

- (ii) In the next stage, the gas cloud starts getting condensed and the matter around the core develops into small-rounded objects. These small-rounded objects by the process of cohesion develop into what is called *planetesimals*. Larger bodies start forming by collision, and gravitational attraction causes the material to stick together. Planetesimals are a large number of smaller bodies.
- (iii) In the final stage, these large number of small planetesimals accrete to form a fewer large bodies in the form of planets.

### OUR SOLAR SYSTEM

Our Solar system consists of eight planets. The nebula from which our Solar system is supposed to have been formed, started its collapse and core formation some time 5-5.6 billion years ago and the planets were formed about 4.6 billion years ago. Our solar system consists of the sun (the star), 8 planets, 63 moons, millions of smaller bodies like *asteroids* and *comets* and huge quantity of dust-grains and gases.

Out of the eight planets, mercury, venus, earth and mars are called as the *inner planets* as they lie between the sun and the belt of asteroids the other four planets are called the *outer planets*. Alternatively, the first four are called *Terrestrial*, meaning earth-like as they are made up of rock and metals, and have relatively high densities. The rest four are called *Jovian* or Gas Giant planets. Jovian means jupiter-like. Most of them are much larger than the terrestrial planets and have thick atmosphere, mostly of helium and hydrogen. All the planets were formed

in the same period sometime about 4.6 billion years ago. Till recently (August 2006), Pluto was also considered a planet. However, in a meeting of the International Astronomical Union, a decision was taken that Pluto like other celestial objects (2003 UB<sub>313</sub>) discovered in recent past may be called 'dwarf planet'. Some data regarding our solar system are given in the box below.

Why are the inner planets rocky while others are mostly in gaseous form?

The difference between terrestrial and jovian planets can be attributed to the following conditions:

- (i) The terrestrial planets were formed in the close vicinity of the parent star where it was too warm for gases to condense to solid particles. Jovian planets were formed at quite a distant location.
- (ii) The solar wind was most intense nearer the sun; so, it blew off lots of gas and dust from the terrestrial planets. The solar winds were not all that intense to cause similar removal of gases from the Jovian planets.
- (iii) The terrestrial planets are smaller and their lower gravity could not hold the escaping gases.

### The Moon

The moon is the only natural satellite of the earth. Like the origin of the earth, there have been attempts to explain how the moon was formed. In 1838, Sir George Darwin suggested that initially, the earth and the moon formed a single rapidly rotating body. The whole mass

The Solar System

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Distance*	0.387	0.723	1.000	1.524	5.203	9.539	19.182	30.058
Density@	5.44	5.245	5.517	3.945	1.33	0.70	1.17	1.66
Radius#	0.383	0.949	1.000	0.533	11.19	9.460	4.11	3.88
Satellites	0	0	1	2	about 53	about 53	about 27	13

\* Distance from the sun in astronomical unit i.e. average mean distance of the earth is 149,598,000 km = 1 @ Density in gm/cm<sup>3</sup>

# Radius: Equatorial radius 6378.137 km = 1

Source: <http://planetarynames.wr.usgs.gov/page/planets>



- (ii) In the next stage, the gas cloud starts getting condensed and the matter around the core develops into small-rounded objects. These small-rounded objects by the process of cohesion develop into what is called *planetesimals*. Larger bodies start forming by collision, and gravitational attraction causes the material to stick together. Planetesimals are a large number of smaller bodies.
- (iii) In the final stage, these large number of small planetesimals accrete to form a few large bodies in the form of planets.

### EVOLUTION OF THE EARTH

Do you know that the planet earth initially was a barren, rocky and hot object with a thin atmosphere of hydrogen and helium. This is far from the present day picture of the earth. Hence, there must have been some events—processes, which may have caused this change from rocky, barren and hot earth to a beautiful planet with ample amount of water and conducive atmosphere favouring the existence of life. In the following section, you will find out how the period, between the 4,600 million years and the present, led to the evolution of life on the surface of the planet.

The earth has a layered structure. From the outermost end of the atmosphere to the centre of the earth, the material that exists is not uniform. The atmospheric matter has the least density. From the surface to deeper depths, the earth's interior has different zones and each of these contains materials with different characteristics.

iron) to sink towards the centre of the earth and the lighter ones to move towards the surface. With passage of time it cooled further and solidified and condensed into a smaller size. This later led to the development of the outer surface in the form of a crust. During the formation of the moon, due to the giant impact, the earth was further heated up. It is through the process of differentiation that the earth forming material got separated into different layers. Starting from the surface to the central parts, we have layers like the crust, mantle, outer core and inner core. From the crust to the core, the density of the material increases. We shall discuss in detail the properties of each of this layer in the next chapter.

