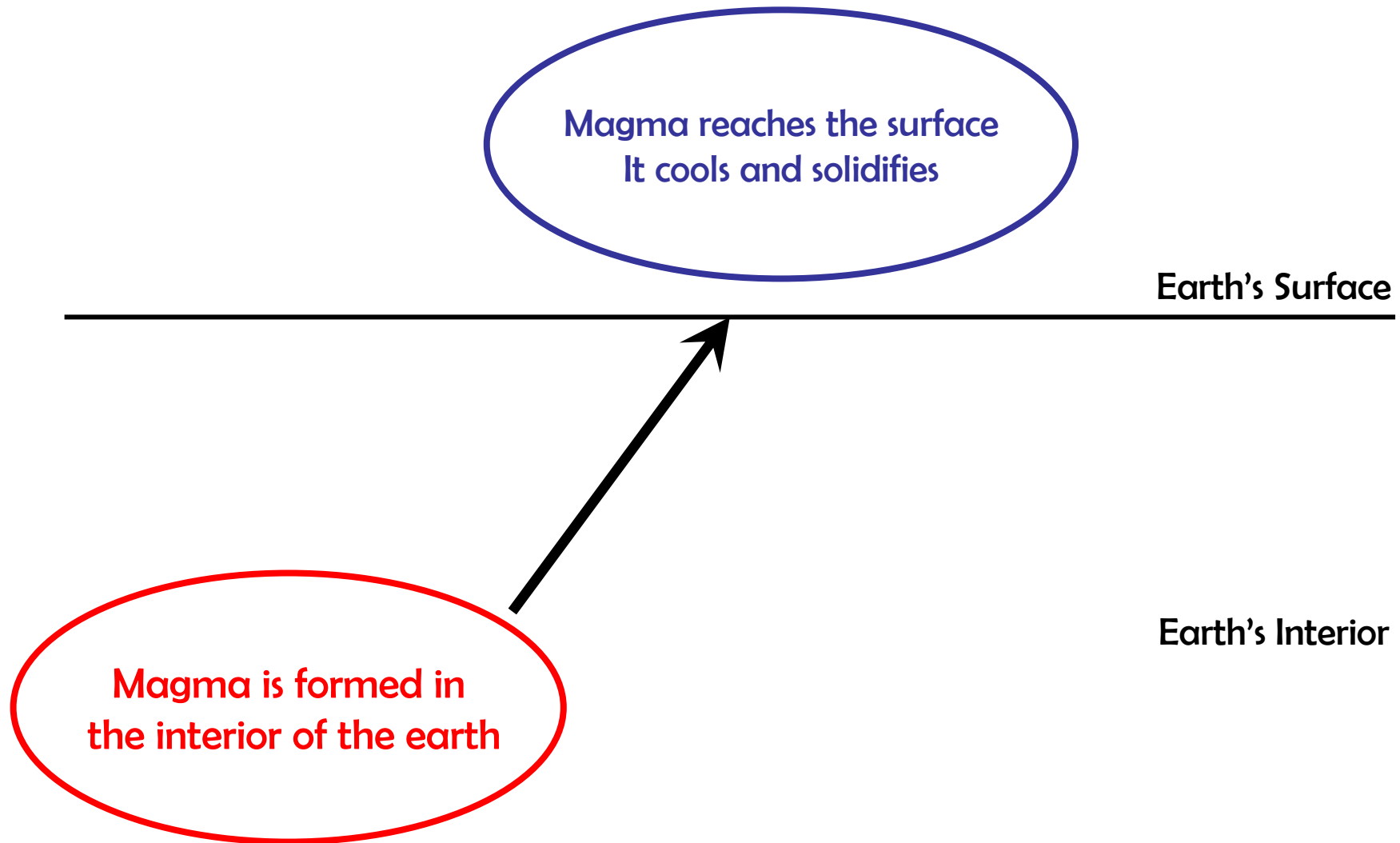
Igneous Rocks:

- Magma is the molten material which is formed when pressure and temperature conditions are high enough to melt the rocks.**
- Magma is formed in the interior of the earth and then, gradually migrates upward to the earth's surface.**

- When magma reaches the surface it cools and solidifies by the process of crystallization.
- The rocks formed as a result are known as Igneous Rock.



