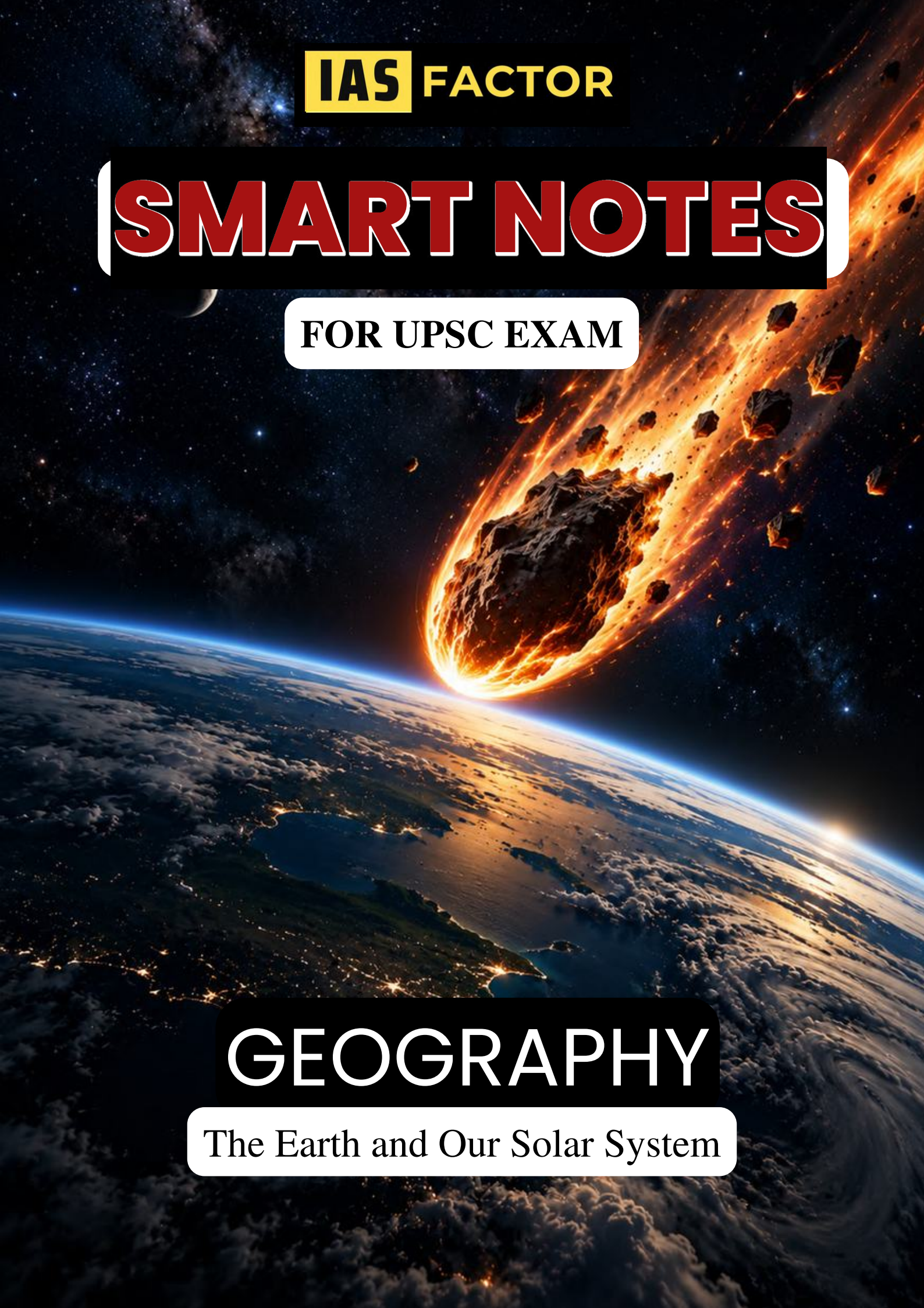
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SMART NOTES

FOR UPSC EXAM



GEOGRAPHY

The Earth and Our Solar System

The Earth and Our Solar System

A Sky Full of Objects

Look at the sky after sunset. At first, you may see only a few bright objects. As the sky becomes darker, more and more of them become visible.

