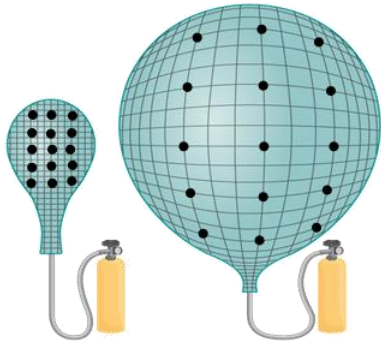


**Origin & Evolution of Earth**



**Big Bang Theory / Expanding Universe Theory**

Singularity → Explosion → Galaxies moving away from each other.  
Edwin Hubble, in 1920, gave evidence that universe is expanding.

- ❖ Universe → Galaxies → Stars → Planets → Moons
- ❖ Galaxies are thousands of light years big
- ❖ They form by accretion in Nebula (large cloud of Hydrogen etc)

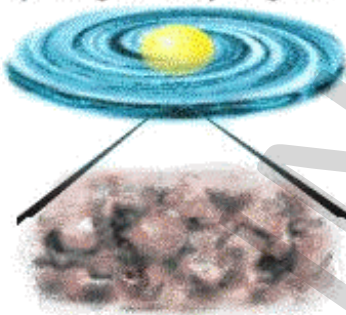
| Creore years ago | Event          | Creore years ago | Event          |
|------------------|----------------|------------------|----------------|
| 1,370            | Big Bang       | 50               | Fish           |
| 500              | Sun            | 45               | Plants         |
| 400              | Planets        | 40               | Amphibians     |
| 450              | Oceans         | 35               | Reptiles       |
| 380              | Life           | 25               | Frogs, Turtles |
| 300              | Photosynthesis | 20-15            | Dinosaurs      |
|                  |                | 15               | Birds          |

- Speed of light = 3 lakh km/s
- Light year = distance light travels in 1 year
- Moon: 1.1 seconds, 3 lakh km
- Sun: 8.3 minutes, 15 crore km
- Proxima Centauri: 4 light years

**Nebular hypothesis**

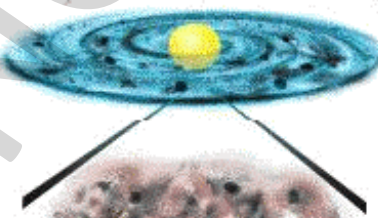
- ❖ Proposed by Immanuel Kant in 1755, modified by Laplace in 1796
- ❖ Planets were formed from gas & dust orbiting a youthful Sun

