GAZING At The INFINITE

DISCOVER THE WONDERS OF SPACE, STARS, AND GALAXIES

RENU SOM

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Message from the author

Have you ever looked up at the night sky and wondered what's out there? *Gazing at the infinite: A handbook for kids to start their journey of astronomy. is* a fun and friendly guide created just for kids who are curious about the stars, planets, and the amazing universe around us.

This book makes big space ideas easy to understand. You'll learn about the Moon, the Sun, the planets, galaxies, the use of telescopes and even making your own telescope. With simple language, colourful illustrations, and exciting facts, this book helps young readers explore the wonders of space in a way that's both educational and exciting.

Whether you're dreaming of becoming an astronaut or just love looking at the stars, this book will take you on a journey through the universe and awaken your imagination. Let your curiosity lead the way—because space is waiting to be discovered!

— Renu Som

Contents

UNIT 1
(INTRODUCTION)

🪐 Chapter 1.1
Cosmic Curiosity: What is Astronomy? And Who are Astronomers?

Have you ever looked up at the night sky and wondered what's out there? Why do stars twinkle? Is the Moon following you? Are there aliens? What's beyond the stars?

Well, guess what? Those are the kinds of questions **astronomers** ask every day! And the science that helps us find answers is called... **Astronomy**!

🧑‍🚀 What is Astronomy?

Astronomy is like a treasure hunt in space! It's the science of studying everything that's out there—planets, stars, moons, comets, black holes, galaxies, and even light from things that are too far to see with just your eyes.

Astronomy helps us learn:

How stars are born?

What planets are made of?

How does the Moon affect Earth?

If there's life on other planets (maybe aliens!)

Astronomy is a giant adventure, and every question leads to a new mystery!

Who Are Astronomers?

Astronomers are space detectives! They don't fly to space (that's what astronauts do), but they use super powerful telescopes, satellites, and even math to study the universe.

There are two main types:

Observational Astronomers use huge telescopes to look at stars and galaxies far, far away.

Theoretical Astronomers use computers to solve space puzzles and imagine how things work in the universe.

Some astronomers work in big observatories on mountains, some work with space telescopes like **Hubble**, and some even help design space missions!

To be an astronomer you don't need a rocket ship to explore the universe—you just need **curiosity**!

How Big is the Universe?

Image of an spiral galaxy

Hold onto your space helmets, because this is going to blow your mind.

We live on earth that is of radius about 6,371 kilometres.

Earth is part of a solar system, which means a bunch of planets (like Mars, Jupiter, and Saturn!) all orbit our star, the Sun. And the average distance from the Earth to the Sun is about 149.6 million kilometres.

Our Sun is just one of more than 100 billion stars in a galaxy called the Milky Way. And the nearest star to our Sun is Proxima Centauri, and it's about 4.24 light-years away from us! That's around 40 trillion kilometres 😳

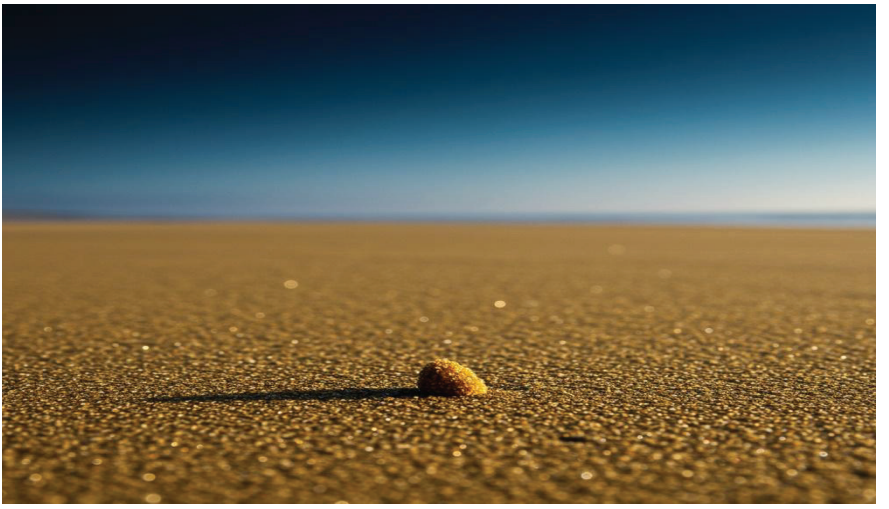
NOTE: A **light-year** is how far light travels in one year — about **9.46 trillion kilometres (5.88 trillion miles)**. Light is the fastest thing in the universe, and it still takes over **4 years** to get from Proxima Centauri to us!

Even our fastest spacecraft would take **thousands of years** to reach it. So yes, it's *very* far — but in space terms, Proxima Centauri is still our **next-door neighbour**!

And the Milky Way? It's just one of about 2 trillion galaxies in the universe! And the nearest galaxy to our Milky Way is The Andromeda Galaxy and its distance from us is about 2.5 million light-years away! or 2.365×10^{19} km in scientific notation) Mind-blowingly huge, right? 🤯

Milky way galaxy as seen from earth.

Imagine a single grain of sand on a huge beach. That's Earth in the universe. We are tiny—but also amazing.



FUN FACT!

the light we see from Andromeda today actually left it 2.5 million years ago, when early humans were just beginning to appear on Earth!
yes—it's incredibly far! If you travelled at the speed of light, it would still take 2.5 million years to get there.
Scientists believe Milky Way and Andromeda will collide in about 4–5 billion years and form a new mega-galaxy!

Where Are We in the Universe?

We live on a beautiful planet called **Earth**, in a solar system, inside the Milky Way galaxy, floating in a giant universe.

But here's something really special: **you are made of stardust**!

That's right! The atoms in your body were made inside stars a long, long time ago. So, in a way, you're part of the universe, and the universe is part of you!

And here's the best part: **we're just getting started**. There's so much more to learn—new planets to discover, black holes to understand, maybe even alien life to find!

Spark Your Curiosity!

If you love looking at the stars, asking big questions, and using your imagination, you might grow up to be an

astronomer! Or maybe a rocket scientist! Or a space explorer!

Here are some fun things you can do right now:

- ✅ Look at the Moon every night and draw how it changes
- ✅ Visit a planetarium or science museum
- ✅ Use a telescope or even binoculars to see the stars
- ✅ Read books about space and watch cool documentaries
- ✅ Ask wild questions—and never stop wondering!

Remember, the universe is huge, but your imagination is even bigger.

Ready to explore the stars?

Let the adventure begin! 

CHAPTER 1.2
From Stars to Lenses: The Journey of Astronomy

Imagine standing on a mountain, in the middle of the night, thousands of years ago. No city lights. No internet. No spaceship. Just you... and a sky filled with thousands of sparkling stars.

Can you believe that long before we had telescopes or satellites, people were already discovering the **secrets of space?**

Let's meet the **awesome ancient astronomers** who used nothing but their **eyes, brains, and wonder** to explore the universe!

Incredible Indian Astronomers

Aryabhata (476 CE)

He said the Earth spins!

