

Geological Time Scale

Eons	Era	Period	Epoch	Age/ Years Before Present	Life/ Major Events
Present	Cainozoic (From 65 million years to the present times)	Quaternary	Holocene Pleistocene	0 - 10,000 10,000 - 2 million	Modern Man Homo Sapiens
		Tertiary	Pliocene Miocene	2 - 5 million 5 - 24 million	Early Human Ancestor Ape: Flowering Plants and Trees
			Oligocene Eocene Palaeocene	24 - 37 Ma 37 - 58 Million 57 - 65 Million	Anthropoid Ape Rabbits and Hare Small Mammals : Rats – Mice
	Phanerozoic	Mesozoic 65 - 245 Million Mammals	Cretaceous Jurassic Triassic		65 - 144 Million 144 - 208 Million 208 - 245 Million
Palaeozoic 245 - 570 Million		Permian		245 - 286 Million	Reptile dominate-replace amphibians
		Carboniferous		286 - 360 Million	First Reptiles: Vertebrates: Coal beds
		Devonian Silurian		360 - 408 Million 408 - 438 Million	Amphibians First trace of life on land: Plants
	Ordovician Cambrian		438 - 505 Million 505 - 570 Million	First Fish No terrestrial Life : Marine Invertebrate	
570	Proterozoic	2500		570 - 2,500 Million	Soft-bodied arthropods
Archean			2,500 - 3,800 Million	Blue green Algae: Unicellular bacteria	
4000			3,800 - 4,800 Million	Oceans and Continents form – Ocean and Atmosphere are rich in Carbon dioxide	
Hadean	Pre-Cambrian 570 Million - 4,800 Million				
4800MYA					
Origin of Stars	5,000 - 13,700 Million			5,000 Million	Origin of the sun
Supernova				12,000 Million	Origin of the universe
Big Bang				13,700 Million	

Geography Class 08

REVISION OF THE PREVIOUS CLASS (9:20 AM):

- We see eclipses when one heavenly body moves into the shadow of another.
- **Solar Eclipse** happens when the moon blocks the light coming from the sun to the Earth.
- We can have total, partial, and annular solar eclipses.
- **Lunar Eclipse** happens when the earth comes between the sun and the moon blocking the light from the sun which was supposed to be reflected by the moon.
- We can have total, partial, and penumbral lunar eclipses.
- **Super Moon** is a phenomenon of a full moon that coincides with the perigee of the moon.
- The **Blood Moon** is the full moon during the lunar eclipse.
- The **Blue Moon** is the second full moon of the month.

Evolution of the Earth:

- The planet Earth was totally barren and rocky at its origin.
- There was a thin atmosphere of hydrogen and helium.
- The early atmosphere with hydrogen and helium was stripped off due to **solar winds**.

Geological Time Scale of the Earth:

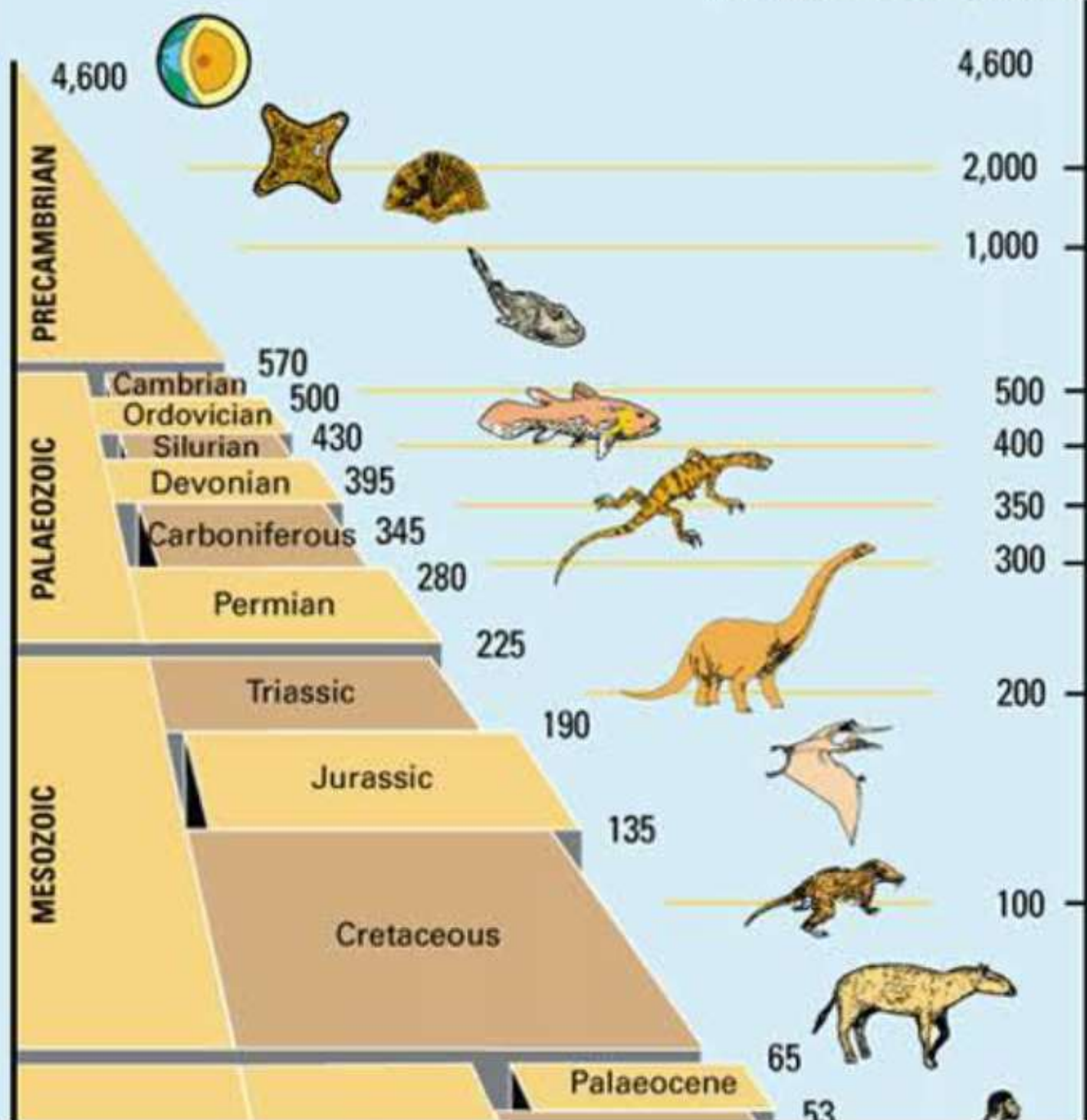
- Features of the earth, as we see it today, were not the same originally- Aravallis were at one point in time higher than the Himalayas.
- The earth is 4800 million years old.
- As animals, we have evolved in the last two million years.
- The cultural evolution(humans residing in community habitations) is around 10,000 years old.
- The survival and eventual dominance of the **Homo Sapiens** is believed to be an accident by many researchers.
- This is because the **Homo Neanderthals** had a bigger brain than us, despite having a shorter size.
- The evolution of our **thumb** was a very major turning point in evolutionary history.
- Our thumb helps us in holding objects, which is seen in very few other mammals like **Orang Utans**.
- Dinosaurs ruled the earth for more than 100 million years.