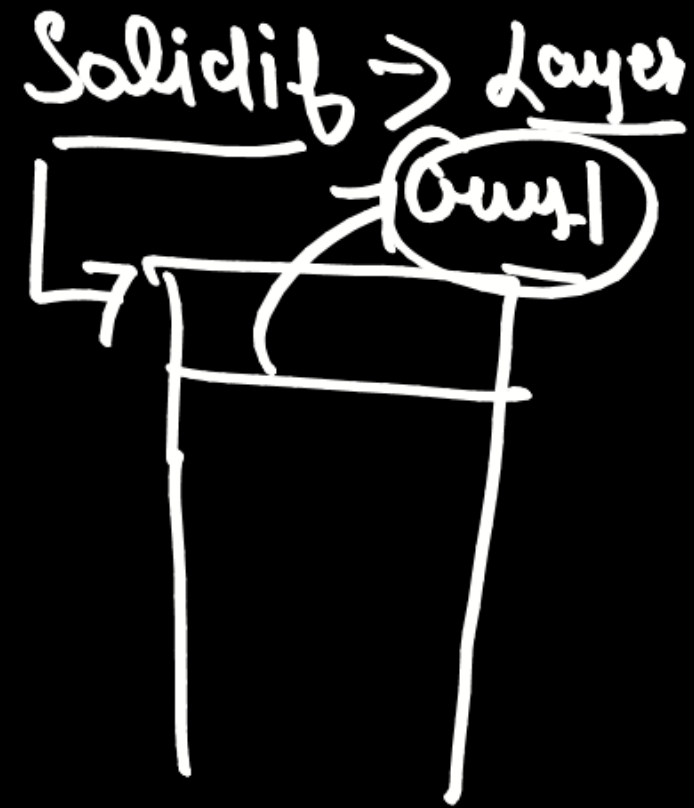
### Evolution of Atmosphere and Hydrosphere

The present composition of earth's atmosphere is chiefly contributed by nitrogen and oxygen. You will be dealing with the composition and structure of the earth's atmosphere in Chapter 8.