Some are bright, while others are faint. Some seem to **twinkle**, while a few appear to shine steadily.

All the natural objects that we see in the sky are broadly called **celestial bodies**. Stars, planets, the Moon, asteroids and meteoroids are examples of celestial bodies.



Q. What are stars? Why does the Sun appear larger and brighter than other stars, and why do stars appear to twinkle at night?

Some celestial bodies are extremely large and hot. They are made mainly of gases and produce their **own heat and light**.

These are called **stars**.

The **Sun is also a star**. It looks much larger and brighter than other stars simply because it is much closer to us.

Stars that we see at night are actually very far away. That is why they appear like tiny points of light even though many of them are enormous.

Why do stars twinkle?

When we look at stars from Earth, their light passes through different layers of our atmosphere. This makes their light appear to change slightly, producing the effect we call **twinkling**. Stars → produce their own light.

Q. What is a constellation? Explain how constellations appear to form patterns in the night sky, with special reference to Ursa Major and Saptarishi.

People have watched the night sky for thousands of years. They noticed that certain groups of stars seemed to form recognisable patterns.

Such a group or pattern of stars is called a **constellation**.

Think of it like joining dots on a piece of paper. The stars are not actually connected, but from Earth they appear to form a pattern.

One famous example is **Ursa Major**, also called the **Big Bear**.

Within it is the easily recognised pattern called **Saptarishi**. The name refers to the **seven sages**, and the pattern contains seven prominent stars.



Q. What is the Pole Star? Explain how the Saptarishi constellation can be used to locate the Pole Star and find the north direction.

Before GPS and modern navigation, people often used stars to find directions.

One particularly useful star is the **Pole Star**, or **Polaris**.

The Pole Star appears almost fixed in the same position in the night sky and indicates the **north direction**.

Saptarishi can help us locate it. Two stars at one end of the Saptarishi pattern are often called **pointer stars**. Imagine a line passing through these two stars and extending outward. It leads approximately towards the Pole Star.:

Saptarishi → Pointer Stars → Pole Star → North

This made the night sky an important natural guide for travellers and navigators.

Q. What are planets? Why are they called "Wanderers"? Explain how planets differ from stars in the way they produce or receive light.

Not every bright object in the night sky is a star.

Some celestial bodies do **not produce their own heat and light**. Instead, they shine because they **reflect the light of a star**.

These bodies are called **planets**.

Our Earth is a planet because it does not produce its own visible light. It receives light and heat from the Sun.

The word **planet** comes from a Greek word meaning **"wanderer."** Ancient observers noticed that planets seemed to change their positions against the background of stars.

A simple difference:

Star → has its own light
Planet → reflects the light of a star

Q. Why is the Moon called Earth's natural satellite? Explain why it shines and appears in different shapes on different nights, with reference to Full Moon (Purnima) and New Moon (Amavasya).

The Moon that we see in the night sky is a **satellite of Earth**.

A satellite is an object that moves around a planet. The Moon moves around Earth, while Earth moves around the Sun.

The Moon does not produce its own light. It shines because it **reflects sunlight**.

The Moon appears in different shapes on different nights because, as it moves around Earth, we see different portions of its sunlit half.

A **Full Moon** occurs when the visible side of the Moon appears completely illuminated. In the traditional Indian lunar calendar, the full-moon day is called **Purnima or Poornima**.

A **New Moon** occurs when the Moon is not normally visible from Earth because its illuminated side is largely facing away from us. This is called **Amavasya**.

The textbook also notes that roughly a fortnight after a full moon comes a new moon.

Q. What is a satellite? Distinguish between natural and artificial satellites with examples, and explain how the movement of a satellite differs from that of a planet.

A **satellite** is a body that moves around another larger body.

The Moon is Earth's **natural satellite**.

Other planets can also have natural satellites. For example, planets such as Jupiter and Saturn have many moons.