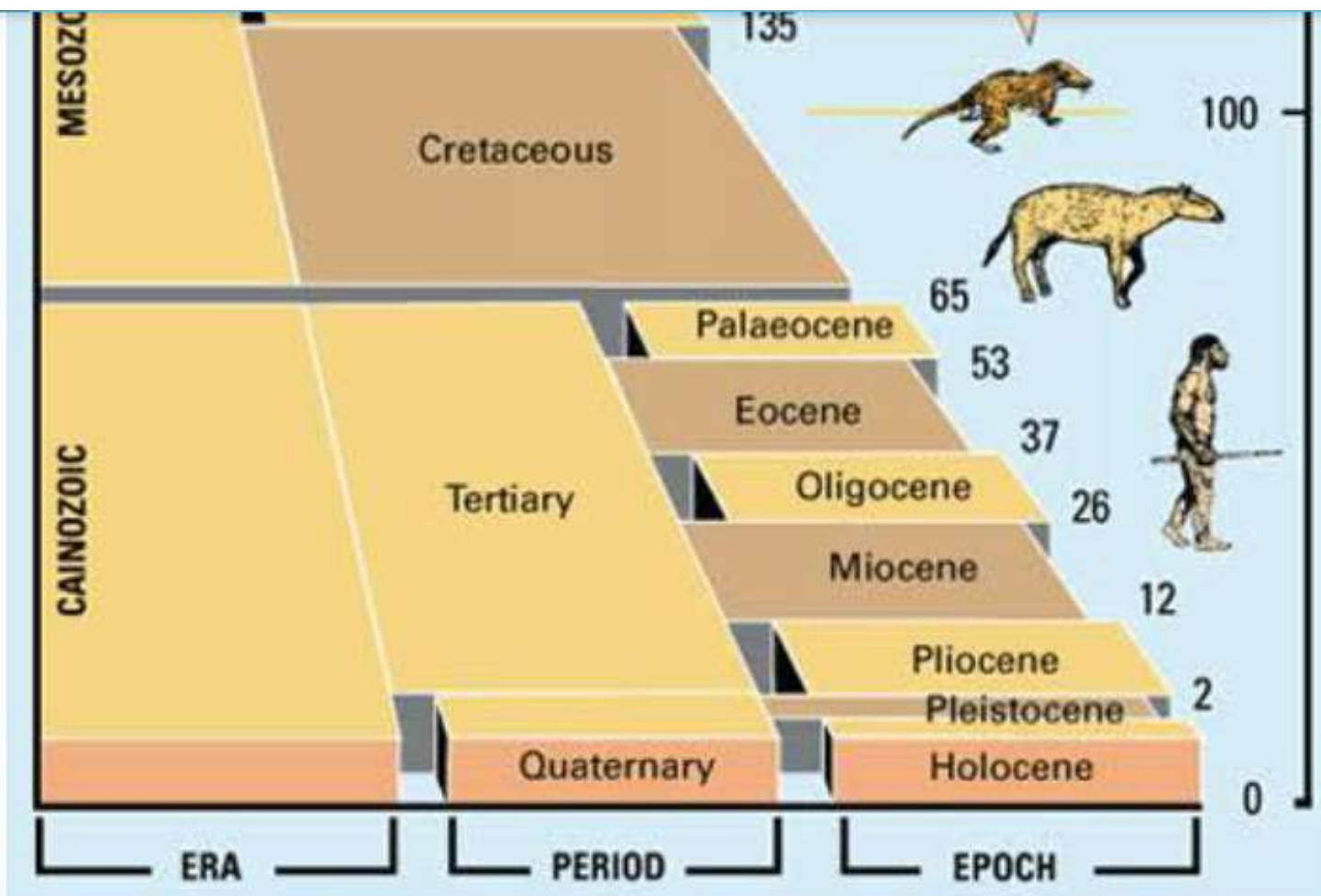
Time Scale divisions:

- Eon-Era-Period-Epoch-Age.
- Every Eon is made up of around one billion years.
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Geological column

Time, in millions of years before the present





- **Hadean Eon** saw the early evolution of the earth- early atmosphere, and hydrosphere.
- **Archaean Eon** saw the evolution of life as blue-green algae
- **Proterozoic Eon** saw changes in the earth as per the changes in oxygen levels.
- This eon saw the coming up of soft-bodied marine multicellular organisms.

Paleozoic Era:

- The **Paleozoic Era** is a sub-division of the **Phanerozoic eon**

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	Eon	Era	Period		Epoch	
<div> <div>Younger</div> <div>↑</div> <div>↓</div> <div>Older</div> </div>	Phanerozoic	Cenozoic	Quaternary		Holocene	← Today
					Pleistocene	← 11.8 Ka
			Neogene		Pliocene	
					Miocene	
					Oligocene	
		Paleogene			Eocene	
					Paleocene	
						← 66 Ma
		Mesozoic	Cretaceous		~	
			Jurassic		~	
			Triassic		~	
		Paleozoic	Permian		~	← 252 Ma
			Carboniferous	Pennsylvanian	~	
				Mississippian	~	
			Devonian		~	
			Silurian		~	
			Ordovician		~	
			Cambrian		~	
	Proterozoic	~	~		~	← 541 Ma
	Archean	~	~		~	← 2.5 Ga
	Hadean	~	~		~	← 4.0 Ga
						← 4.54 Ga

- The **Paleozoic Era** is divided into **six periods**:
- I. We see sudden explosion of life during the **Cambrian Period**.
- II. **Ordovician Period** saw the evolution of the first vertebrates which were primitive fish.
- Life was still in water only and the land was still barren.
- This period saw the first mass extinction.