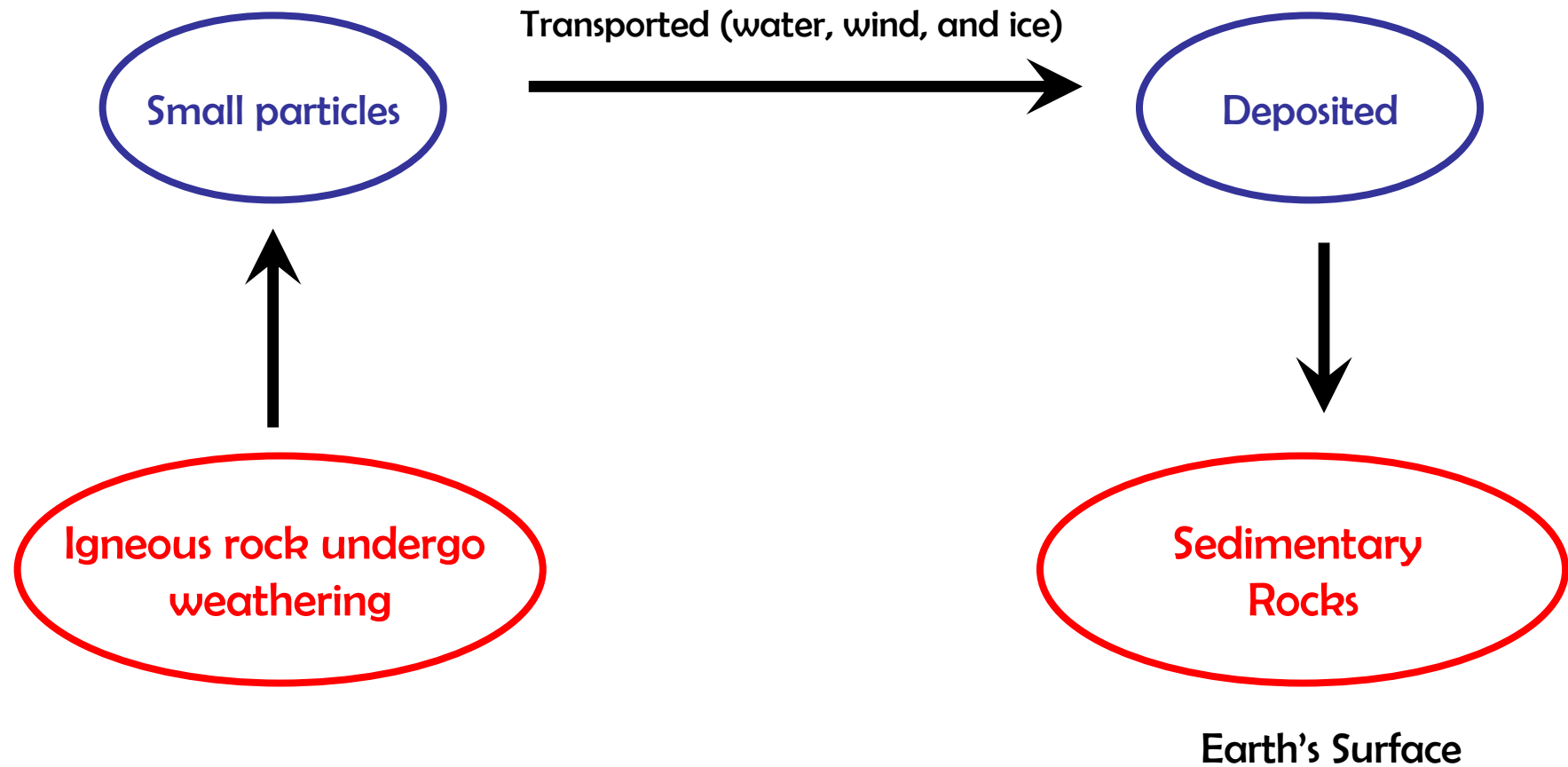
Crystallization



Sedimentary Rocks:

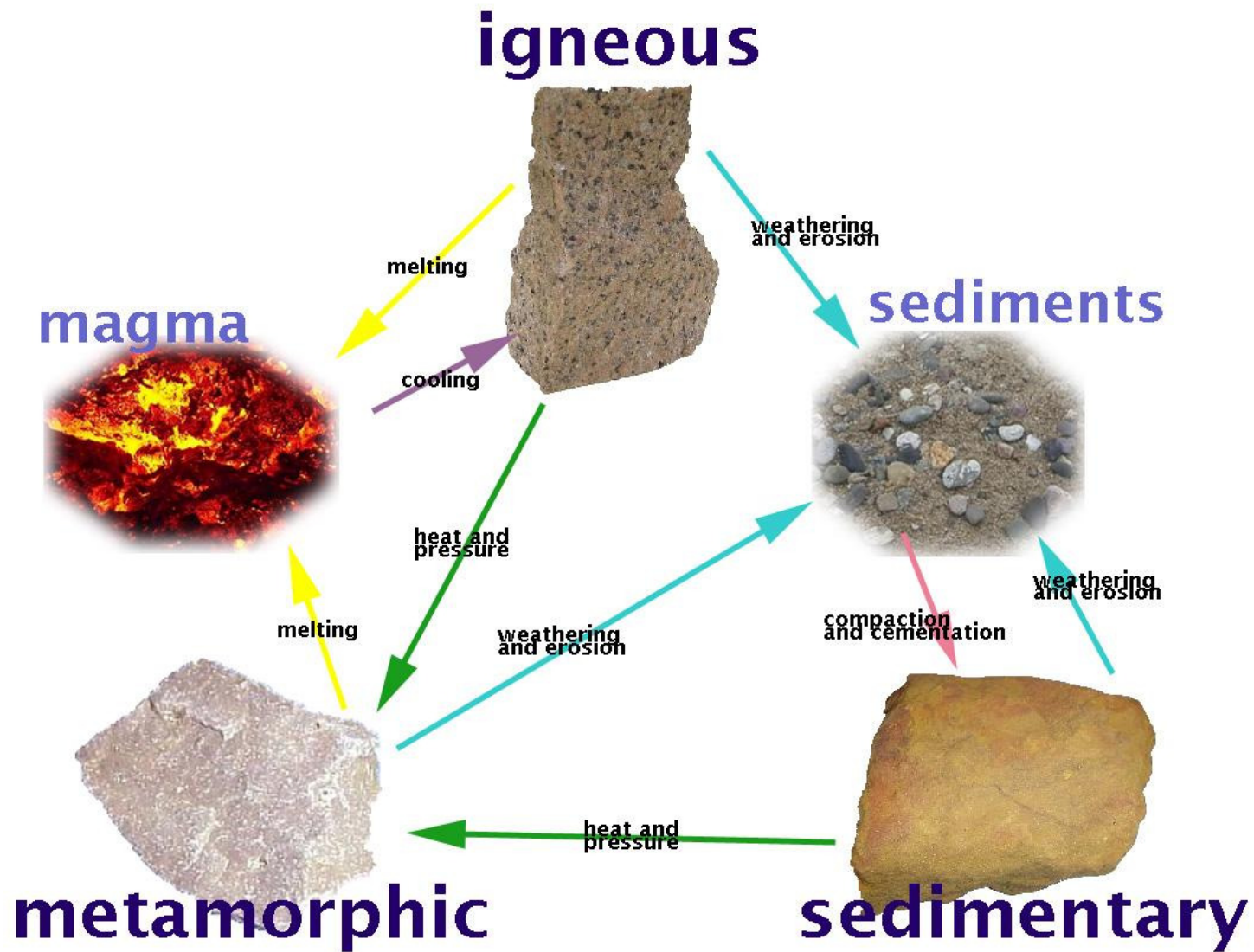
- These igneous rocks when exposed to the atmosphere undergo weathering where they disintegrate into small particles.
- These particles known as sediments are transported by the agents of erosion such as water, wind and ice.
- Finally, these sediments are deposited and converted to rocks “lithification”.
- The resulting rocks are known as **Sedimentary Rocks.**