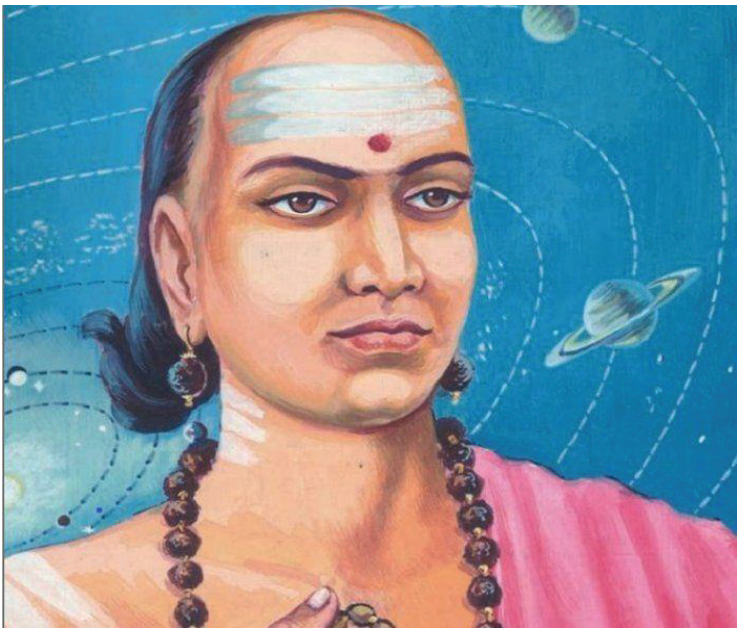
With no telescope, at just 23 years old, he wrote a book called **Aryabhatiya**, where he said that:

The Earth spins around its axis! (Way before many others believed it.)

The Moon and planets shine because they reflect sunlight.

He gave ideas to figure out the size of the Earth and distances to planets.

Varahamihira (505 CE)



He predicted eclipses!

Solar Eclipse

Lunar Eclipse

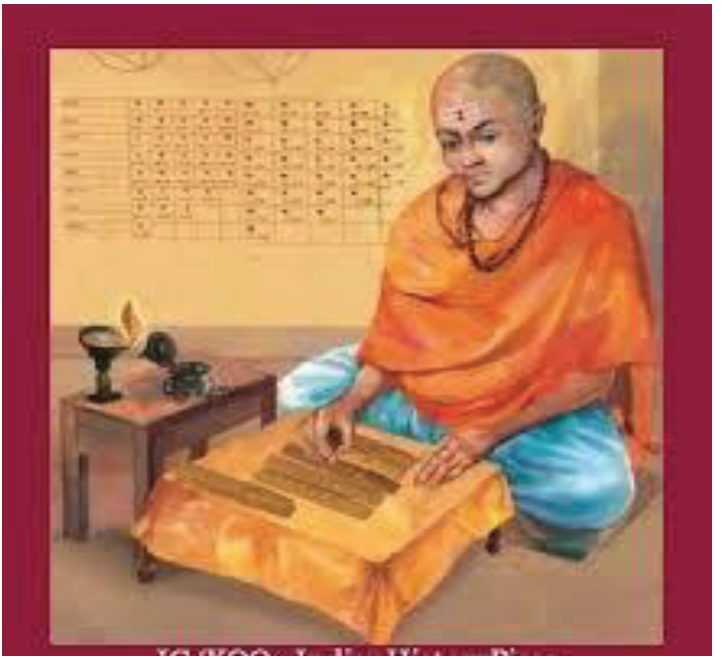
Varahamihira wrote a book called **Brihat Samhita**, which had:

Weather forecasting (like predicting rain).

Star patterns and planet movements.

Tips for building houses using directions from the sky!

Brahmagupta (598 CE)



He explained gravity… before Newton!

Brahmagupta was great at both **math and astronomy**. He told people:

How to calculate the positions of planets.

Rules for using **zero** in calculations (a big deal!).

That the Earth attracts things (early ideas about gravity!).

FUN FACT!

In the Hanuman Chalisa, written over 400 years ago by the great poet Tulsidas, there's a line that secretly holds a super cool space fact!

"Yug sahasra yojan par bhanu"

(It means: The Sun is 'Yug × Sahasra × Yojan' away

Let's break it down like a math detective!

- 1 Yug = 12,000 years
- Sahasra = 1,000
- 1 Yojan = about 8 miles

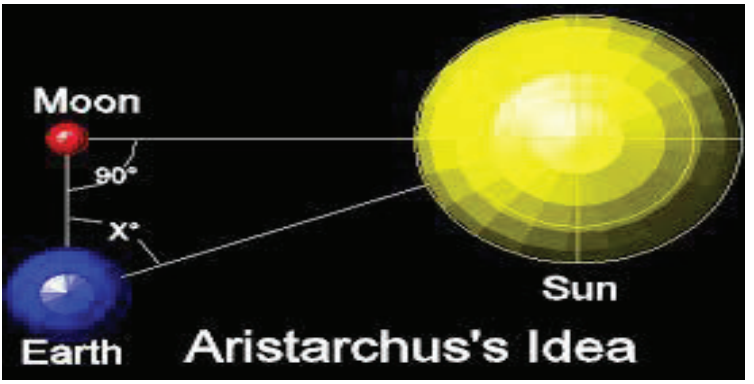
$12,000 \times 1,000 \times 8 = 96,000,000$ miles

That's almost the exact distance from Earth to the Sun that scientists calculated hundreds of years later.

World Explorers of the Sky

Aristarchus of Samos (Greece)

He guessed the Sun was the center!



He looked at the Moon and the Sun and used shadows to guess their distances. He even thought Earth orbits the Sun—way before most people believed it!

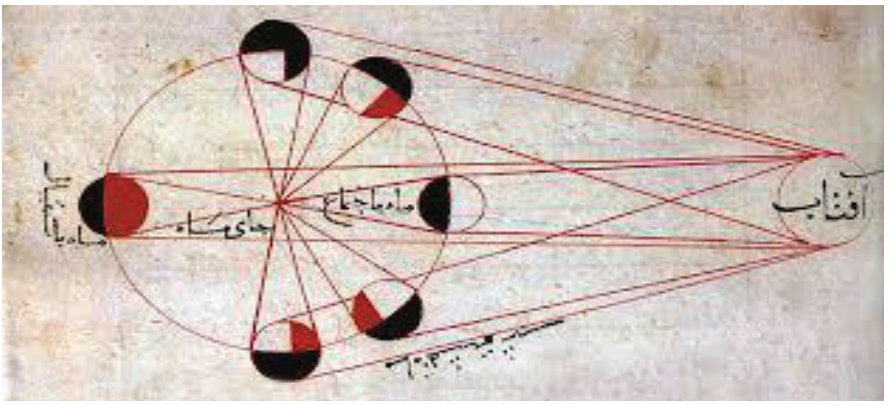
Chinese Sky Watchers

They saw a star explode in 1054!

They recorded comets, eclipses, and even supernovas (giant star explosions) in books made of bamboo! They were like ancient space reporters!

Al-Biruni (Persia)

He measured Earth's size… with shadows!



Al-Biruni Came to India around 1000 CE to study Indian astronomy and write about it. He used a stick, a mountain, and a shadow to measure the size of the Earth. And he was *almost exactly right*!

DID YOU KNOW?

The ancient universities like Takshashila (around 700 BCE) and Nalanda (founded in the 5th century CE) played a huge role in developing astronomy, making India a leader in star science at a time when the rest of the world was still figuring out the basics.

But wait… No Telescopes?

Yes! These sky scientists didn't have fancy tools like we do. They watched the sky every single night, tracked star movements, and passed down their discoveries through scrolls and stories.