- **III. Silurian Period** saw the evolution of life on the surface of the land.
- Plants were the first life on the land.
- These plants were non-flowering plants.
- **IV. Devonian Period** saw the rise of amphibians.
- The Devonian period ended with another mass extinction which was driven by global climatic changes.
- **V. Carboniferous Period** saw the rise of the first reptiles.
- **VI. Permian Period** saw the reptiles dominate and replace the amphibians.
- The Permian period ended with another mass extinction.
- **Corals** are some remnants of the Paleozoic era.

MESOZOIC ERA (10:15 AM):

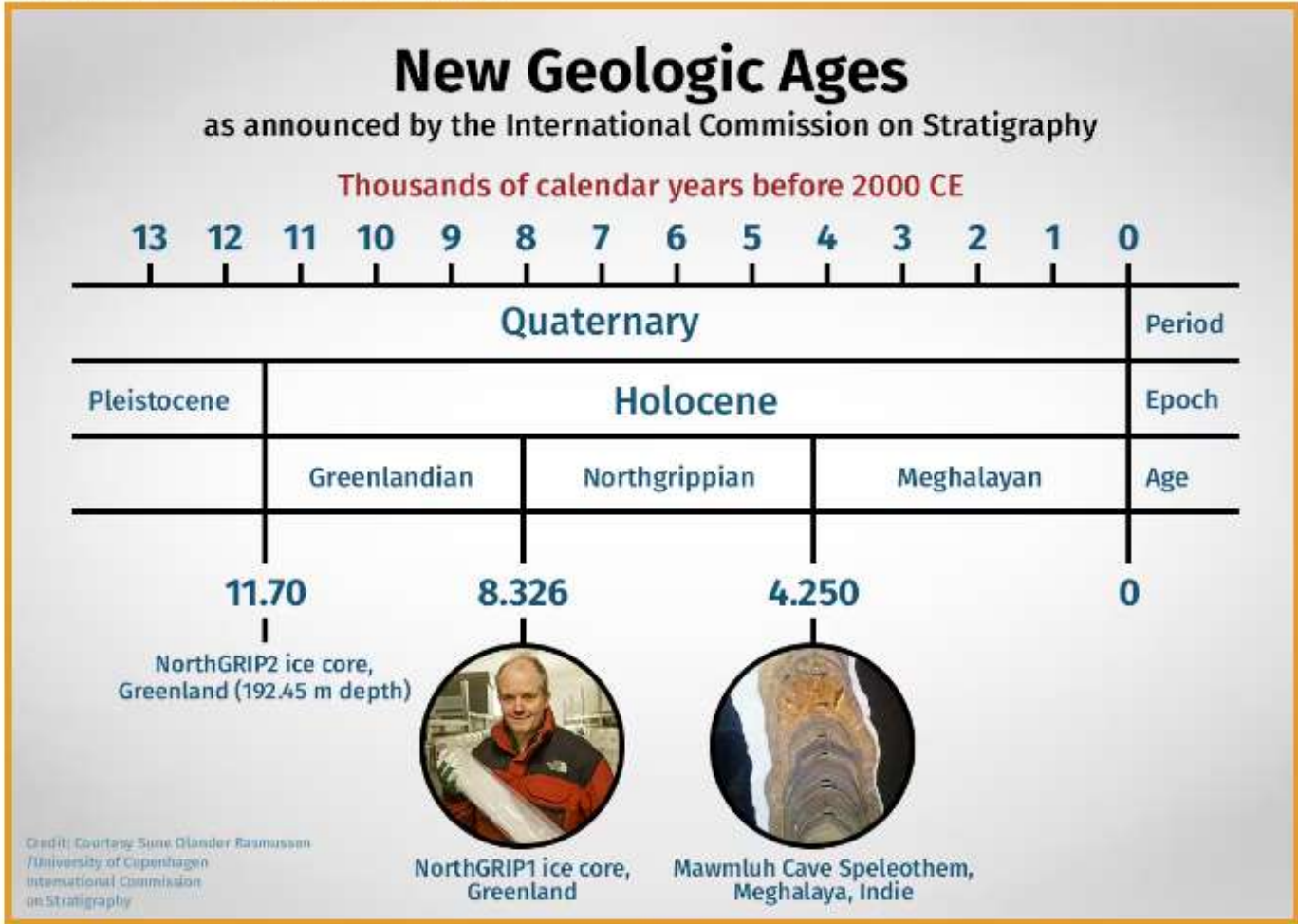
- This era is divided into **three periods**:
- **I. Triassic period** saw the diversification of reptiles.
- This period also ended with a mass extinction.
- **II. Jurassic period**(200 million years ago) is named after the **Jura** mountains of Europe(Switzerland, France, etc.) where pieces of evidence of the period were found.
- The age saw the evolution of **dinosaurs** which were the most dominant creatures on the earth.
- The age also had some mammals.
- Jabalpur, Jaisalmer, etc are some places in India where dinosaur pieces of evidence have been found.
- **III. Cretaceous period** saw dinosaurs rising to their peak.
- This period also ended with a mass extinction.
- Global warming had also reached its peak.
- As per most of the evidence, this mass extinction was caused due to an impact of a huge meteorite that happened near the **Yucatan Peninsula** near the **Gulf of Mexico**.