Lithification



Metamorphic Rocks:

- The resulting sedimentary rock is buried deep within Earth involved in the dynamic of mountain building (subject to great pressure and heat)**
- The rock will react to the change and turn into metamorphic rock.**
- When it is subject to additional pressure and heat, it will melt, and will be igneous rock, starting the cycle all over again.**

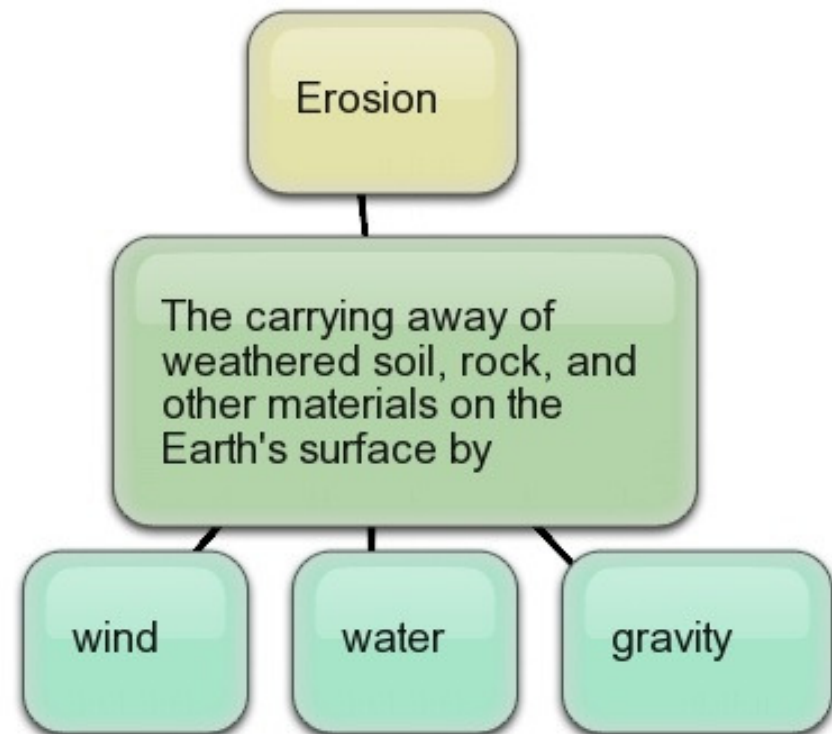
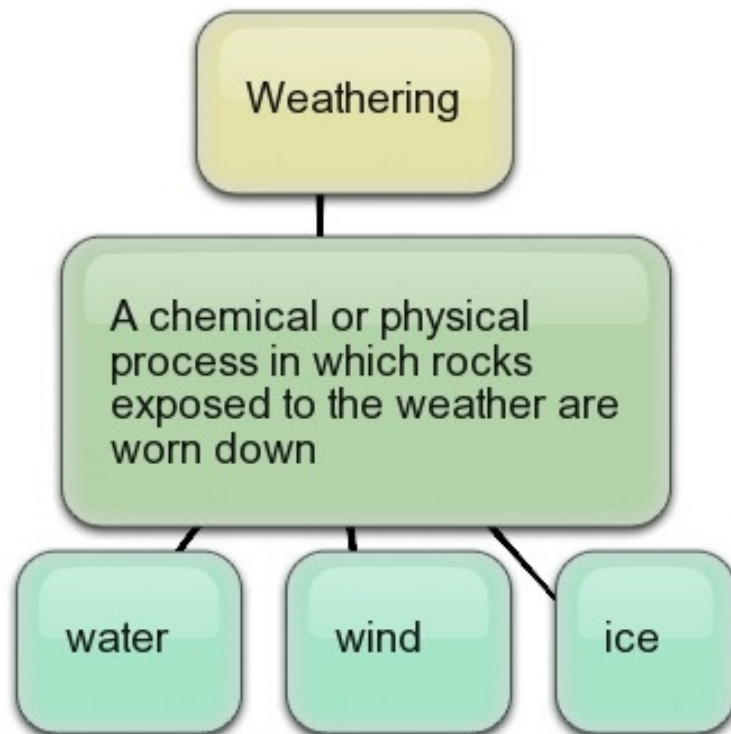