Disk of gas and dust spinning around young Sun

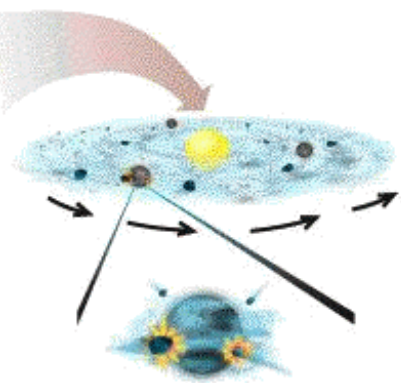


Dust grains

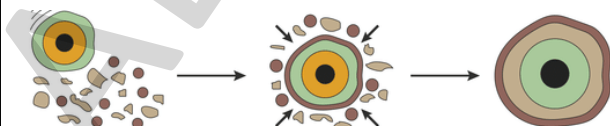
**A**



Dust grains clump into planetesimals

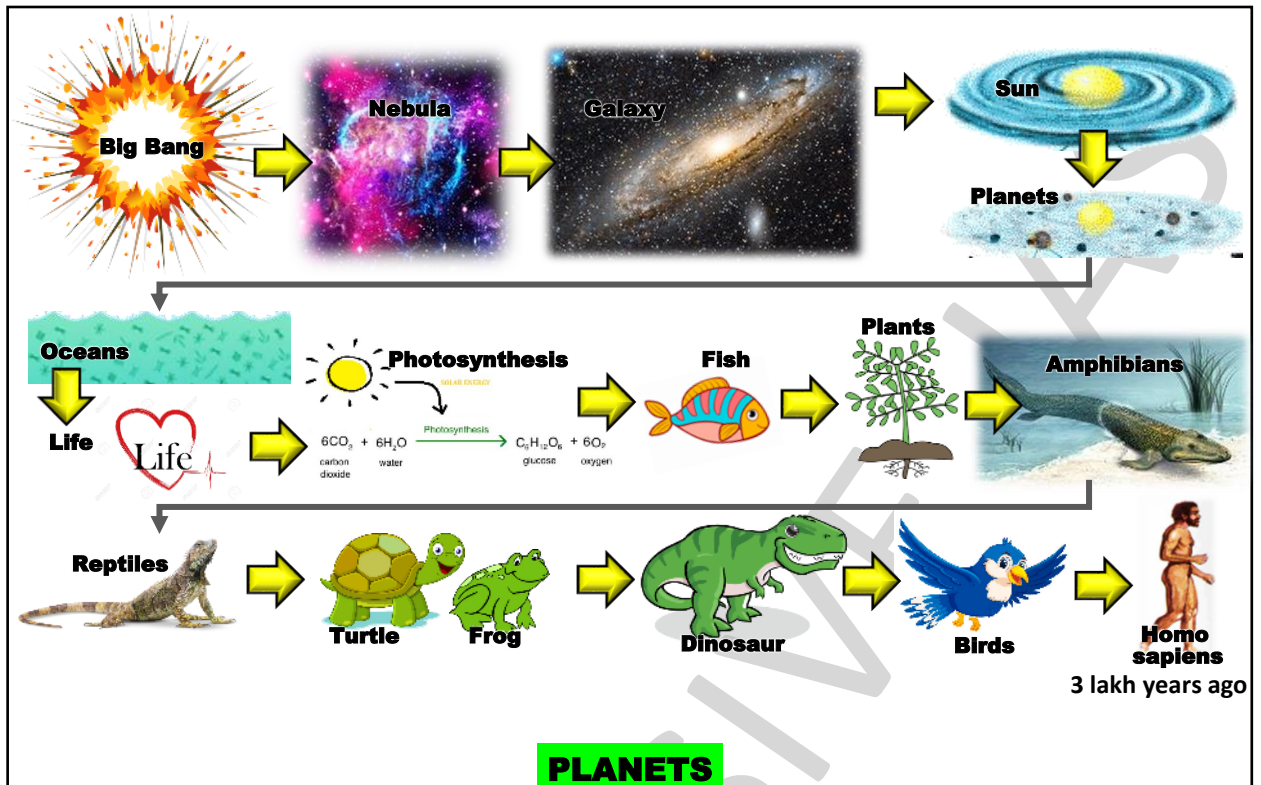


Planetesimals collide and collect into planets



**Accretion:**

accumulation of particles into a massive object due to gravity.



**PLANETS**

**Revolution and Rotation:**

All 8 planets revolve around Sun in direction of Sun's rotation? **Yes**  
 All 8 planets rotate in same direction? **No**

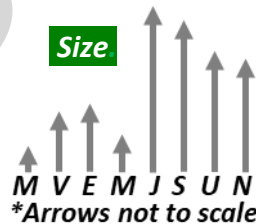
**Time to orbit around Sun?**

(in earth days)  
 Mercury → Neptune

**Why are inner planets rocky? (NCERT)**

- ✓ Too hot for gases to condense
- ✓ Intense Solar wind blew off gases
- ✓ Low gravity could not hold gases

**Size**

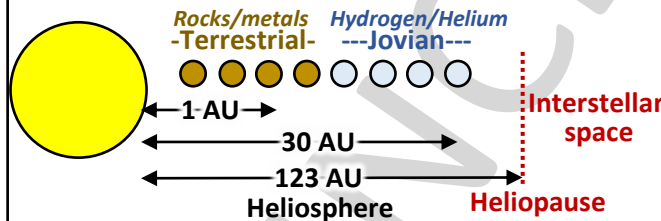


**Density**

- Max Earth
- Min Saturn

**Rings**

- X Terrestrial
- ✓ Jovian



**Astronomical Unit** 15 crore or 150 million km

**Moons** **Zero:** Mercury, Venus **Most:** Saturn

**Prelims 2003**

Among following, which planet takes maximum time for one revolution around Sun?  
 (a) Earth (b) Jupiter (c) Mars (d) Venus