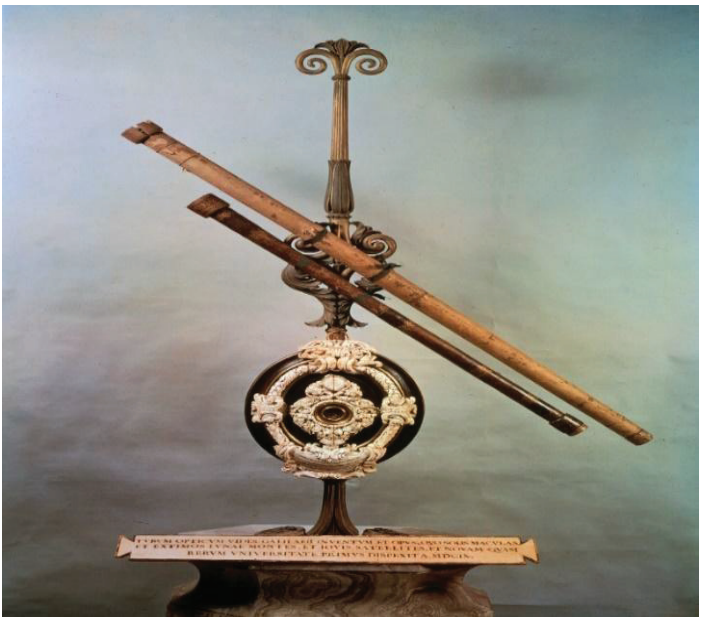
🔭 The Birth of the Telescope: The Accidental Discovery

In the early 1600s, a Dutch eyeglass maker named Hans Lippershey was working in his shop. One day, he noticed that when he looked through two lenses held at a certain distance, distant objects appeared closer and clearer.

Excited by this discovery, Hans quickly built a device using these lenses. He called it a "looker," and it could magnify things three times their original size!

Galileo's Gaze into the Heavens

News of Hans's invention spread across Europe and reached an Italian scientist named Galileo Galilei. Intrigued, Galileo built his own version of the telescope in 1609. But he didn't stop there—he improved it to magnify objects up to 20 times!



Galileo pointed his telescope to the night sky and made astonishing discoveries:

Mountains and craters on the Moon

Four moons orbiting Jupiter

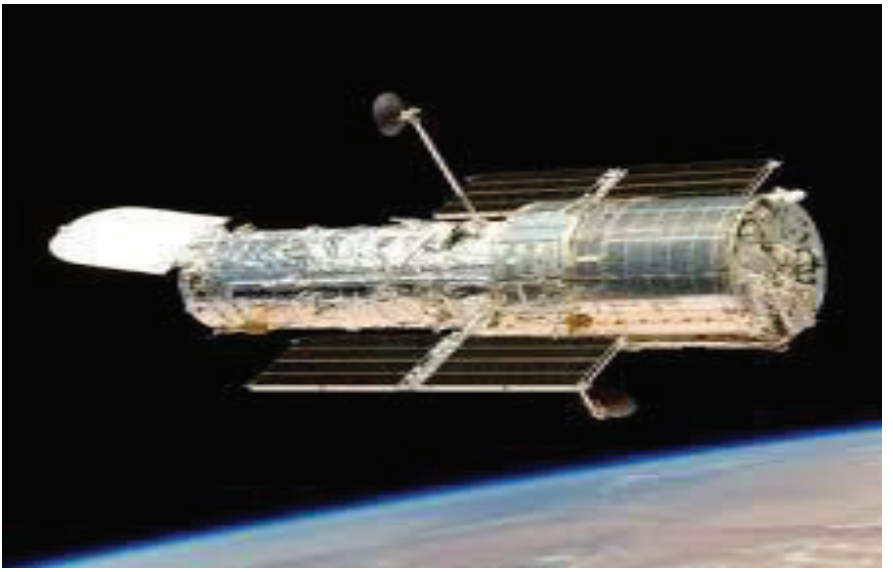
Countless stars invisible to the naked eye

These observations changed our understanding of the universe forever!

Modern Marvels

Today, we have advanced telescopes like the Hubble Space Telescope that orbit Earth, using sophisticated lenses and mirrors to capture stunning images of distant galaxies,

nebulae, and stars. These instruments continue to expand our knowledge of the cosmos.



Hubble Space Telescope

Some great pictures taken by the hubble space telescope.

The Butterfly Nebula

The star cluster

The Helix Nebula

The deep field

The Eagle Nebula (images credit: NASA Science)

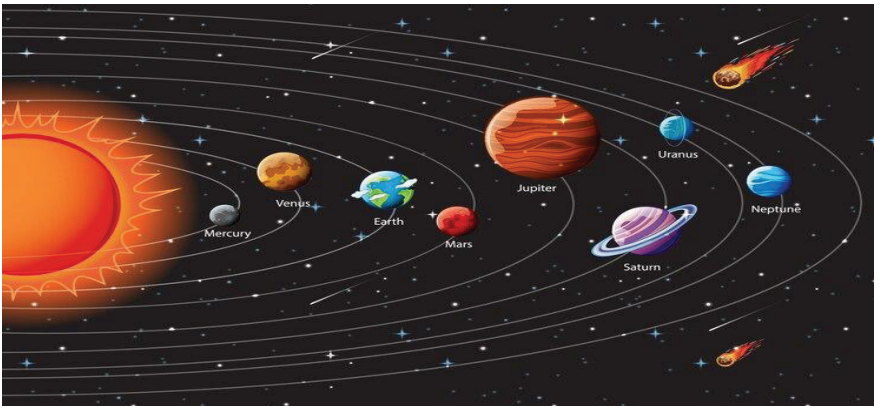
🧠 Spark Your Curiosity!

Want to try like the ancient astronomers?

- ✅ Make your own star journal: Look at the sky every night for a week. Draw what you see!
- ✅ Try a sundial: Use a stick and mark the shadow every hour to tell time!

Chapter 1.3
The Cosmic Ballet: Stars, Planets, Comets, Satellites, Meteors, Asteroids, Space Stations Etc

"Welcome, young explorer! Buckle your space boots—we're going on a journey across the stars in the greatest show of all... the COSMIC BALLET!"

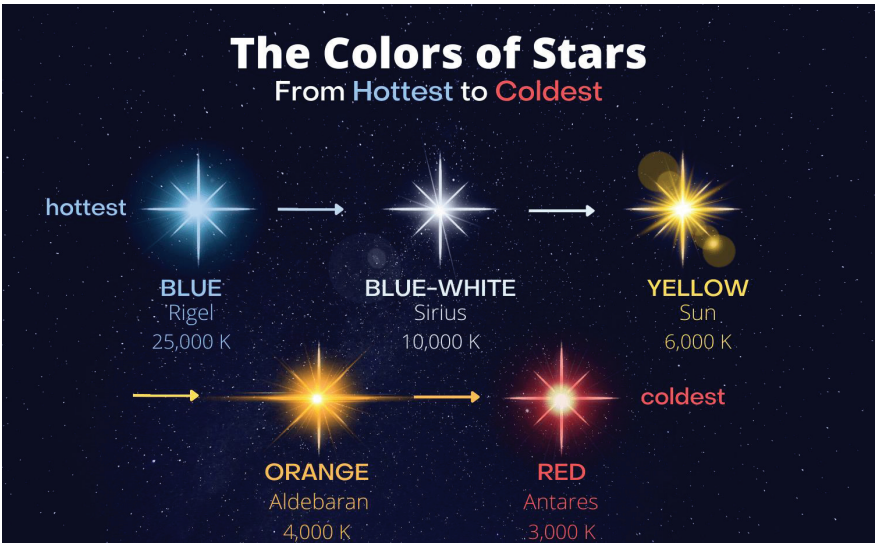


This magical ballet takes place on the grand stage of space, where the dancers are stars, planets, comets, moons, meteors, asteroids, and even space stations! They don't wear tutus or tap shoes—but they glide, spin, zoom, and sparkle in perfect rhythm across the universe.

Let's meet the dazzling dancers of space!

🌟 Stars: The Shining Superstars

Stars are **giant balls of fire** that light up the universe. Some stars are tiny, while others are hundreds of times bigger than the Sun. They sparkle in different colours—white, blue, yellow, even red—depending on how hot they are. Our very own **Sun** is a yellow star—big, bright, and warm. But some stars are even bigger and *bluer*, burning millions of degrees hotter. Others are red and ancient, glowing gently like bedtime night lights. Just like dancers in the spotlight, stars brighten the stage of the universe!