Q. What are the main important factors that affects the rock cycle ?

Answer:

1. Heat
2. Pressure
3. Weathering
4. Erosion
5. Cooling

**Q. What are the difference
between weathering and erosion?**



Formation of the Solar System:

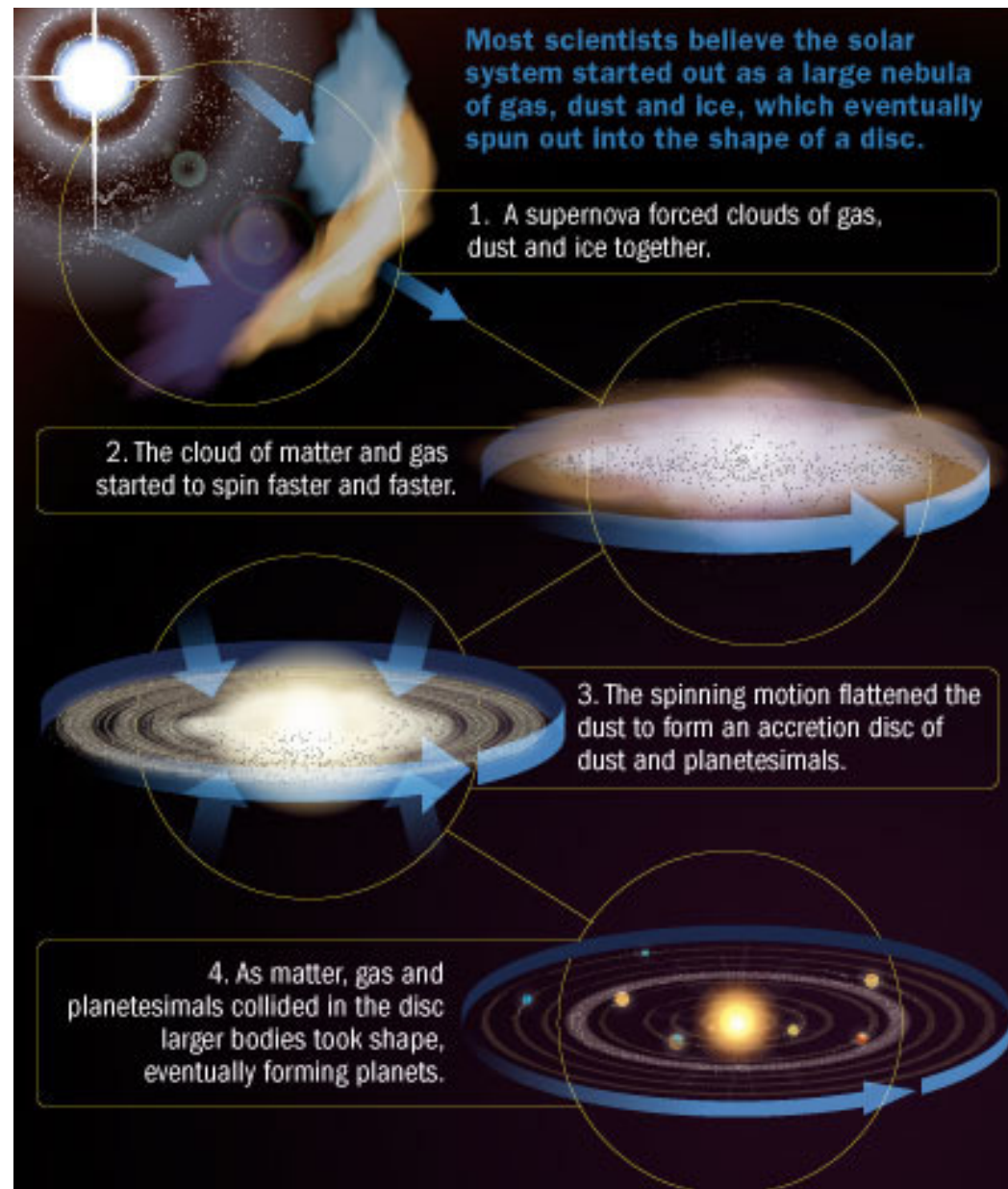
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v=Uhy1fucSRQI](http://www.youtube.com/watch?v=Uhy1fucSRQI)