**Prelims 2006**

**Assertion (A):** To orbit around the Sun, **Mars takes lesser time** than the time taken by earth.

**Reason (R):** The diameter of Mars is less than that of earth.

- (a) Both A & R are true and R is the correct explanation of A
- (b) Both A & R are true but R is NOT a correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

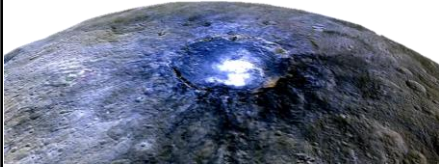
**Prelims 2002**

Which one of the following statements is correct with reference to our solar system?

- (a) The Earth is the densest of all the planets in our solar system
- (b) The predominant element in the composition of Earth is silicon **OXYGEN**
- (c) The Sun contains 75 per cent of the mass of the solar system **99.8%**
- (d) The diameter of the Sun is 190 times that of the Earth **100 times**

### Ceres:

- ❑ Largest asteroid (940 km).
- ❑ Salty water discovered, hence called Ocean World.



### DWARF PLANETS

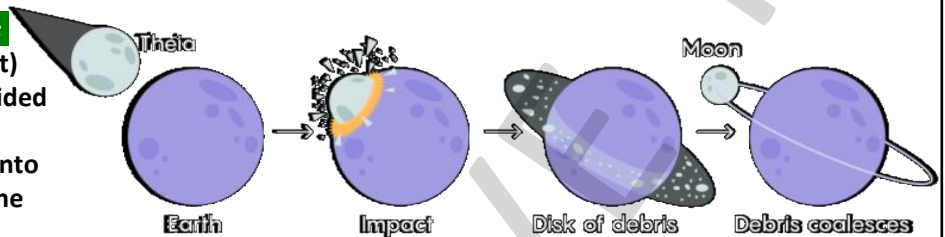
- ❑ By International Astronomical Union (1919, Paris, NGO)
- ❑ How many? **Five** (Pluto, Eris, Makemake, Haumea, Ceres).
- ❑ **Hygiea**, an asteroid, may soon be labelled as Dwarf planet.
- ❑ **Criteria** used by IAU to identify Dwarf planets:
  - It orbits **Sun**, but is **not** a **moon** (natural satellite)
  - It has **not cleared the neighborhood** around its orbit.
  - It is roughly **spherical** due to its strong gravity.

**Note:** Not to be confused with **Planetesimals** (dust particles came together, developed into planets)

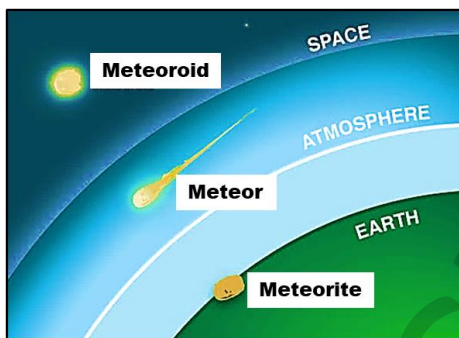
### Giant Impact Hypothesis

(Big splash / Theia impact)

- Mars sized object collided with Earth.
- Part of earth blasted into space, later forming the moon.



### COMET / ASTEROID / etc



- ❑ **Comet:** made of ice, rock, dust; leaves a tail of gas and ice as it travels near the Sun.
- ❑ **Asteroid:** rocky body, larger than 10 meters, orbiting the Sun. Mostly between Mars & Jupiter.
- ❑ **Meteoroid:** rocky body, smaller than 10 meters.
- ❑ **Meteor:** a meteoroid that enters earth's atmosphere and vaporizes.
- ❑ **Meteorite:** A meteor that hits earth's surface.