Humans have also placed **artificial satellites** around Earth for communication, navigation, weather observation, scientific research and many other purposes.

So:

Planet → moves around a star
Satellite → moves around a planet

The Solar System – Our Cosmic Family

Imagine a large family with the Sun at its centre.

The **Sun, eight planets, their satellites, asteroids, meteoroids and other smaller objects together form the Solar System**.

The Sun is the dominant member of this system.

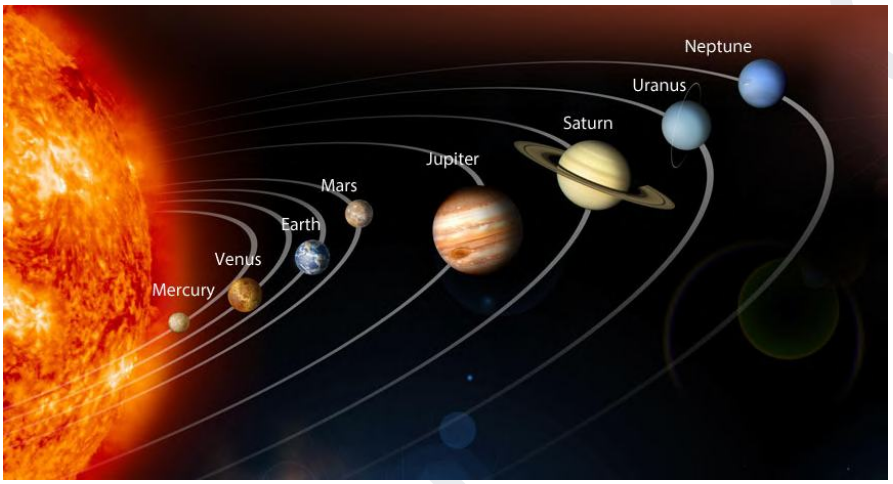
The eight planets, in order from the Sun, are:

Mercury → Venus → Earth → Mars → Jupiter → Saturn → Uranus → Neptune

A simple mnemonic from the textbook is:

My Very Efficient Mother Just Served Us Nuts.

The first letter of each word gives the first letter of a planet.



The **Sun lies at the centre of the Solar System**.

It is extremely large and consists mainly of very hot gases/plasma. It provides the **heat and light** that support life on Earth and supplies energy throughout the Solar System.

Although the Sun looks huge from Earth, it is still very far away.

Its average distance from Earth is about **150 million kilometres**.

This distance is one reason we receive useful amounts of solar energy without being exposed to the Sun's extreme surface conditions.

The Eight Planets

The eight planets move around the Sun along definite paths called **orbits**.

They are not equally distant from the Sun.

Mercury

- **Mercury is the nearest planet to the Sun.**
- It is also the **smallest planet** in our Solar System.
  It completes one revolution around the Sun in only about **88 Earth days**.

Venus

- Venus is the **second planet from the Sun**.
- It is often called **Earth's twin** because its size and overall rocky composition are broadly similar to Earth's.

Earth

- Earth is the **third planet from the Sun**.
- It is the planet on which we live and the only world currently known to support life
- Earth's shape as a **geoid**, meaning an Earth-like shape.
- Earth is not a perfect sphere; it is slightly flattened at the poles and bulges somewhat around the equator.

Mars

- Mars is the **fourth planet from the Sun**.

Jupiter

- Jupiter is the **fifth planet from the Sun** and the **largest planet in the Solar System**.

Saturn

- Saturn is the **sixth planet from the Sun** and is especially famous for its prominent **ring system**.

Uranus

- Uranus is the **seventh planet from the Sun**.

Neptune

- Neptune is the **eighth and farthest recognised major planet from the Sun**.

Q. Why is Pluto no longer considered a planet? Explain the change made by the International Astronomical Union (IAU) in 2006 and name other dwarf planets such as Ceres and Eris.

Many people grew up learning that the Solar System had **nine planets**.

The ninth was **Pluto**.

That changed in **2006**.