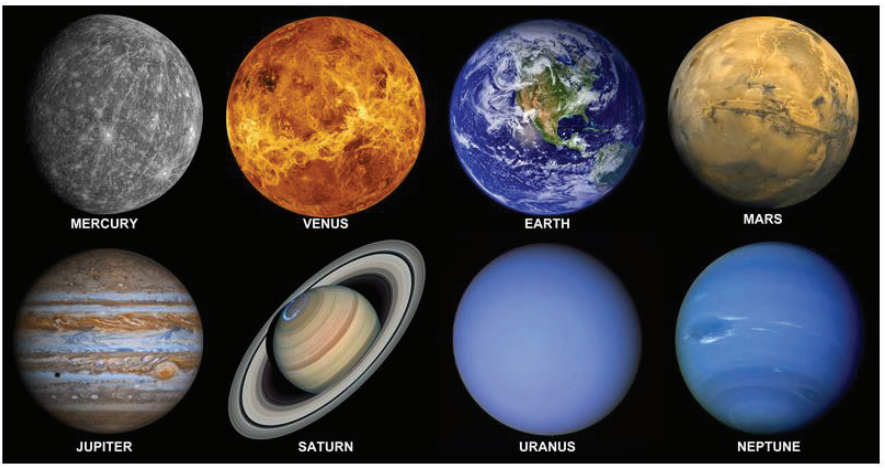


🧠 Did you know?

There are stars so big they could fit 1,000,000 Suns inside them! And some live in *pairs*, dancing around each other like cosmic twins.

Some stars dance together in pairs or even groups! These are called binary stars or star clusters.

🪐 Planets: The Graceful Gliders



Planets are big, round space travellers that move around stars. Earth is a planet, and so are Mercury, Venus, Mars, Jupiter, Saturn, Uranus, and Neptune! They don't shine on their own—they borrow light from stars like the Sun. Some planets have rings, others have moons, and all of them move in beautiful loops called **orbits**.

☄️ Comets: The Space Snowballs with Tails

Comets are like dirty snowballs made of ice, dust, and rock. They zoom around the Sun in long, loopy paths. When they get close to the Sun, they start to melt and form a glowing tail that can stretch for millions of kilometres! It's like a sparkly ribbon flying through the night sky.

Look up the photos of **Halley's Comet**—it visits Earth's sky every 76 years!

Halley's Comet 1986

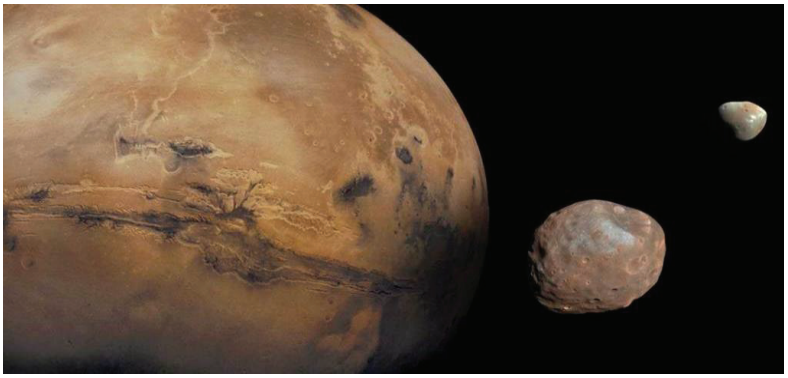
Satellites: The Space Spies and Helpers

Some satellites are natural—like **our Moon**, which orbits Earth. Others are human-made machines we send into space to take pictures, help us with weather forecasts, or even let us use the internet and GPS. They quietly float and spin around our planet, doing important jobs every day.

A picture of artificial satellite

Did you know?

- Earth has thousands of satellites zooming around it right now!
- Mars has two natural satellites Phobos and Deimos.



Mars with its moons
(image credit: NASA Science)

☄️ Meteors: The Shooting Stars That Zip!

Have you ever seen a shooting star? That's a **meteor**—a tiny rock from space that burns up in Earth's atmosphere. It looks like a bright streak of light. zooming across the sky. If a piece is big enough to land on Earth, it's called a **meteorite**.

Look out!

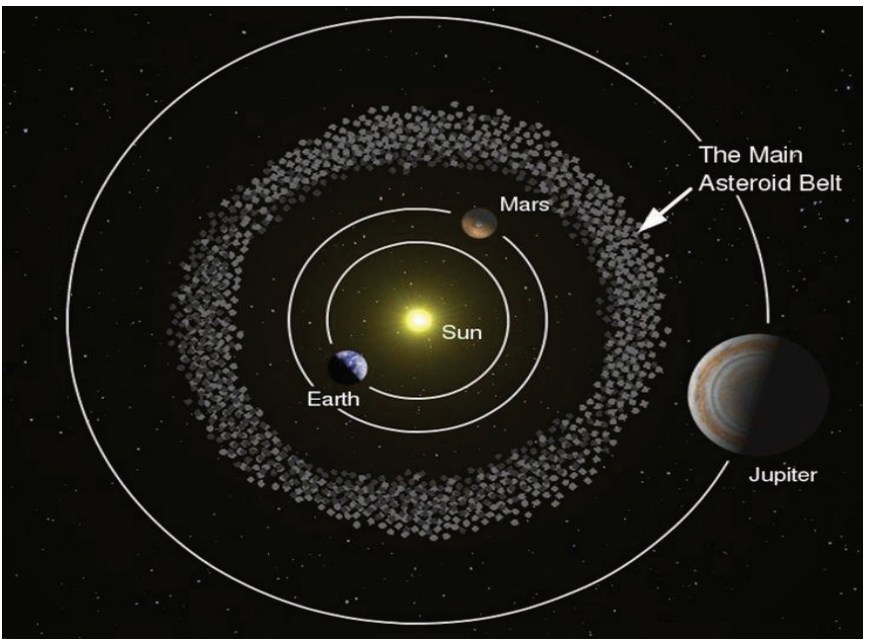
During **meteor showers**, you can see lots of these space sparks in just one nig**ht.**

the most famous meteor shower are the Perseids, which peak around August 12 every year.

Asteroids: The Space Rocks on the Move

Asteroids are rocky chunks left over from when the solar system was forming. They mostly live in the **asteroid belt**

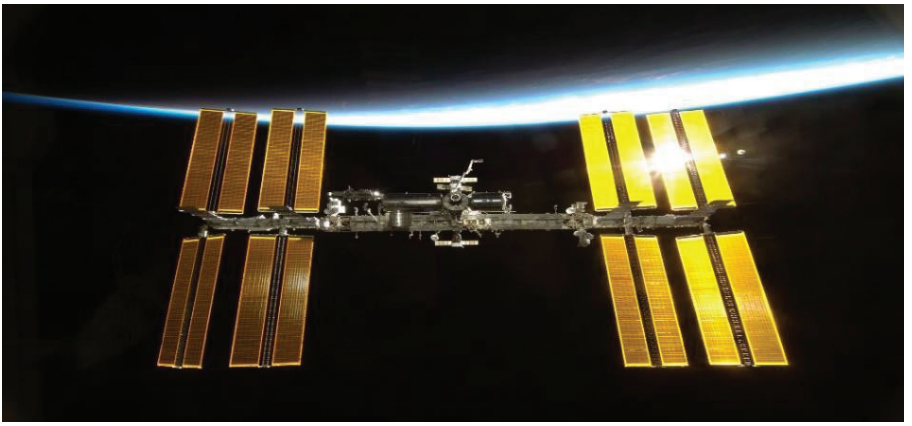
between Mars and Jupiter. Some are as small as a pebble, others as big as mountains! They're like wandering boulders in the cosmic dance.