- The impact resulted in large tsunamis and volcanic eruptions all over the earth.
- Around 95% of the dinosaurs were wiped out.
- Some dinosaurs that were capable of flying, live in water were able to survive.
- Some mammals also survived this event.

Cenozoic Era:

- The Mesozoic era was followed by the **Cenozoic era**.
- 65-2 million years- **Tertiary Cenozoic era:**
- Major events were an evolution of flowering plants, and alpine mountains(Himalayas, Rockies, etc).
- The most important event was the evolution of apes which eventually saw the rise of Homo Sapiens
- 2 million years to present- **Quaternary Cenozoic era:**
- Humans evolved along with lions and cheetahs from the Savannah grasslands of Africa.
- The **Pleistocene epoch** saw the biological evolution of humans.
- The **Holocene epoch** saw the social evolution of humans.

HOLOCENE EPOCH (10:45 AM):



- **Stalagmite** analysis can give very vital information- as one deposited layer takes around 100 years to form.

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- Time analysis of different layers can point to droughts for specific time periods.
- It might also help in discovering if long droughts had wiped out civilizations.
- Stalagmite analysis in 2017 from **Mawmluh caves of Meghalaya** gave us information about what is now known as the **Meghalayan age**.

SOURCES OF INFORMATION ON THE INTERIOR OF THE EARTH (11:15 AM):

Direct Sources:

- Direct sources provide limited observation as we lack the technology to reach the deep interiors of the earth.
- Two sources of direct information are mining and volcanism.

Mining:

- The deep mine and drilling projects have provided a good amount of information such as the increase in pressure, density, and temperature with the depth.
- The maximum depth achieved through mining is about 4 km - **Mponeng gold mine in South Africa.**

Kola Deep Ocean drilling mission:

- The project in 1970 attempted to drill as deeply as possible into the earth's crust.
- It could reach up to 12 km (6300km is the earth's radius).



- The **Kolar** Gold Mines was the deepest gold mine in India (3 km deep) and one of the deepest in the world.
- Mining provides us with limited information through the materials extracted.