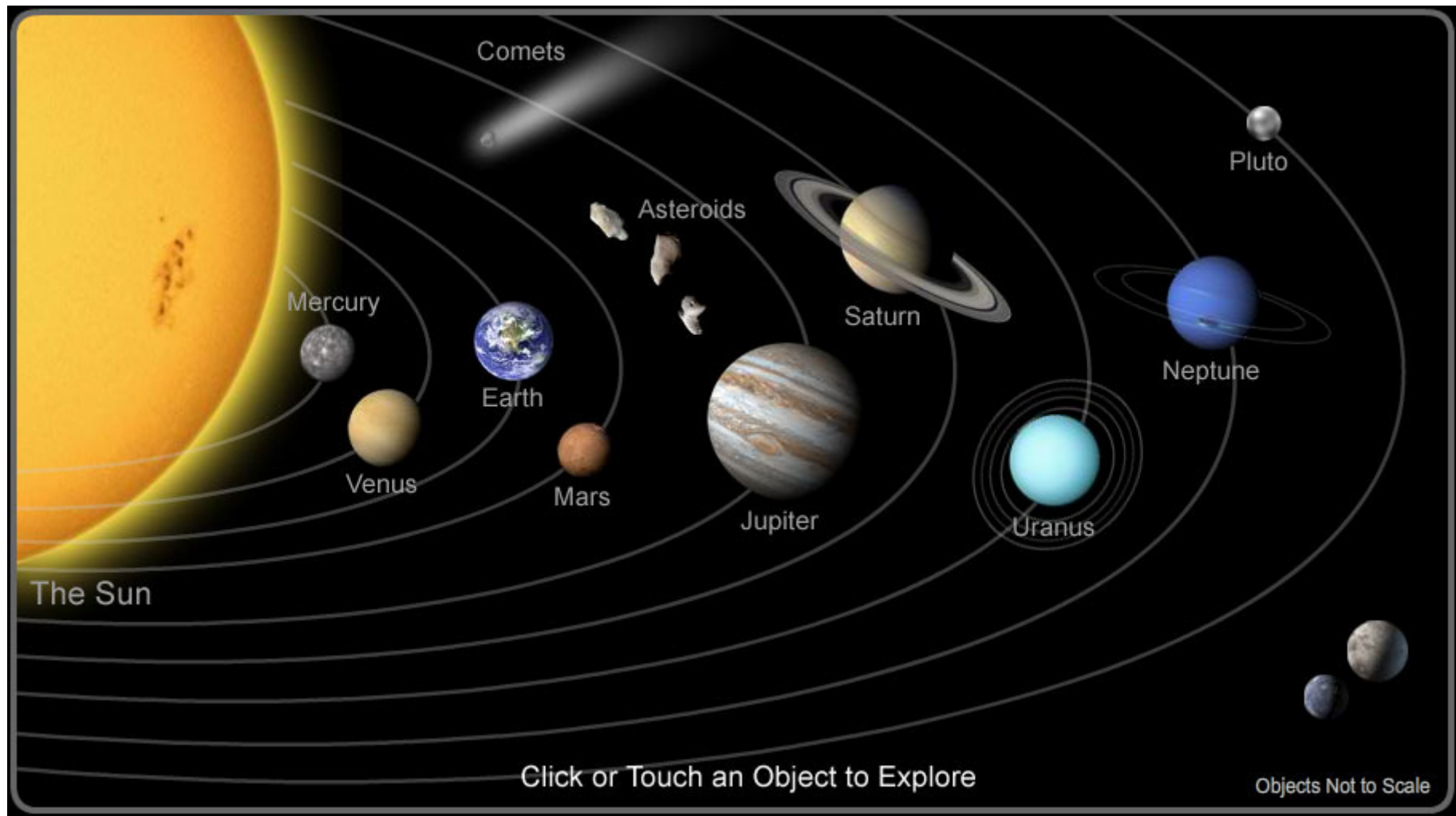
- The universe began 10 billion years ago, and Earth was not around at the beginning. (Q. How old is Earth?)

The universe started out with only two elements, hydrogen and helium gas.

H₂ and He form stars.

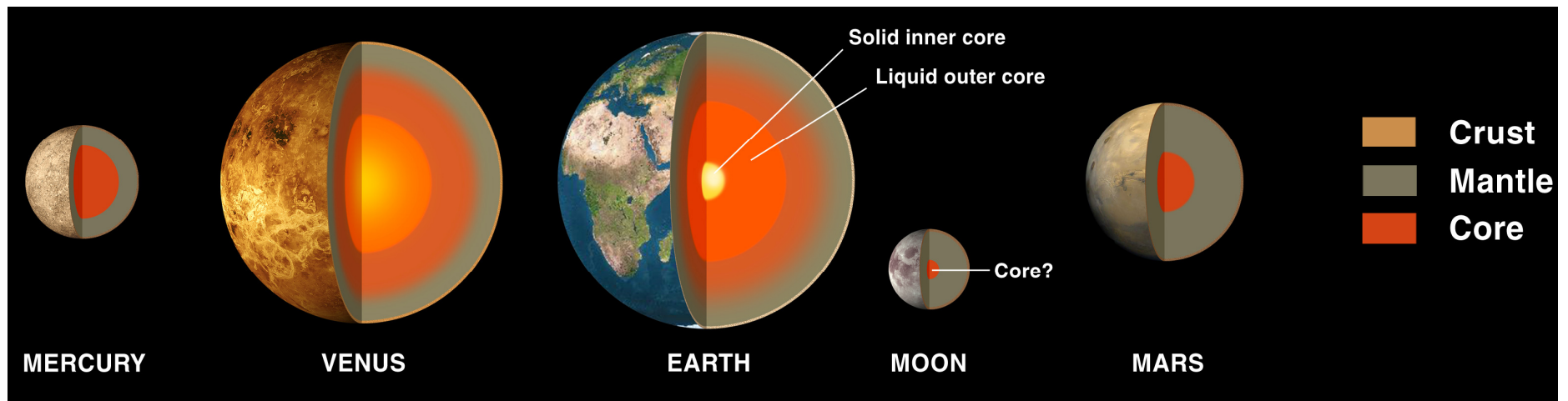
Generation of stars were born in gas clouds and died in explosive novas.