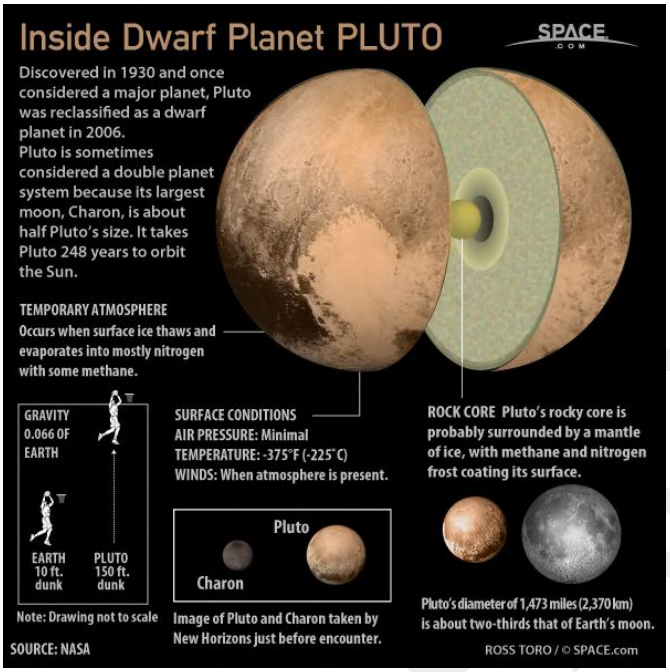
The **International Astronomical Union (IAU)** adopted a formal definition of a planet. Pluto did not meet all the requirements and was classified as a **dwarf planet**.

Therefore, today we recognise:

8 planets + several dwarf planets

Pluto did not disappear. Its **classification changed**.

It also refers to **Ceres** and **2003 UB313** in this context. The latter is now known as **Eris**; both Ceres and Eris are classified as dwarf planets.



Why Is Pluto No Longer a Planet?

Pluto was considered the **ninth planet from 1930 to 2006**.

In 2006, the **International Astronomical Union (IAU)** created a clearer definition of what should be called a planet.

For an object to be a planet, it must satisfy **three conditions**:

1. **It must orbit the Sun.**
Pluto does.
2. **It must be nearly round because of its own gravity.**
Pluto is nearly round.
3. **It must have cleared the neighbourhood around its orbit.**
Pluto has **not** done this.

What Does "Cleared Its Neighbourhood" Mean?

A planet must be **gravitationally dominant** in the region through which it travels.

For example, Earth is much more massive than the other objects near its orbit. Over time, its gravity has captured, scattered or removed most comparable objects from its orbital region.

Pluto is different.

Pluto is located in the **Kuiper Belt**, a region beyond Neptune containing thousands of icy objects. Pluto shares this region with many other bodies and is **not massive enough to dominate its orbital neighbourhood**.

Why Did This Become an Issue?

Astronomers discovered several objects beyond Neptune that were similar to Pluto.

One important example was **Eris**, discovered in 2005. It was comparable to Pluto in size.

Scientists then faced a question:

Should Eris and many other similar objects also be called planets?