### Note:

- ❑ **Asteroid belt:** between Mars Jupiter
- ❑ **Kuiper belt:** beyond Neptune
- ❑ **Hailey's comet:** seen every 76 years
- ❑ Comet **Shoemaker-Levy 9** crashed into Jupiter in 1994

### Prelims 1998

Consider the following statements regarding asteroids:

1. Asteroids are **rocky** debris of varying size **orbiting the sun**
2. Most of the asteroids are **small but some** have diameter as **large** and 1000 km
3. The orbit of asteroids lies between the orbits of **Jupiter and Saturn**

Which of the above statements are correct:

- (a) 1, 2, 3      (b) 2 and 3  
 (c) 1 and 2      (d) 1 and 3

### Prelims 2011

What is difference between asteroids and comets?

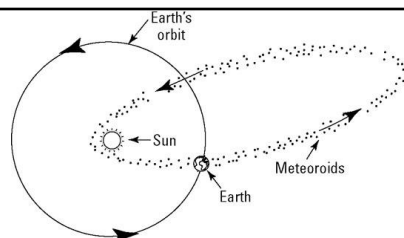
1. **Asteroids** are small **rocky** planetoids, while **comets** are formed of **frozen gases** held together by rocky and metallic material.
2. **Asteroids** are found mostly between the orbits of **Jupiter and Mars**, while **comets** are found mostly between **Venus and Mercury**.
3. **Comets** show a perceptible glowing **tail**, while asteroids do not.

Which of the above statements are correct:

- (a) 1 and 2 only      (b) 1 and 3 only  
 (c) 3 only      (d) 1,2 and 3

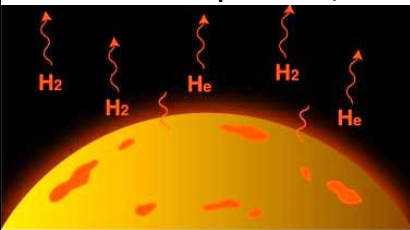
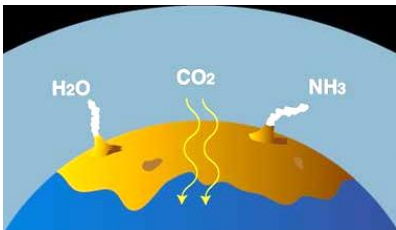
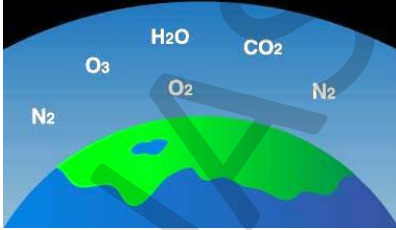
### METEOR SHOWER

- ❑ number of meteors observed in night.
- ❑ when earth passes through path of a comet.
- ❑ due to **debris of comet** from its tail.
- ❑ size no more than grain of sand.





## EVOLUTION OF ATMOSPHERE

| Stage-1<br>Primordial atmosphere of H, He  | Stage-2<br>Secondary atmosphere by Degassing  | Stage-3<br>Modern Atmosphere   |
|--|---|--|
|  |    |  |
| <p>Early atmosphere (Hydrogen, Helium) stripped off by solar winds</p>           | <ul style="list-style-type: none"> <li><input type="checkbox"/> During cooling, volcanoes released water vapour and many gases (CO<sub>2</sub>, NH<sub>3</sub>, etc but very little oxygen)</li> <li><input type="checkbox"/> Water vapour condensed, rained for thousands of years</li> <li><input type="checkbox"/> Water collected into depressions, formed oceans.</li> </ul> | <p>Life and Photosynthesis began, flooding oceans and air with oxygen.</p>         |

### Prelims 2009:

In the structure of Earth, below the mantle, the core is mainly made up of which of the following?