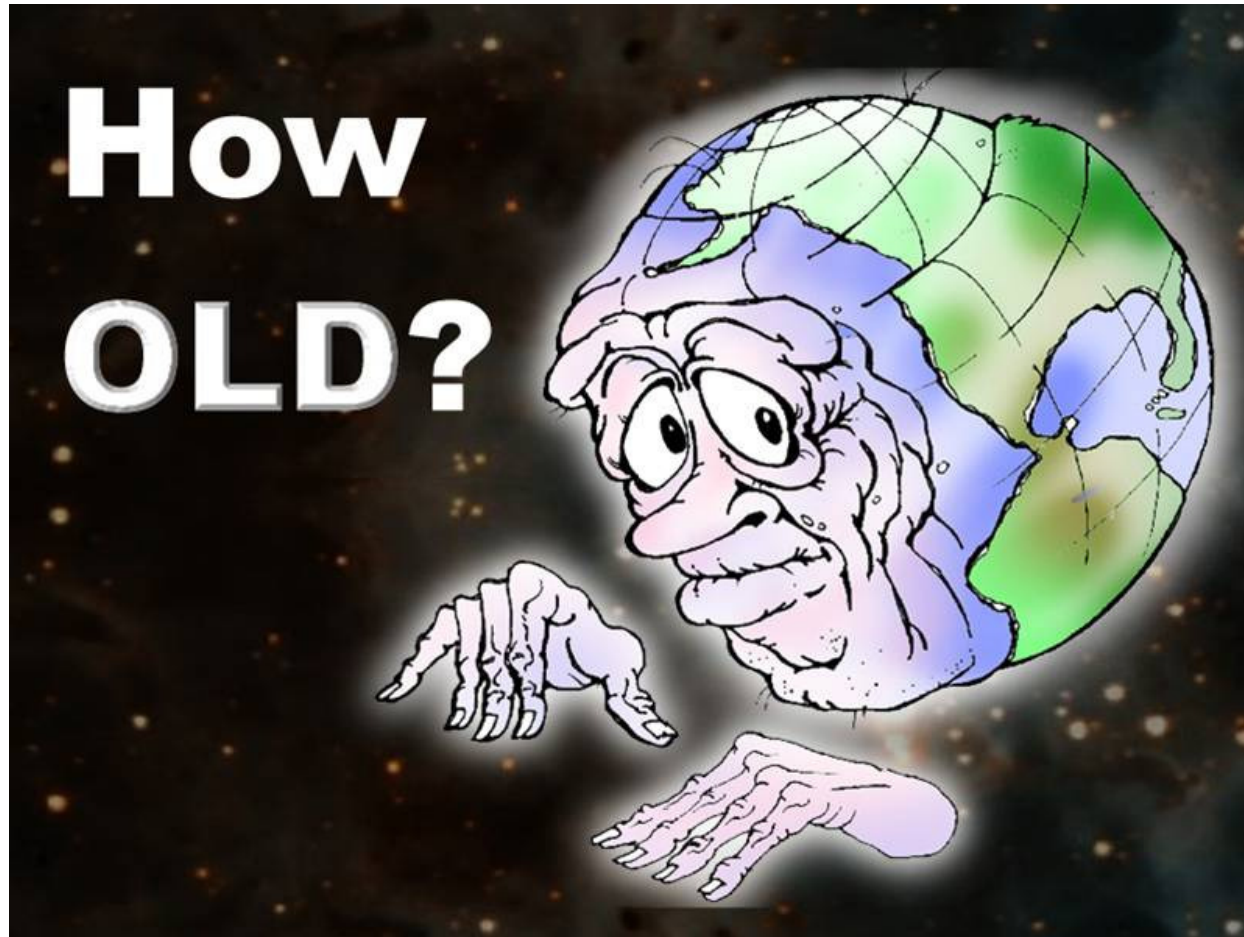
Q. Which one is the biggest? And the smallest?

The Terrestrial Planets



All four planets are small, rocky and dense (3 g/cm^3 or more)