Cool fact!

Scientists are studying asteroids to learn how Earth and other planets were made

Space Stations: The Floating Science Labs



International Space Station (ISS)
(image credit: NASA Science)

NASA astronaut Sunita Williams
(image credit: NASA)

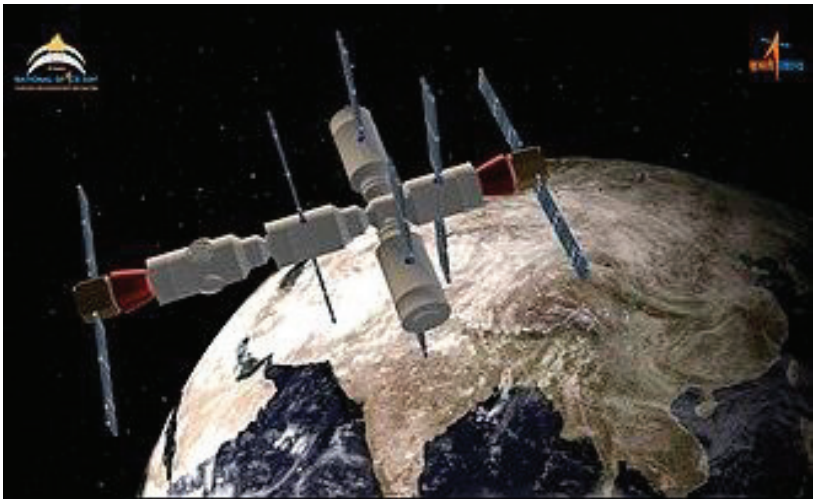
The **International Space Station (ISS)** is like a giant science lab floating above Earth! Astronauts live and work there, doing experiments and learning how to survive in

space. It orbits Earth every 90 minutes—faster than a jet plane! You can sometimes see the ISS fly overhead—it looks like a fast-moving bright dot!

YOU MUST KNOW!

Bharatiya Antariksh Station (BAS) is a planned modular space station to be constructed by India and operated by the Indian Space Research Organisation (ISRO).

As of December 2023, the first module is expected to be launched in 2028 on an LVM3 launch vehicle, with the remaining modules to be launched by 2035 on the Next Generation Launch Vehicle.



A graphical representation of Bharatiya Antariksh Station

🌀 And the Dance Goes On…

All these space objects—stars, planets, comets, satellites, meteors, asteroids, and space stations—are moving in a beautiful, never-ending dance. Together, they make the universe feel alive, like a cosmic ballet that stretches across time and space.

So next time you look up at the night sky, remember—you're watching a magical performance that's been going on for billions of years!

🧠 Spark Your Curiosity!

Try to find out the answers of these questions:

✅ Is the universe standing still or always moving?

✅ Why do planets closer to the Sun move faster than the ones farther away?

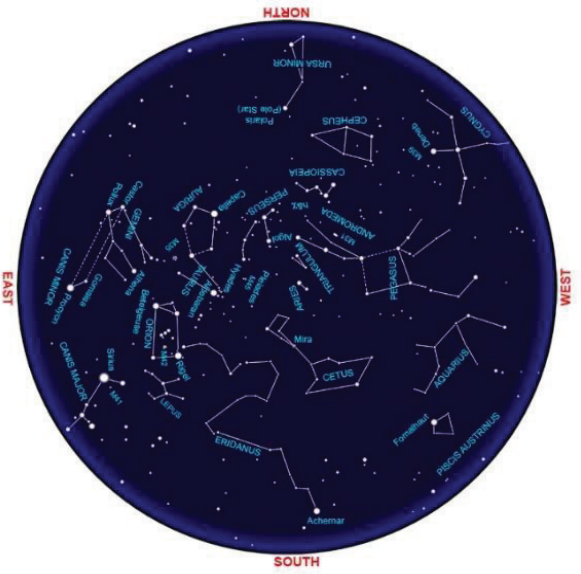
✅ What would happen if Earth stopped spinning?

UNIT 2
(SKYWATCHING WITH OUR OWN EYES)

Chapter 2.1
Constellations: Stars Patterns and Their Stories

If you love to watch stars at night then you may have noticed different patterns made by stars, also you have heard some related stories like Saptarishi and Dhruv Tara from your grandparents.

We will learn about some important constellations in this chapter, and yes! There are many Indian and western stories related to them.



(Picture Credit: Astronomical Society of India)

A **constellation** is a group of stars that form a pattern. These patterns might look like animals, people, tools, or even magical creatures. Long ago, people around the world gave names and stories to these star shapes. It was observed that long before any pattern can be considered as a constellation. But the problem was, different people in different places saw different constellations and sometimes gave the same stars different names. This made it confusing when astronomers wanted to talk about the stars clearly.

So, in 1928, something very important happened. The International Astronomical Union, or IAU for short, decided it was time to bring order to the sky.

The IAU officially defined the boundaries of 88 constellations, covering the entire celestial sphere. These constellations are divided into two hemispheres.

Northern Hemisphere: 36 constellations

Southern Hemisphere: 52 constellations

Here we will understand about some most famous and easy to find constellations.

The Ursa Major — The Big Bear – Have you seen **Saptarishi Taramandal** before. it is a group of 7 stars forming a big spoon -that's how many people see Ursa Major! The ladle's handle is made of three stars, and the bowl is made of four stars. This group of stars is also called the **Big**

Dipper. Well, this big dipper is just a part of ursa major. Ursa Major is visible all year round in most parts of India, so you can look for the Saptarishi anytime you go outside at night.

🌟 1. Saptarishi – The Seven Wise Stars (Big Dipper)

Saptarishi means **"Seven Sages"**—seven super-wise men from ancient times who guide the world with their knowledge and goodness.

These sages were: 1.**Atri** 2.**Bharadvaja** **3.Gautama** 4.**Jamadagni** 5.**Kashyapa** 6.**Vashishta** 7.**Vishvamitra**

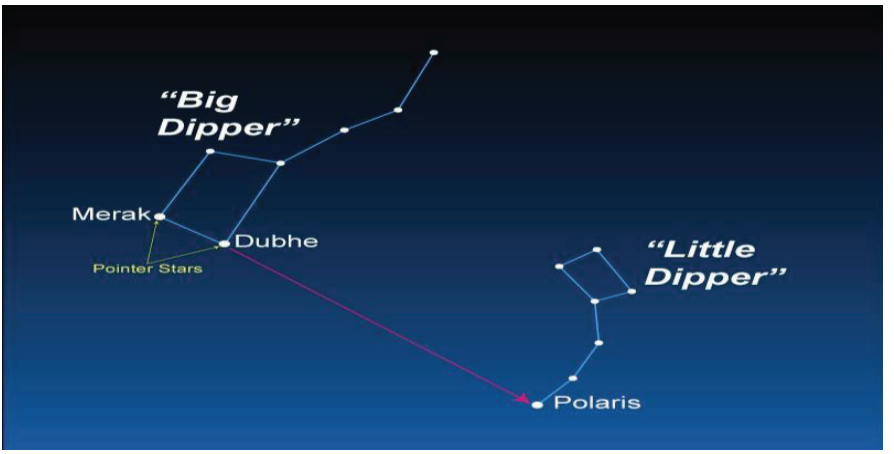
In Indian stories, these sages were sent by Lord Brahma to spread wisdom and protect the Earth.

There's even a small, faint star next to one of the Saptarishi stars. It's called Arundhati, the wife of sage Vashishta.

The Ursa Major - The Big Bear constellation

Meet Ursa Minor — The Little Bear in the Sky!