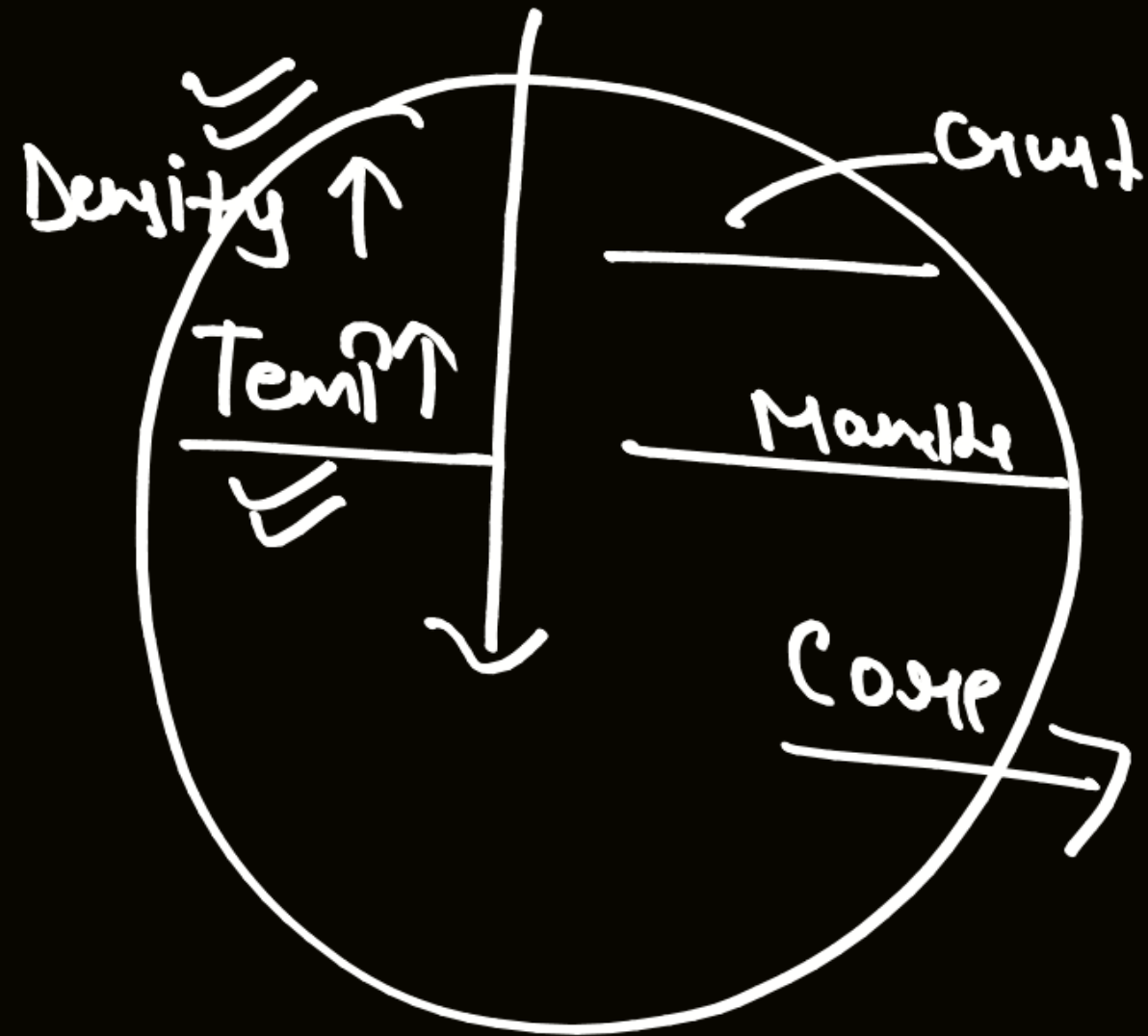
There are three stages in the evolution of the present atmosphere. The first stage is marked by the loss of primordial atmosphere. In the second stage, the hot interior of the earth contributed to the evolution of the atmosphere. Finally, the composition of the atmosphere was modified by the living world through the process of *photosynthesis*.

The early atmosphere, with hydrogen and helium, is supposed to have been stripped off as a result of the solar winds. This happened not only in case of the earth, but also in all the terrestrial planets, which were supposed to have lost their primordial atmosphere through