Formation of the Earth



Q. How old is Earth?

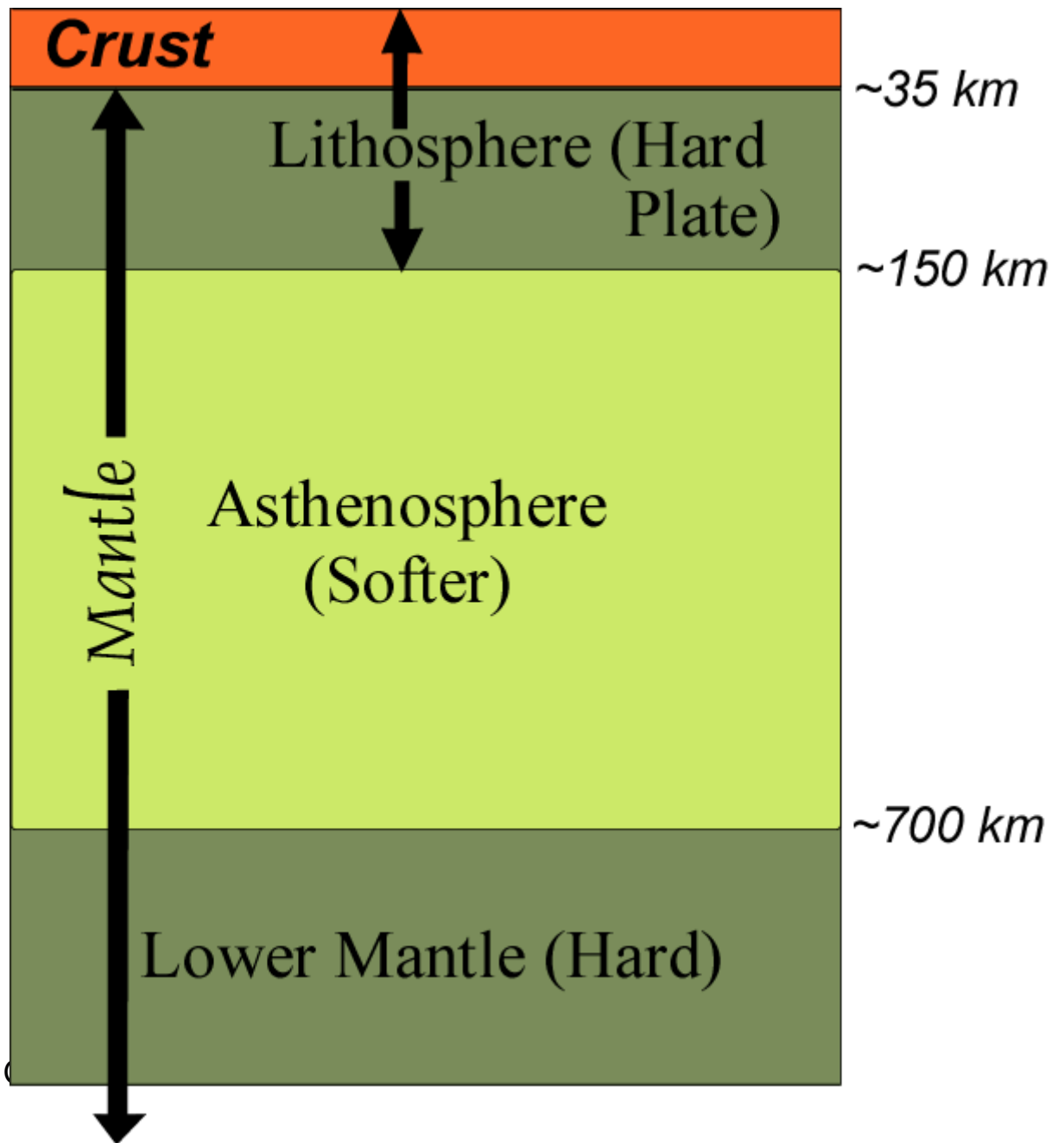
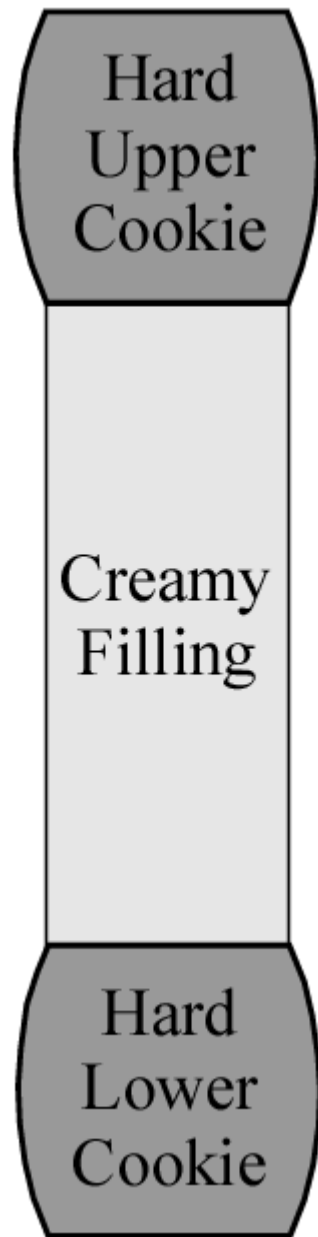
Answer:

Earth is 4.6 billion years old

- The earth has a layered of structure. The centre is a dense, hot core composed mainly of iron and nickel.
- A thick mantle, composed of mainly of solid rock, surrounds the core and contains 80% of the Earth's volume.
- The curst is a thin surface also composed of rock.