Just like there's a Great Bear (Ursa Major) in the sky, there's also a Little Bear — and its name is Ursa Minor! Ursa Minor is a constellation, which means it's a group of stars that form a shape in the sky. People long ago imagined this group of stars looking like a small bear with a long, curly tail. The brightest stars in Ursa Minor form a shape just like a tiny spoon, so people also call it the **Little Dipper!** It has **7 main stars** — just like the Big Dipper. Pole star or Dhruv tara is a part of it.



Meet Orion — The Mighty Hunter in the Sky!

Look up at the sky on a clear night, and you might see three stars in a straight line. This is the belt of the famous constellation Orion, a sparkling warrior standing tall! People imagined the stars forming the shape of a man with a belt, a sword, and even a shield! Orion is a winter constellation — it shines bright from November to February.

What does Orion look like?

Orion is easy to spot because of three bright stars in a row — that's **Orion's Belt**!

Here's how to imagine Orion:

Three stars in a straight line: Orion's Belt

Two bright stars above the belt: his shoulders

Two bright stars below the belt: his legs or knees

A line of faint stars hanging from the belt: his sword

One arm is stretched out, holding a shield or bow!

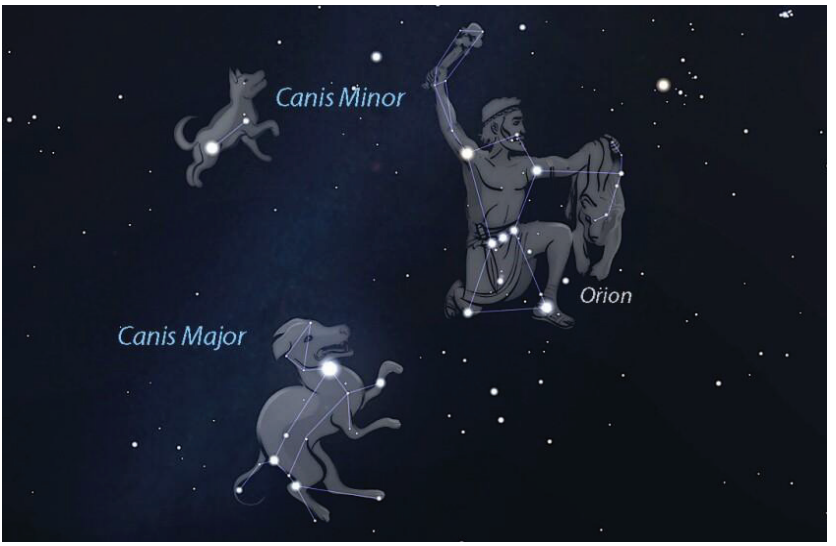
One of the stars in Orion's shoulder is called **Betelgeuse** — it glows orange-red and is HUGE! Another bright star in his foot is called **Rigel** — it shines a bluish-white.

FUN FACT!

- The middle "star" in Orion's sword isn't just a star — it's the Orion Nebula, a big cloud where new baby stars are being born!
- In India, Orion is sometimes linked to stories of Lord Shiva's bow or wise hunters in old tales. And known as "Mriga or mrigashirsha".
- In Greek mythology, Orion was a giant hunter placed in the sky by Zeus.

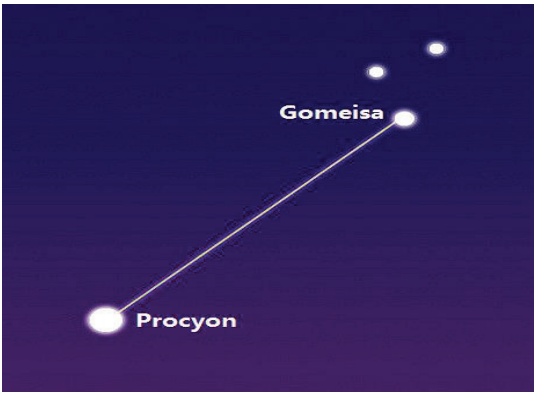
Meet Canis Major — The Big Dog in the Sky!

Look up at the night sky Draw an imaginary line down and to the left from the belt. You'll see a super-bright star — Sirius, look for a few other stars around it — together, they make the shape of a leaping dog, with Sirius at its chest or neck. This starry dog is called **Canis Major**, which means **"Big Dog"** in Latin! Canis Major is a constellation, a group of stars that form a picture in the sky. Long ago, people imagined this group of stars as a giant dog chasing across the sky beside Orion. In Indian astronomy, it is known as— **"Mrigavyadha"** — the deer hunter. In Greek myths Canis Major is one of Orion's hunting dogs — he has two! The other one is called **Canis Minor** (the Little Dog).



Canis Minor — The Little Dog in the Sky!

Canis Minor is a **constellation**, which means it's a group of stars that form a shape in the sky. People long ago imagined these stars as a **little dog**, running alongside **Canis Major**, the Big Dog, and their master, **Orion the Hunter**. It is just behind the canis major like the small dog is following the big dog.



Meet the Gemini Twins!

You can spot Gemini in the winter sky in the Northern Hemisphere. Look for Orion the Hunter first. Then look up to the left, and you might see the twin stars of Gemini shining brightly!

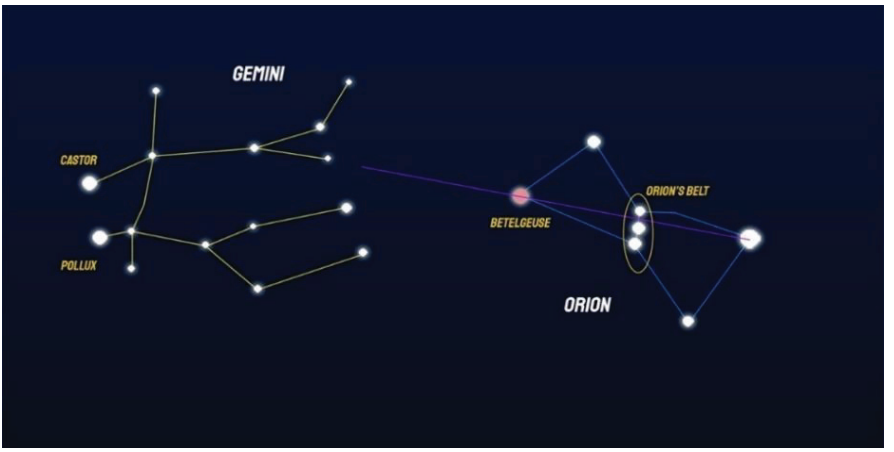
Castor (the twin on the right)

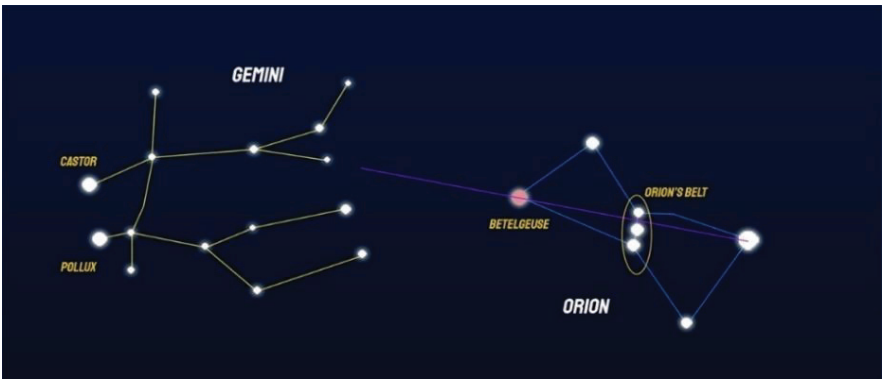
Pollux (the twin on the left)

These stars are like the **heads of the twins**, and lines of stars stretch down like arms and legs!