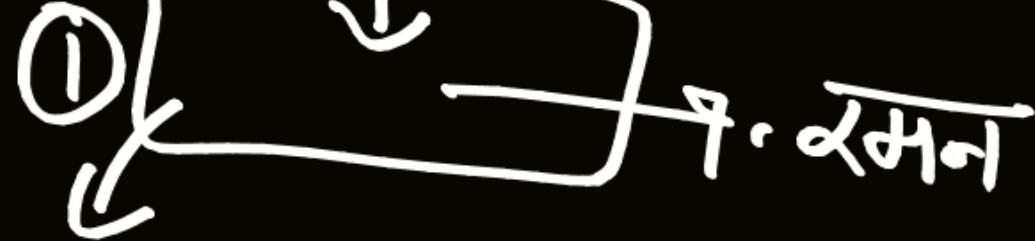
Ne  
Topp  
Cooling



Primordial  
Cooling  
↓  
भारी → अलग  
हल्के → अलग  
Density ↓



Density  
ખાર

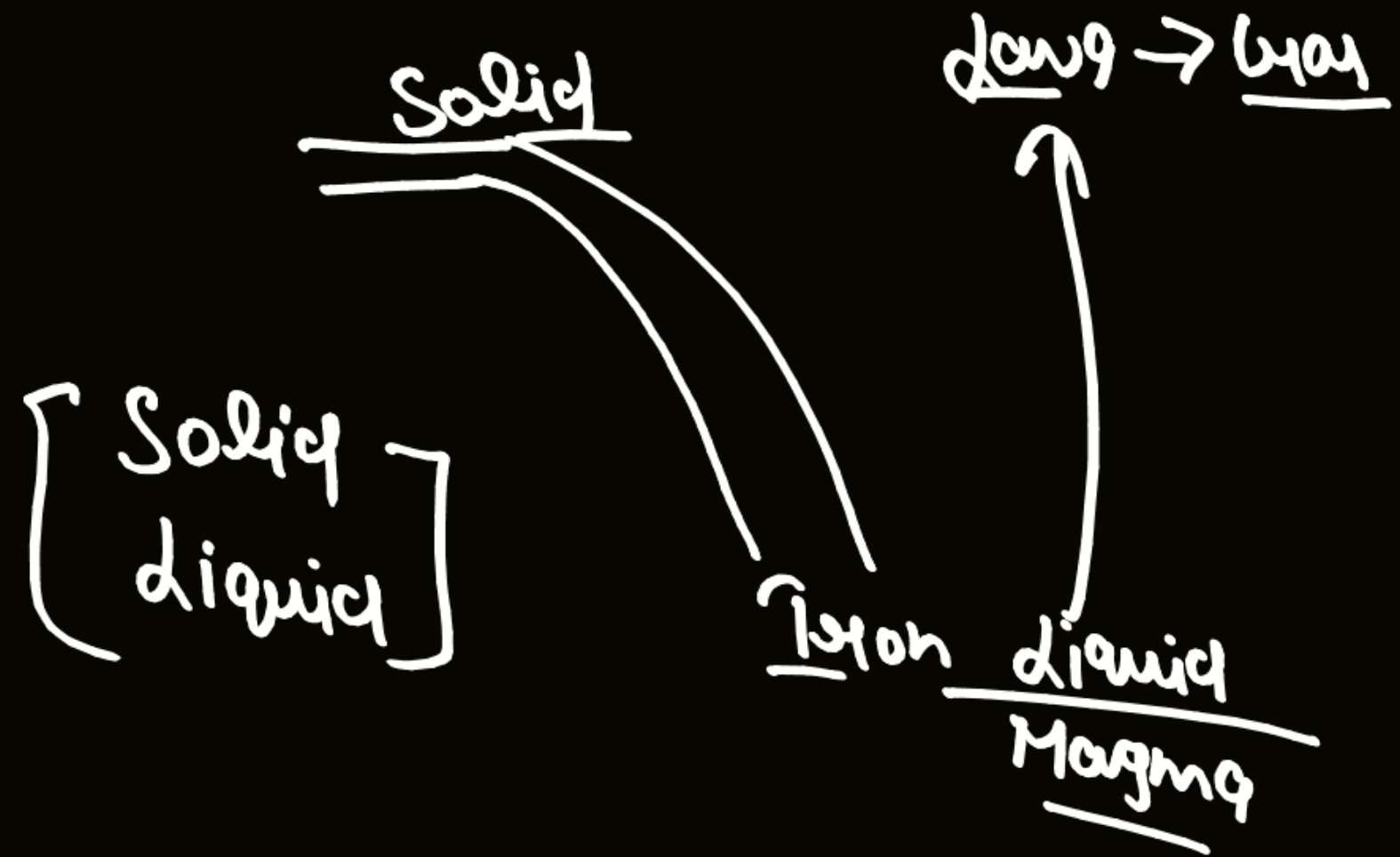


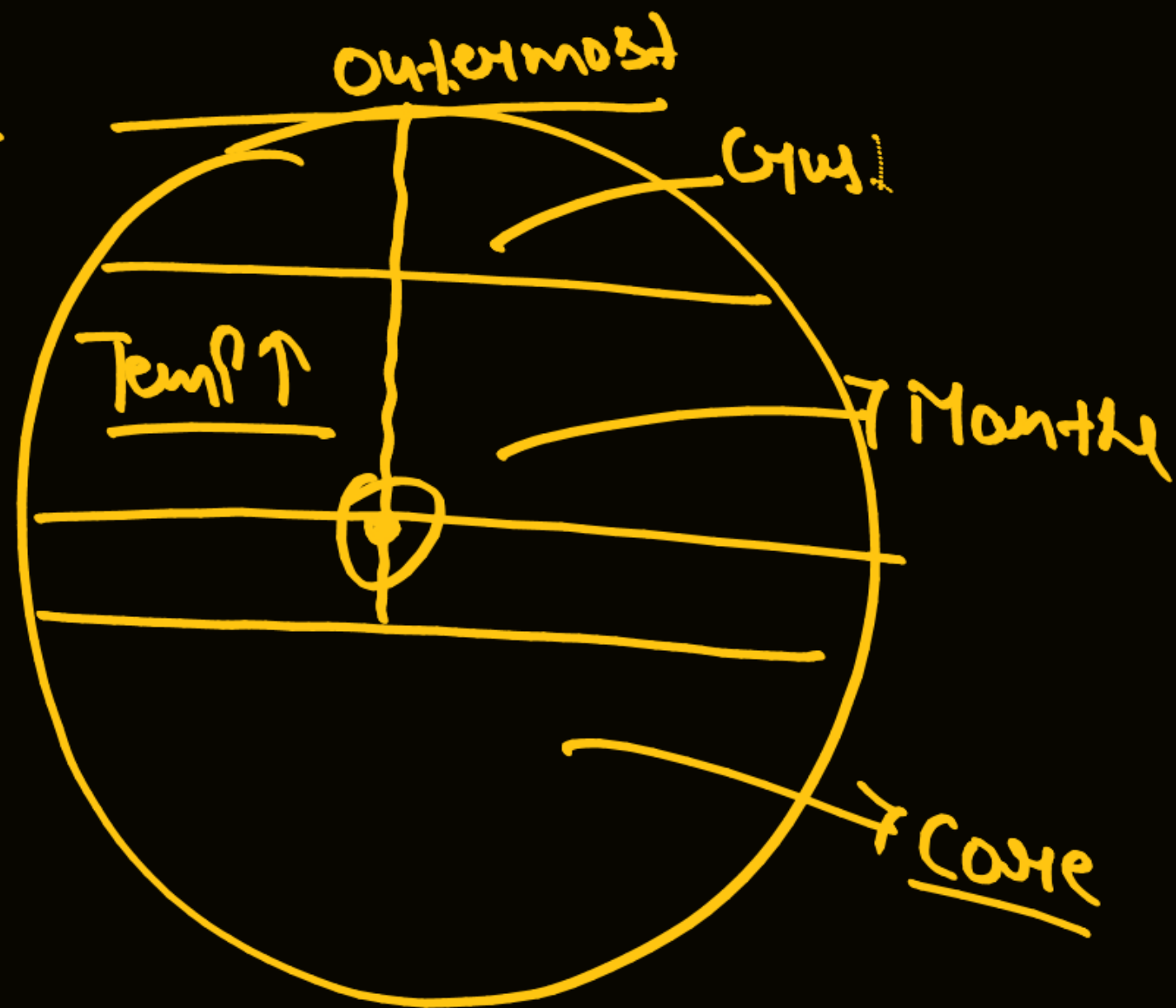
Density  
ખાર

વ. રમન

CHapati







① Earth: { 4.5 <sup>billion</sup> years ago

IMCQ

[ Barren, Rocky: Rock ]

air

thin line  
atmosphere

→ more  
IMP  
(Hydrogen)  
- Helium

Outgassing / Degassing

Earth of Hot C Magma

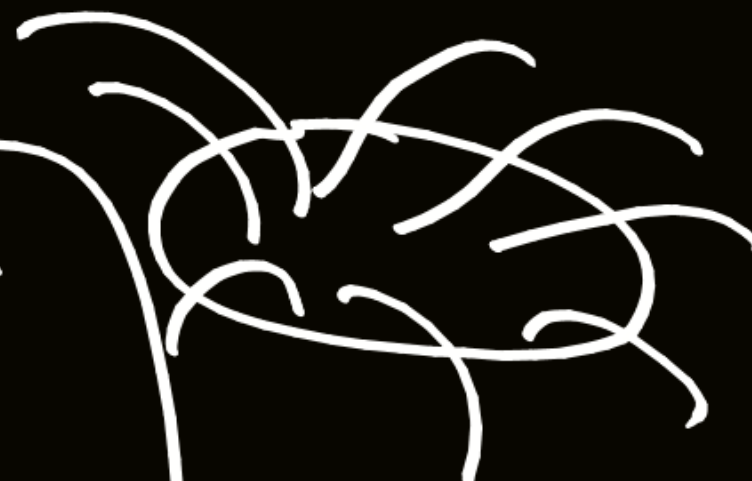
Hydrogen,  
Helium

Released

O<sub>2</sub> X there  
way no

Water

- ✓ Water Vapor
- ✓ Carbon Dioxide
- ✓ Methane
- ✓ Sulfur Dioxide
- ✓ N<sub>2</sub>





(billions)  
Condense (cooling)

→ ↓ Reduce 100°C ↓

[Water cyclone]

Cycle  
Hydro

Water Vapour

→ Condense

→ liquid

Water droplets



→ Sky: Rain

रुकना नहीं है, थमना नहीं है,  
तुम्हें खुद को पाना है।





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## KEEP LEARNING

*Thank You*



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