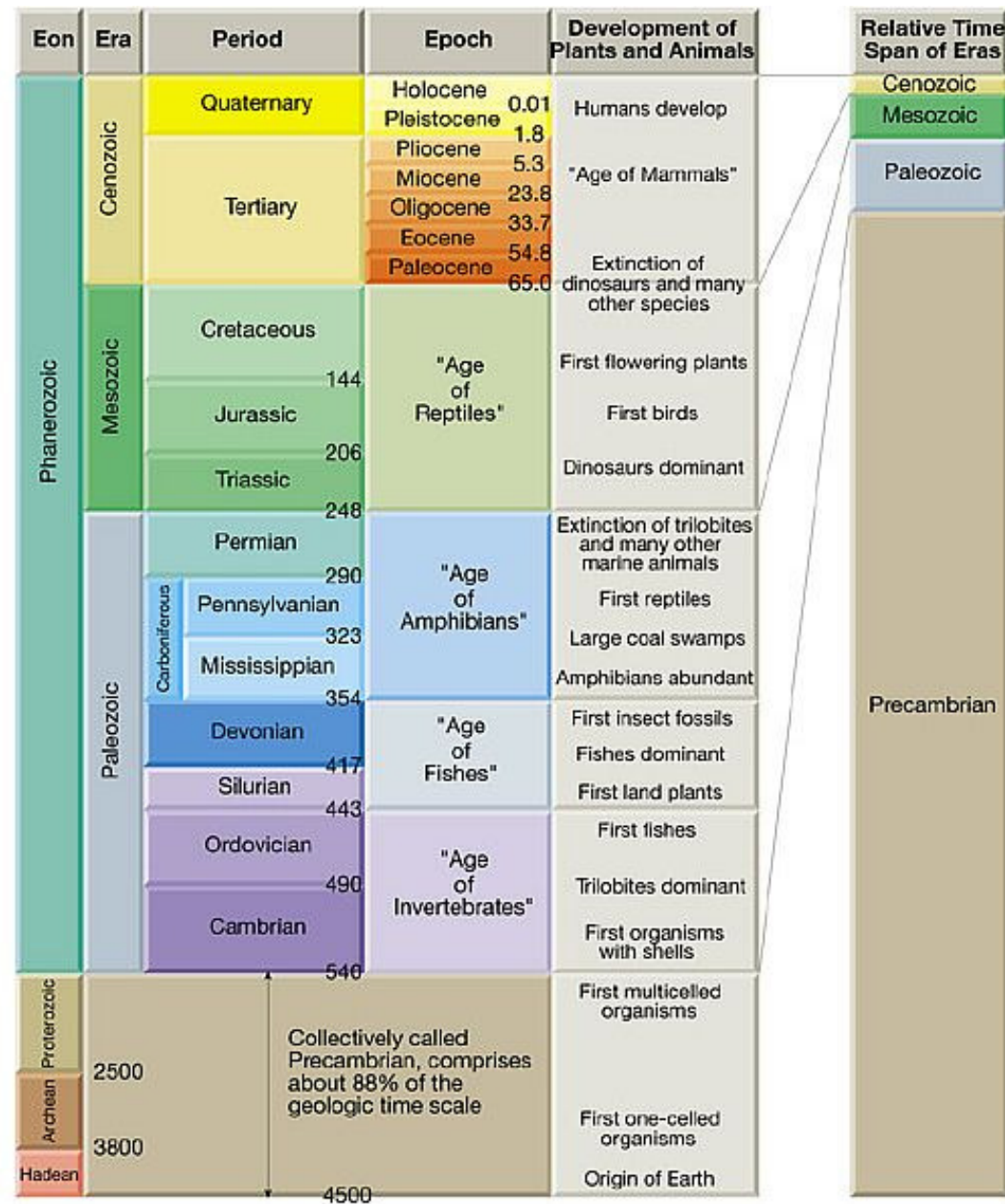
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Geologic Time:

Q. What is geologic time? Is it in seconds, minutes, hours, days, weeks, months, or years?

- The geologic time scale is the calendar that geologists use to date past events in Earth's history.
- The geological time scale is divided into:
 - Eons الدهر
 - Eras الزمن
 - Periods الحقبة
 - Epochs العهد


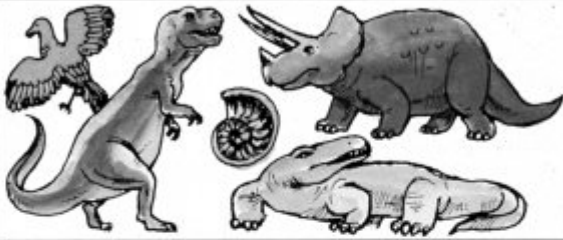



**Q. What is the importance of
geologic time scale?**

- Time is a very important variable in geology, because the exact timing of spatially separated events allows us to reconstruct the surface and surface conditions of the ancient earth.

- It also allows us to put events into chronological order and by those means to deduct the driving forces behind the continuous changes of the Earth.

GEOLOGIC TIME SCALE

ERA	PERIOD	EPOCH	SUCCESION OF LIFE
CENOZOIC recent life	QUATERNARY 0-1 Million Years Rise of Man	Recent Pleistocene	
	TERTIARY 62 Million Years Rise of Mammals	Pliocene Miocene Oligocene Eocene	
MESOZOIC middle life	CRETACEOUS 72 Million Years Modern seed bearing plants, Dinosaurs		
	JURASSIC 46 Million Years First birds		
	TRIASSIC 49 Million Years Cycads, first dinosaurs		
PALEOZOIC ancient life	PERMIAN 50 Million Years First reptiles		
	PENNSYLVANIAN 30 Million Years First insects		
	MISSISSIPPIAN 35 Million Years Many crinoids		
	DEVONIAN 60 Million Years First seed plants, cartilage fish		
	SILURIAN 20 Million Years Earliest land animals		
	ORDOVICIAN 75 Million Years Early bony fish		
	CAMBRIAN 100 Million Years Invertebrate animals, Brachiopods, Trilobites		
	PRECAMBRIAN Very few fossils present (bacteria-algae-pollen?)		