Who was twins?

Long ago, people told stories about two brothers named **Castor** and **Pollux**. They were brave, kind, and loved going on adventures together. When they passed away, the gods placed them in the sky so they could shine together forever.





Cassiopeia – The Queen of the Sky!

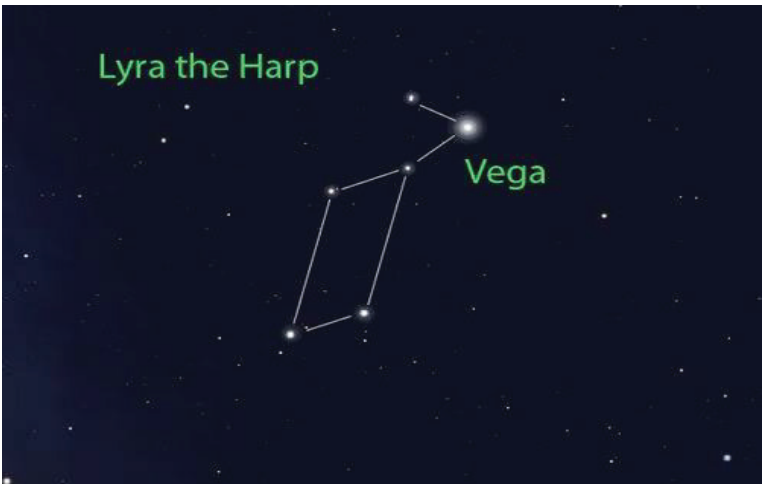
Cassiopeia looks like a big, bright **letter W** made of **five shining stars**. That "W" shape is like the queen's royal throne, where she sits watching the sky. Look for Cassiopeia in the **northern sky**, especially during fall and winter nights. If you can find the Big Dipper, use it to help find the North Star. Cassiopeia is on the opposite side of the North Star from the Big Dipper!

Who was Cassiopeia?

Cassiopeia was a queen in Greek mythology. She was very proud of her beauty — maybe too proud! She once said she was more beautiful than the sea nymphs (the daughters of the sea god), and that made the gods angry! As a result, she was placed in the sky — **forever spinning around the North Star** — sometimes even upside down!

Lyra – The Starry Harp in the Sky!

Look up at the night sky, and you might spot a small but mighty constellation called **Lyra**. It's shaped like a little **harp or lyre**, a musical instrument from ancient times — kind of like a mini harp with strings. Lyra is home to one of the brightest stars in the whole sky — a blue-white star called **Vega**. Vega is so bright that you can see it even from cities! Look for it best on summer nights, especially in July and August. In this time, it is just above you. Lyra is small, but it's easy to spot with the help of Vega.



🎶 A Constellation That Sings!

In Greek mythology, **Lyra** represents the magical harp of **Orpheus**, a musician so good that his music could make animals stop and listen, calm storms, and even make rocks cry! After he passed away, the gods placed his harp in the sky to honour his music forever.

🧠 Spark Your Curiosity!

- ✅ In a dark room, poke constellation patterns into a cardboard sheet and shine a flashlight through it to project stars on a wall.
- ✅ Use glow stickers to recreate a night sky on classroom walls or ceilings. Try to form real constellations!

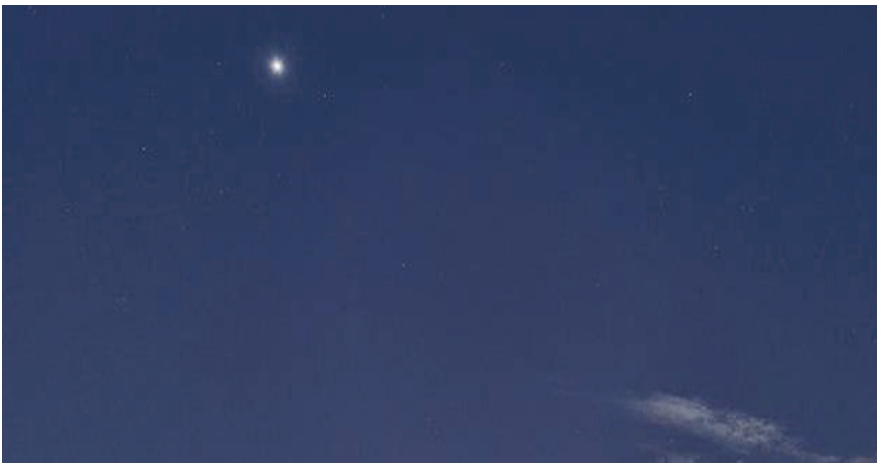
Chapter 2.2
Jewels of the Night Sky: Watching the Sky Beyond Constellations

"Look up at the stars and not down at your feet."
— Stephen Hawking.

Morning Wonders: The Sky at Sunrise

Have you ever woken up really early and looked at the sky?

At dawn, the sky slowly turns from black to blue, and you might spot a bright star in the east. But surprise! It's not a star at all – it's the planet **Venus (Shukra Tara)**, also called the **Morning Star or evening star**.



Venus in early morning

Yeah, you read it right, some star looking things in the sky are not actually a star but a planet.

Here's a **quick and easy table** to help you remember how stars and planets are different when you look at them in the sky:

Feature	⭐ **Stars**	🪐 Planets
Twinkle	Yes, they sparkle and blink	No, they shine with steady light
Brightness	Less bright than planets	Often very bright (like Venus)
Movement	Stay in the same place in star patterns (constellations)	Slowly move across the sky over day and night

Night-time Magic: A Sky Full of Stars

As the Sun sets and the sky turns dark, millions of tiny twinkling stars appear like diamonds on a black velvet cloth.

How to find and identify the sky gems.

STARS – The Twinkling Dots

1. Pole Star – Dhruv Tara:

Stays **fixed in one spot** — always in the **North**.

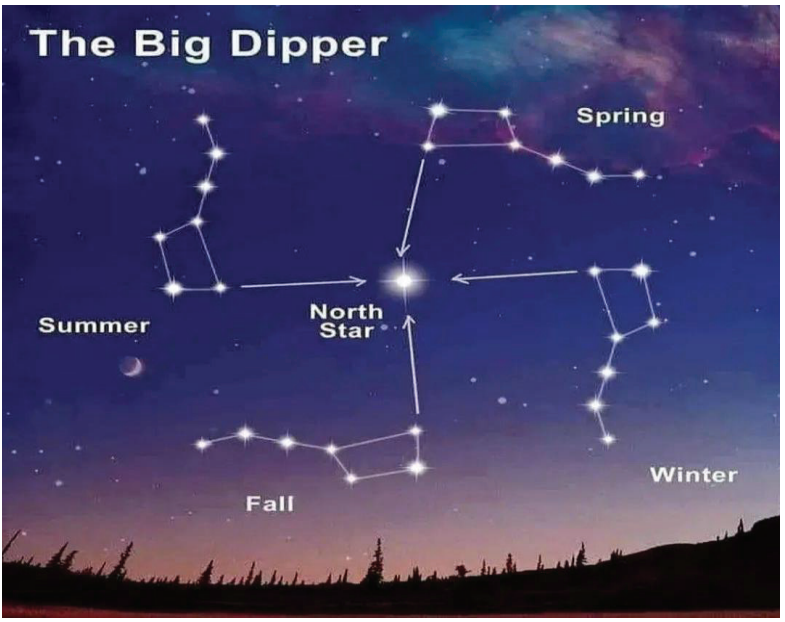
Used for navigation by sailors and travellers.

🔍 How to Find:

Find the **Big Dipper** (Saptarishi Mandal).