- (a) Aluminium (b) Chromium  
(c) Iron (d) Silicon

### Lithosphere:

Crust and some upper mantle  
 Thickness varies 10-200 km

### Asthenosphere:

Up to 400 km; Upper portion of mantle  
 Main source of magma

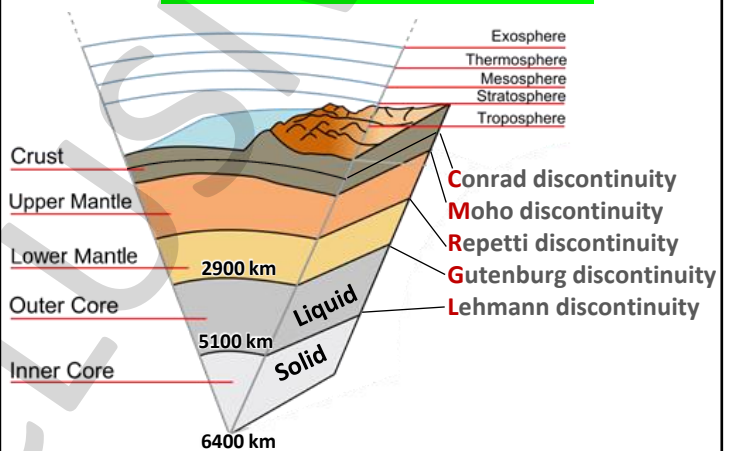
### Core:

Mostly made of nickel & iron (nife)

### Why layers? (Process of Differentiation)

- Formation of earth; High temperature
- Material separated as per to density
- Heavy sank; lighter rose
- Crust cooled and solidified

## STRUCTURE OF EARTH

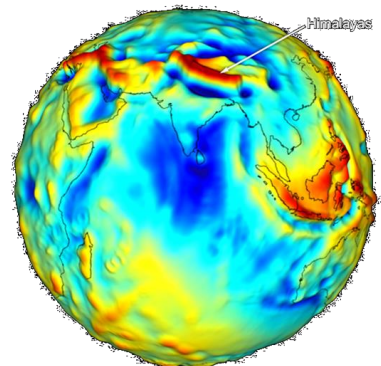


- 70 km** : thickness of Continental crust at **Himalayas**
- 30 km** : thickness of Continental crust at **plains**
- 05 km** : thickness of **oceanic** crust

**SIAL** → Silica + Magnesium → Upper layer of crust  
**SIMA** → Silica + Aluminium → Lower layer of crust

### Source of info about earth interior:

- Direct sources:** rocks from mining, Volcanic eruptions
- Indirect sources:** change in temp/pressure in mines, Meteorite, gravitation, magnetic field, seismic activity



## GRAVITY ANOMALY

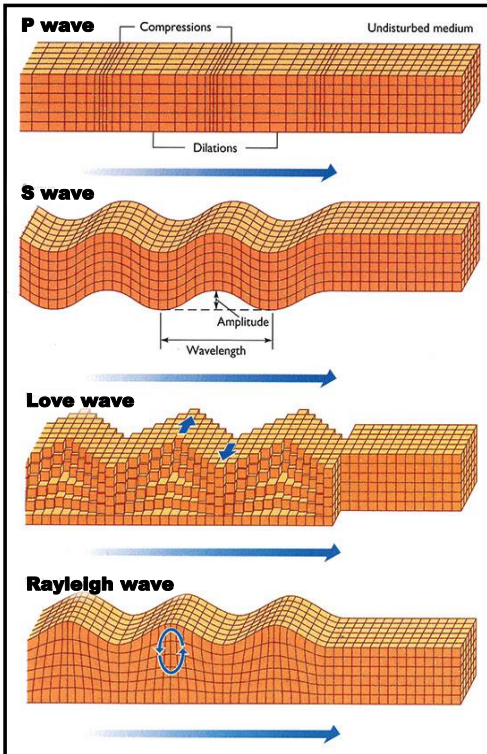
**What:** difference b/w actual and expected gravity at a place

**Reason:** uneven distribution of mass in earth

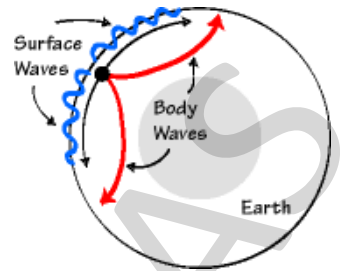
Gravity comes from mass.