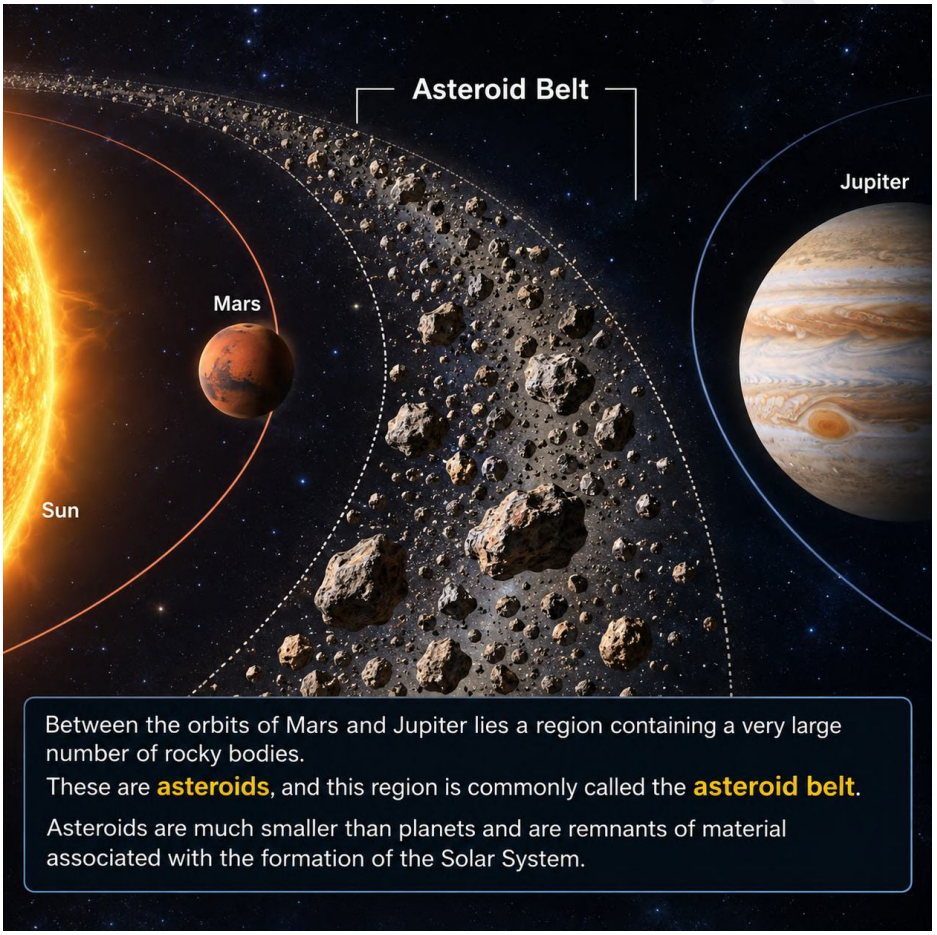
In 2006, the IAU formally defined a planet. Since Pluto did not satisfy the third condition, it was placed in a new category:

Q. What are Asteroids? Where is the asteroid belt located in the Solar System, and what do asteroids tell us about the formation of the Solar System?

Between the orbits of **Mars and Jupiter** lies a region containing a very large number of rocky bodies.

These are **asteroids**, and this region is commonly called the **asteroid belt**.

Asteroids are much smaller than planets and are remnants of material associated with the formation of the Solar System.