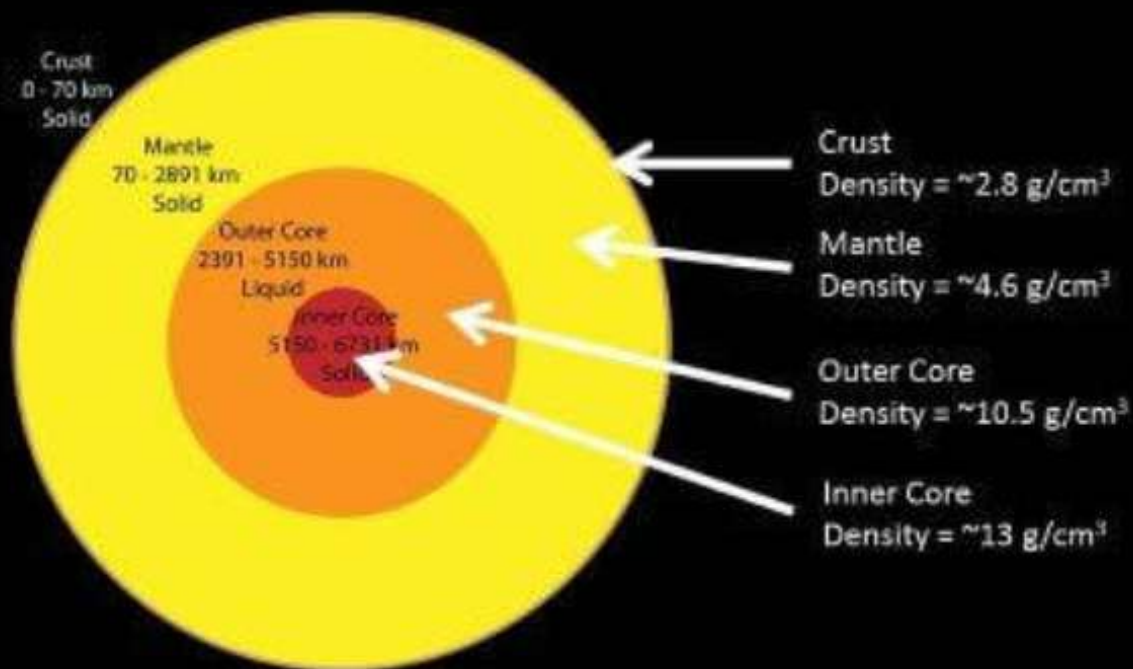
Volcanism:

- The cooling of magma after eruptions and other materials released provide information regarding the earth's interior.
- This is one of the major sources of direct information.
- Eruptions give a clear picture of the constituents, temperature, and density.
- So the need for indirect sources rose.

Indirect sources:**Density study:**

- The average density of the earth is 5.5 gm/cm^3 .
- But the surface continental crust exhibits an average density of 2.7 gm/cm^3 which is almost half of the total average.
- So to attain the average, it is evident that there is an increase in the density with the depth.
- The density is a maximum of 13 gm/cm^3 at the center.
- We could also conclude that the crust is lighter and the core is heavier.

Density increases as you travel from the crust to the inner core.



Seismic Studies

- Through the analysis of different types of earthquake waves, their speed and direction while passing through the earth's interior.
- These are the waves generated during the earthquake that results in the shaking of the lithosphere which is primarily due to the energy released in the form of waves.
- This energy gets transformed into the following types of waves:
- **Body waves:**
- A body wave is a seismic wave that moves through the interior of the earth, as opposed to surface waves that travel near the earth's surface.
- **Surface waves:**
- They move across the surface of the earth.