Mass is **not** uniformly distributed.

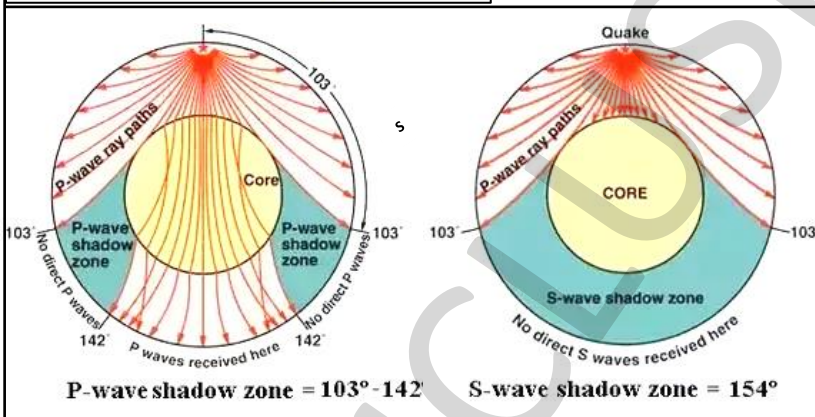
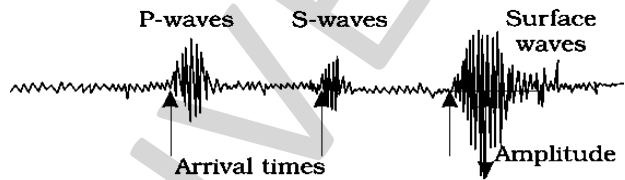
I read I forget, I see I remember | See explanation of this PDF on **YouTube** [www.youtube.com/c/allinclusiveias](http://www.youtube.com/c/allinclusiveias)



## EARTHQUAKES



- All natural earthquakes take place in the **lithosphere**
- Waves are **faster in denser material**.
- **Body waves:** move through the body. **P-waves** travel through solid liquid gas. **S-waves** travel only through solid. **P-waves** are faster, arrive first.
- **Surface waves:** move along the surface. They are generated when body waves interact with surface rocks. Most **destructive**.

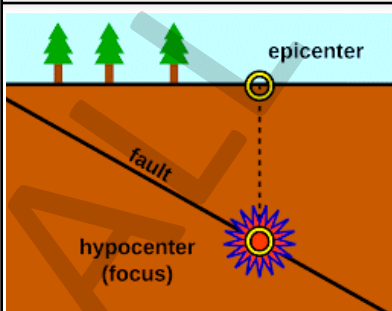


- Earthquakes can be **predicted** few hours before. No
- Warning** can be sent seconds before an earthquake strikes? Yes (**P vs S**)
- Google** is turning Android phones into Earthquake Detectors.
- Benefit:** Elevators, gas pipelines can be shut off automatically

### Remember:

- Richter scale has log base 10.
- So, each increase in number has 10 times more amplitude (magnitude) and 30 times more energy

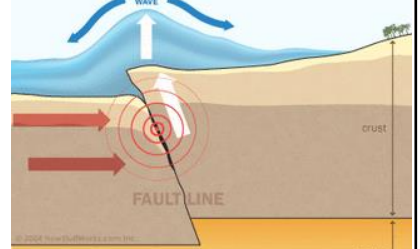
| Richter                             | Mercalli                     |
|-------------------------------------|------------------------------|
| Magnitude (Seismic waves or energy) | Intensity (observed effects) |
| Energy released (Magnitude)         | Damage caused (Intensity)    |
| Measured by Seismograph             | Measured by Observation      |
| Range 0-10                          | Range 1-12                   |



**Epicentre:**  
point on surface nearest to Focus.

**Focus:**  
point where the energy is released.

### Epicentre in ocean may cause Tsunami



I read I forget, I see I remember

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