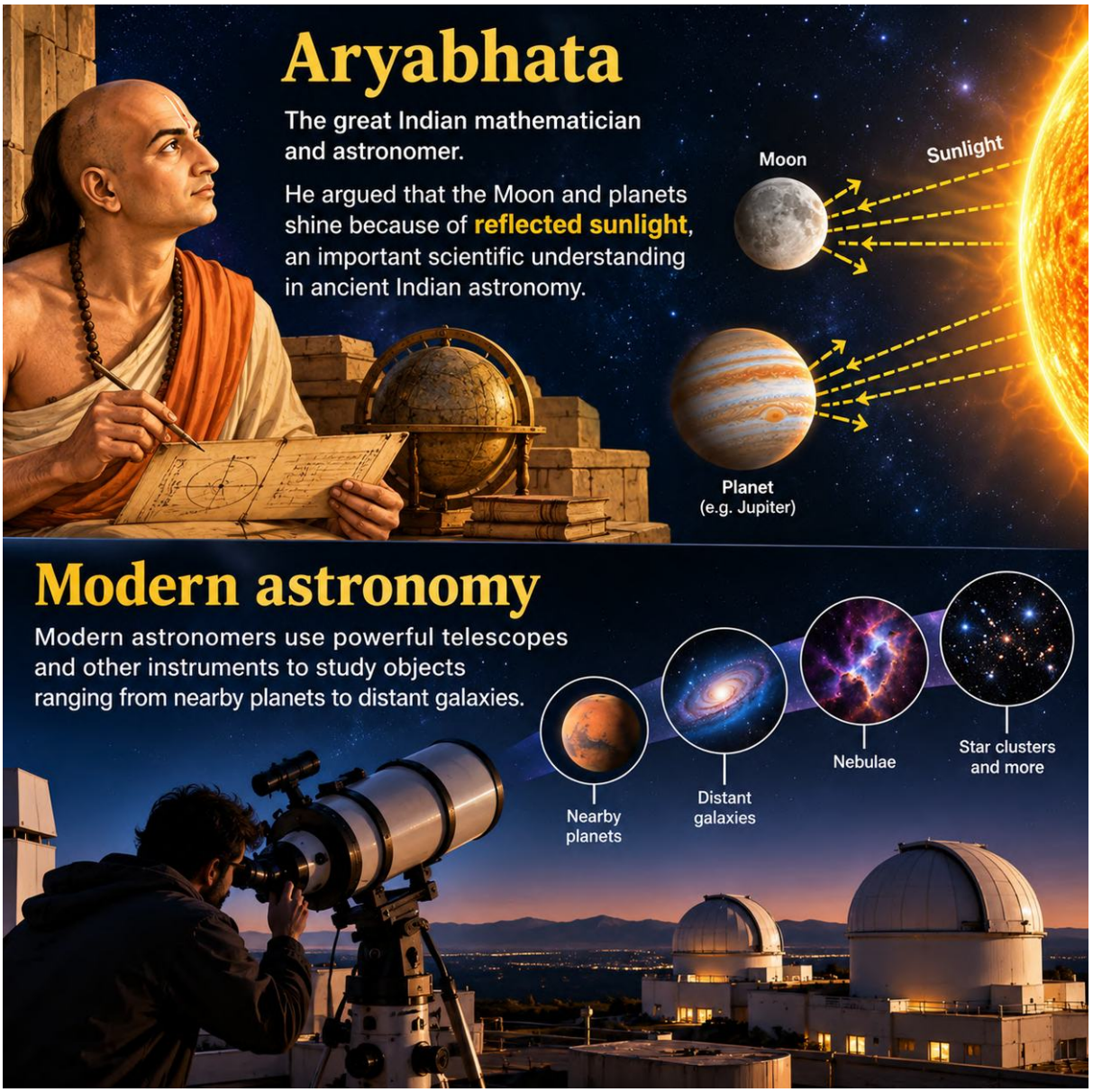
Meteoroids

Smaller rocky or metallic bodies travelling through space are called **meteoroids**.

Meteoroid → object travelling through space
Meteor → streak of light when it enters an atmosphere and burns/ablates
Meteorite → part that survives and reaches the ground

Q. Why do stars appear as tiny points of light even though many of them are enormous? Explain how distance affects the apparent size of celestial objects.

- When you see an aeroplane high in the sky, it looks tiny even though it is actually large.
  The same principle helps us understand stars.
- Stars may be enormous, but because they are **extremely far away**, they appear as tiny points of light.
- So apparent size does not always tell us the real size of a celestial body.



Q. Why is Earth considered suitable for life? Explain the major conditions that support life on Earth and why Earth is known as the Blue Planet.

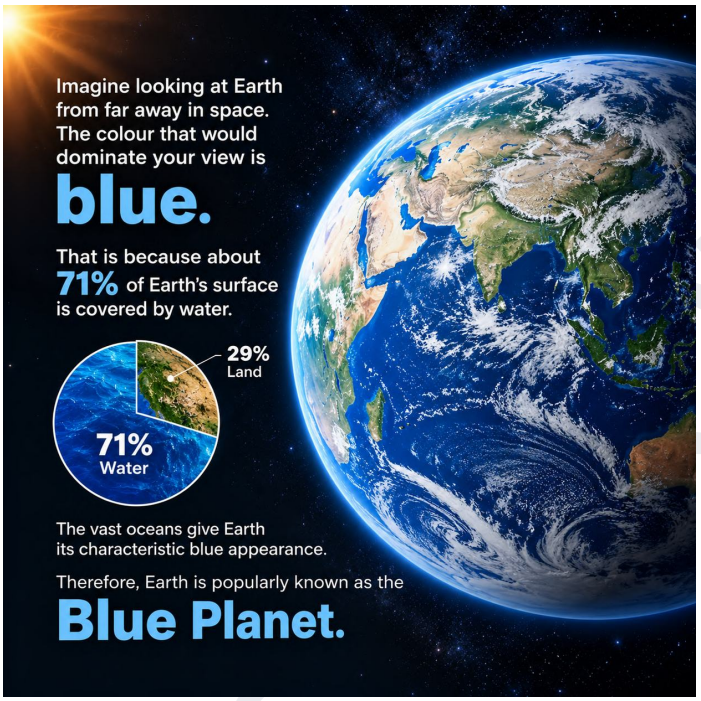
Look around us. We have oceans, rivers, air, soil, plants, animals and millions of other forms of life. As far as we currently know, **Earth is the only planet known to support life**.