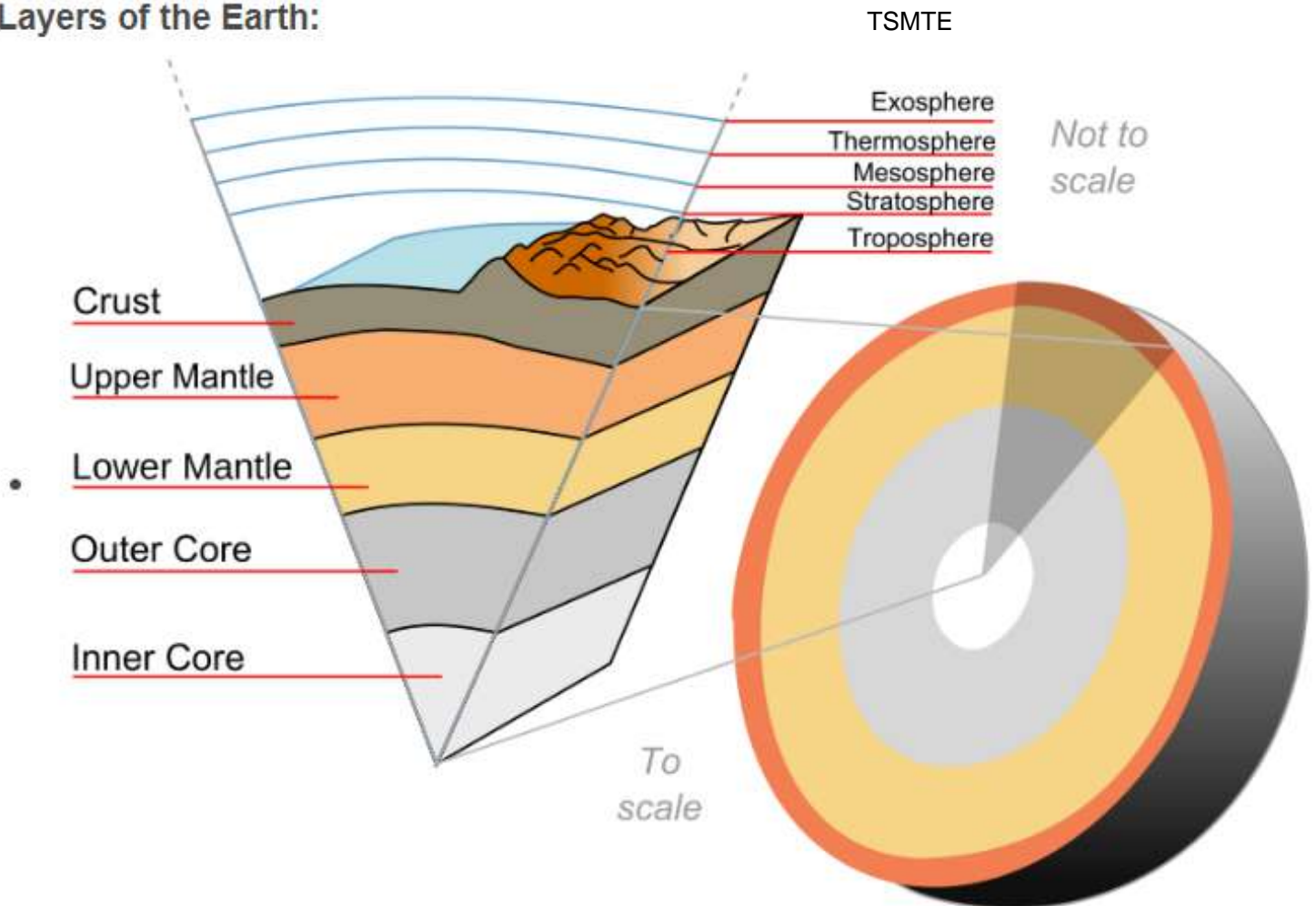
TEMPERATURE & PRESSURE STUDIES (11:45 AM):

- The temperature increases by 1 degree Celsius for every 32 meters as we go deep into the earth.
- However, with the increase in depth, higher pressure increases the melting point of rocks causing variations in the rate of change of temperature.
- Also if we go by the same rate(1 degree/32 meters), the temperature of Earth's center must have been more than Sun's temperature, which is not the case

Meteorites:

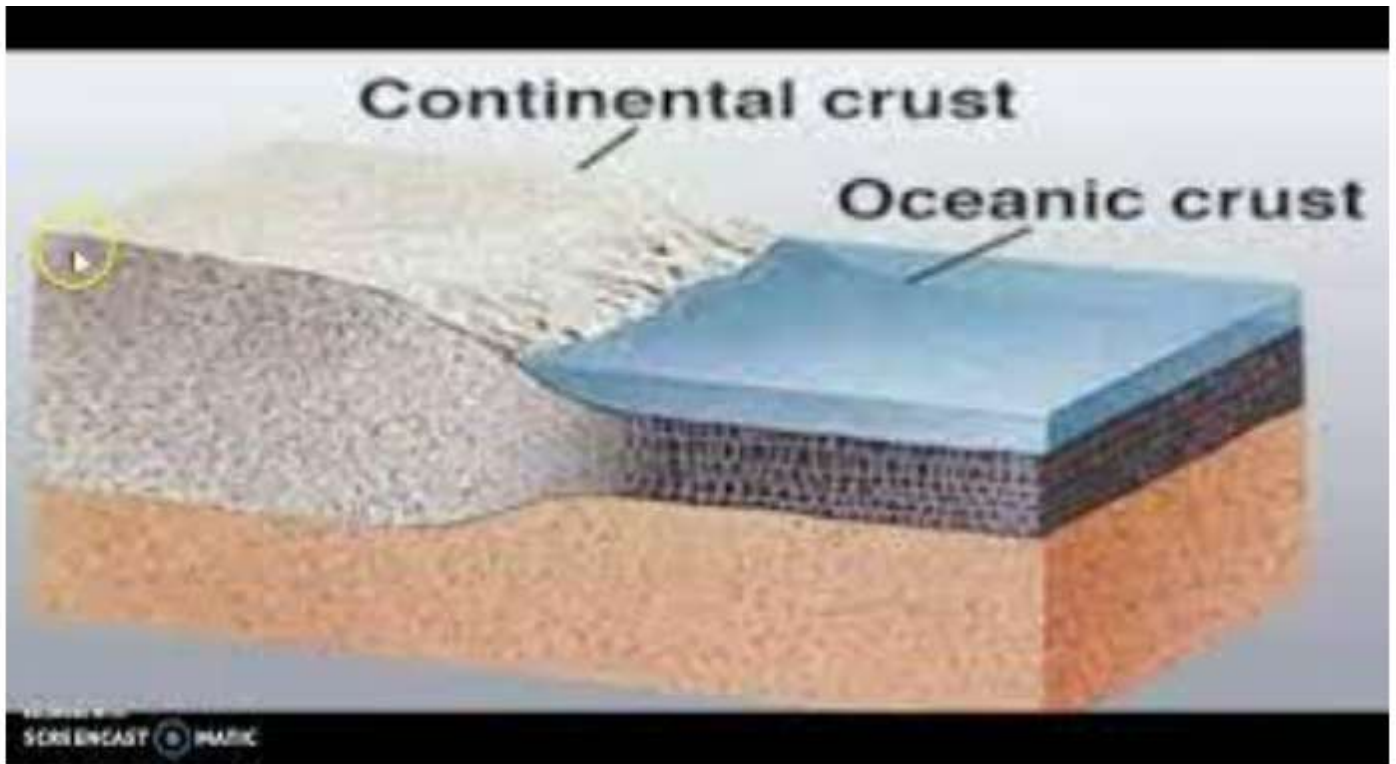
- By analyzing the structure, mineralogy, etc. we can conclude about the earth's interior as meteorites are the remnants of the planets.

Layers of the Earth:



Crust:

- It is the uppermost layer of the earth.
- It is divided into **continental and oceanic crusts**.
- The crust is the lightest and thinnest layer.
- The crust is majorly made up of Silica, Aluminium, Sodium, Magnesium, etc.
- The continental crust has continents over it & the Oceanic crust has oceans above it.
- Continental Crust and Oceanic crust are next to each other, and no one floats above the other.



Mantle:

- This is the thickest layer of the earth.
- It covers 83% of the Earth's volume and 63 % of the Earth's mass.
- It is denser than the crust and lighter than the core.
- it is divided into upper & lower mantle.
- As we go from crust to mantle, the amount of silica & aluminum decreases, and iron & magnesium increase.

Core:

- This is the innermost and densest layer.
- It is almost twice as dense as the mantle.
- It is mainly composed of nickel and iron.
- So it is also called the **Nife** layer.
- it is divided into ^{outer} ~~outer~~ cores & inner core.
- The outer core is liquid (molten rocks) and the inner core is solid.
- As the pressure increases, even the melting point increases.
- The pressure at the inner core is very high and hence, the melting point of the rocks there gets too high.

The topics for the next class are a continuation of the earth's interior, types of discontinuities, types of rocks, etc.