

Nuclear Disc Model (Neo-Laplacian Model)

Core Idea

- The solar system formed from a **rotating interstellar nebula** (gas + dust).
- Explains **Sun and planets formation together**, unlike earlier encounter theories.

Timeline

- Nebula collapse began: **~5–5.6 billion years ago**
- Formation of Sun & planets: **~4.6 billion years ago**
- Age of Earth: **~4.54 billion years**

Formation of the Sun

- Nebula became **gravitationally unstable** (possibly due to a nearby supernova shock).
- **Gravitational collapse** led to a dense, hot central core.
- **~99.9%** of matter accumulated at centre → **Protosun**.
- Nuclear fusion started → **Sun formed**.
- Remaining **~0.1% matter** formed a rotating **protoplanetary disc**.

Protoplanetary Disc

- Flat, rotating disc of gas and dust around the Sun.
- Site for **planet formation**.

Formation of the Planets

- Dust particles collided → **accretion**.
- Formation sequence:
 1. Dust grains
 2. **Planetesimals** (a few km-sized bodies)
 3. **Protoplanets**
 4. Planets

Planet Types (Temperature-based differentiation)

Inner Solar System (Hot Region)

- Composition: **Silicates & metals**
- Planets: **Mercury, Venus, Earth, Mars**
- Type: **Terrestrial (rocky) planets**
- Metal-rich cores (Iron, Nickel)

Outer Solar System (Cool Region)

- Composition: **Ice, hydrogen, helium**
- Planets: **Jupiter, Saturn, Uranus, Neptune**
- Type: **Gas & ice giants**

Asteroids

- Leftover rocky material not accreted.
- Concentrated mainly in the **Asteroid Belt (Mars–Jupiter)**.

Iron Catastrophe

- Occurred **~4.5 billion years ago**.
- Earth heated beyond the **iron melting point (~1538°C)**.
- Triggered a large-scale internal rearrangement.

Planetary Differentiation

- Heavy metals (**iron, nickel**) sank to form the **core**.
- Lighter materials (**silicates, water, gases**) rose upward.
- Led to the formation of:
 - **Core**
 - **Mantle**
 - **Crust**

MCQs

Q1. According to the Nuclear Disc Model, what percentage of the original nebular material formed the Sun?

- A. About 50%
- B. About 75%
- C. About 90%
- D. About 99.9%

Answer: D

Q2. The flat, rotating structure from which planets formed in the early solar system is known as the:

- A. Solar wind belt
- B. Asteroid halo
- C. Protoplanetary disc
- D. Kuiper disc

Answer: C

Q3. Planetesimals in the inner solar system were primarily composed of:

- A. Ice and hydrogen
- B. Water ice and methane
- C. Silicates and metals
- D. Helium and ammonia

Answer: C

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