Several conditions make this possible.

Earth is neither too hot nor too cold for liquid water to exist widely on its surface. It has **water and air**, both essential for life. The atmosphere contains gases necessary for living organisms, including **oxygen**, which humans and many other organisms need for respiration.

This combination of suitable temperature, liquid water and an atmosphere makes Earth a remarkable planet.

Why Is Earth Called the Blue Planet?



The Moon – Our Nearest Celestial Neighbour

Earth has **one natural satellite – the Moon**.

A natural satellite is a celestial body that revolves around a planet. The Moon revolves around Earth just as Earth revolves around the Sun.

The Moon is much smaller than Earth. Its diameter is roughly **one-quarter of Earth's diameter**.

Yet, when we look at the night sky, the Moon appears quite large. Why?

It is because the Moon is much closer to us than most other celestial bodies.

The average distance between Earth and the Moon is about **384,400 km**.

Q. Why Do We Always See the Same Side of the Moon from Earth? Explain the Moon's Rotation, Revolution and the Concept of Synchronous Rotation.

- The Moon takes about **27.3 days** to complete one orbit around Earth relative to the distant stars.
- Interestingly, it also takes approximately the same amount of time to rotate once on its own axis.
- Because these two periods are almost equal, the **same side of the Moon always faces Earth**.
- This is called **synchronous rotation**.
- It does not mean that the Moon does not rotate. In fact, it rotates exactly once during each orbit around Earth.



Q. What Are Satellites? Distinguish Between Natural and Human-Made Satellites. Explain the Major Uses of Artificial Satellites with Reference to India's INSAT and IRS Programmes.

The word **satellite** does not refer only to moons.

A satellite is an object that moves around a larger celestial body.

There are two broad types.

Natural Satellites

These occur naturally.

The **Moon is Earth's natural satellite**.

Many other planets also have moons.

Human-Made Satellites

Humans also build machines and place them into orbit around Earth or other celestial bodies.

These are called **artificial or human-made satellites**.

They are launched into space using **rockets**.

Once in orbit, they can perform many different jobs, including:

Communication → Television → Weather forecasting → Navigation → Mapping → Scientific research → Earth observation

India has launched many satellites. Important satellite programmes include **INSAT** for communication and meteorological services and **IRS – Indian Remote Sensing satellites** for observing and studying Earth.



Q. What Are Meteoroids, Meteors and Meteorites? Explain the Different Stages of a Space Rock as It Travels Through Space, Enters Earth's Atmosphere and Reaches the Ground.

- Smaller pieces of rock or metal moving through space are called **meteoroids**.
- But their names can change depending on what happens to them.

Imagine a small rocky object travelling through space.

Stage 1 – Meteoroid

While it is travelling through space, it is called a **meteoroid**.

Stage 2 – Meteor

- If it enters Earth's atmosphere at high speed, it becomes extremely hot, largely because the air in front of it is rapidly compressed and heated.
- It produces a bright streak across the sky.
- This visible phenomenon is called a **meteor**.
- People often call it a **shooting star**, although it has nothing to do with an actual star.

Stage 3 – Meteorite

- Most small meteoroids burn up or break apart before reaching Earth's surface.
- If a piece survives its journey through the atmosphere and reaches the ground, it is called a **meteorite**.
- So the easiest way to remember it is:

Space → Meteoroid

Bright streak in atmosphere → Meteor

Reaches the ground → Meteorite



The Milky Way – Our Galactic Home

Go somewhere with a very dark sky, far away from city lights.

On a clear night, you may notice a faint, whitish band stretching across the sky.

This is our view from inside the **Milky Way galaxy**.

A **galaxy** is an enormous system containing stars, gas, dust and other matter held together mainly by gravity.

Our **Solar System is part of the Milky Way**.

The Milky Way contains **hundreds of billions of stars**, including our Sun.

So the Sun is not alone. It is just one star among an enormous number of stars in our galaxy.

Q. How Is Earth Placed Within the Universe? Explain the Hierarchy from Earth to the Solar System, the Milky Way Galaxy and the Universe.

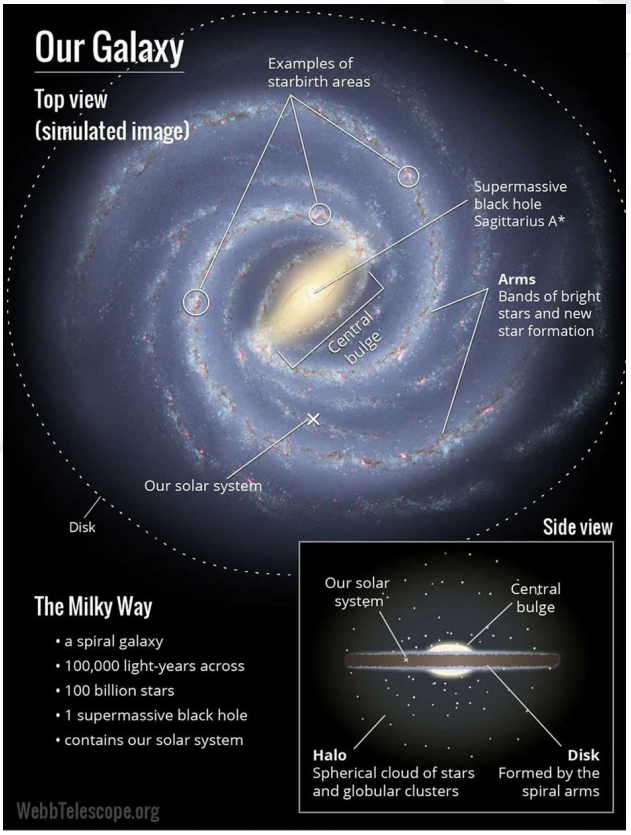
- **Earth** is a planet.
- Earth belongs to the **Solar System**.
- The Solar System is located inside the **Milky Way galaxy**.
- The Milky Way is only one among a vast number of galaxies.
- All galaxies, stars, planets, matter, energy, space and time together form the **Universe**.

Think of it like an address:

Earth → Solar System → Milky Way → Universe

The scale becomes larger at every step.

And this gives us an extraordinary perspective: our entire planet, with all its countries, oceans, mountains and billions of people, is only a tiny part of an unimaginably large universe.



Mains Practice Questions

1. What makes Earth suitable for the existence of life? Explain the major conditions that make Earth different from most other known celestial bodies. (10 Marks, 150 Words)
2. Why does the same side of the Moon always face the Earth? Explain with reference to the rotation and revolution of the Moon. (10 Marks, 150 Words)
3. Differentiate between asteroids, meteoroids, meteors and meteorites. Explain their significance in understanding the Solar System. (10 Marks, 150 Words)
4. Artificial satellites have become an essential part of modern life. Discuss their major applications in communication, navigation, weather forecasting, disaster management and Earth observation. (15 Marks, 250 Words)
5. Describe the major components of the Solar System. How do planets, satellites, asteroids and smaller celestial bodies together form a complex planetary system? (15 Marks, 250 Words)
6. Explain the position of Earth in the Universe by tracing the hierarchy from Earth to the Solar System, the Milky Way and the larger Universe. What does this hierarchy reveal about the scale of the cosmos? (15 Marks, 250 Words)

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