Use the two edge stars of the "bowl" part.

Draw a line straight out — the first bright star on this line is Pole Star.



✨ Did You Know?
Dhruv Tara is named after **Prince Dhruva** from Indian mythology who became a star because of his unshakable devotion!

✨ 2. Sirius (The Dog Star)

The brightest star in the night sky.

Part of the constellation **Canis Major** (The Big Dog).

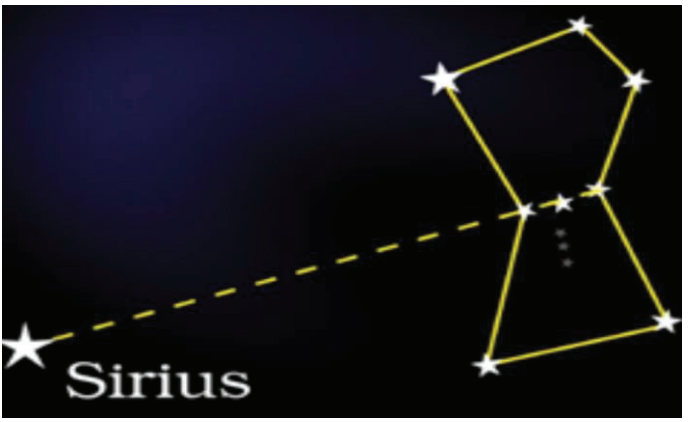
Colour: Bluish-white.

When to see: Winter nights (December–February) in the **southeast** sky after sunset.

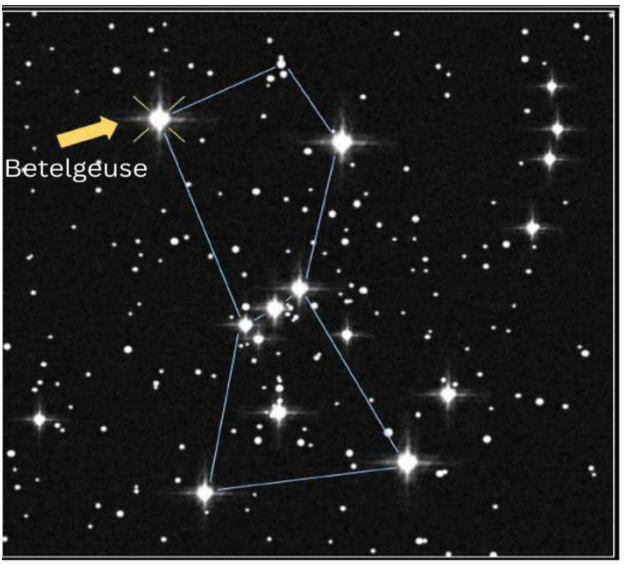
🔍 How to Find:

Find **Orion's Belt** (three stars in a line).

Draw an imaginary line down through the belt stars — it points directly to **Sirius**!



3. Betelgeuse (Orion's Shoulder)



Located in the **Orion** constellation.

Colour: Orangish-red.

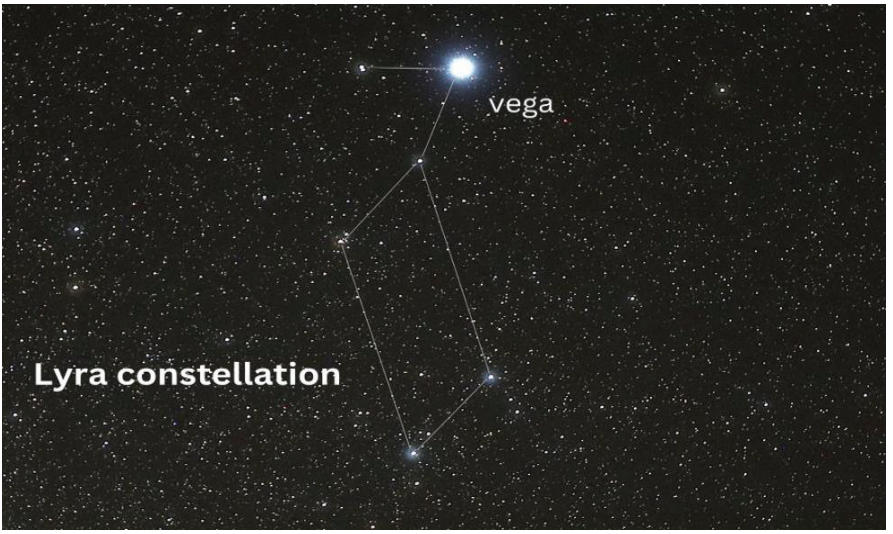
One of the largest stars visible to the naked eye.

🔍 How to Find:

Look for **Orion** (a rectangle with three stars in the middle).

Betelgeuse is the bright red star in the top left corner.

4. Vega (Part of the Summer Triangle)



One of the brightest stars in the summer sky.

Part of the Lyra constellation.

🔍 How to Find:

Look straight overhead in May–July around 9 PM.

It's the brightest star directly above you!

🪐 PLANETS – The Calm Wandering Shiners

1. Venus (Morning/Evening Star)

Brightest planet in the sky.

Appears just before sunrise or just after sunset.

🔍 How to Find:

Look low near the eastern horizon (morning) or western horizon (evening).

If it's the first thing you see, not twinkling — it's Venus.

2. Mars (The Red Planet)

Has a reddish tint.

🔍 How to Find:

Look for a non-twinkling red-orange light in the eastern or southern sky (depending on time of year).

Often found near constellations like Taurus or Gemini.

Jupiter (The Giant Planet)

Bright and non-twinkling.

🔍 How to Find:

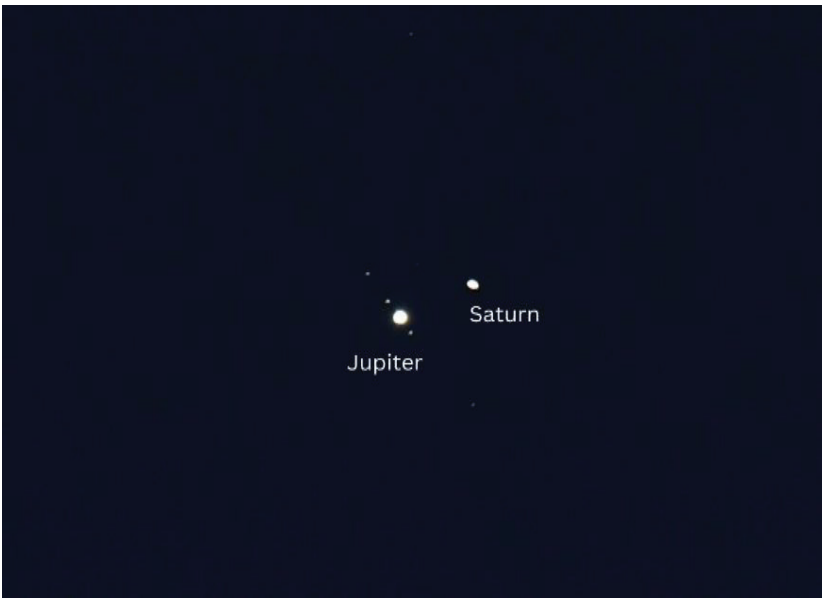
Look in the eastern sky after sunset or in the west before dawn.

One of the **brightest** objects in the night sky.

Sometimes, you can spot tiny dots (its moons!) if you use a telescope or binoculars.

Fun Fact: Jupiter is so big it can fit **1,300 Earths** inside it!

4. Saturn (The Ringed One)



Pale yellow glow, shines steadily.

🔍 How to Find:

Harder to spot, but usually close to Jupiter.

Look for a **steady, faint yellow** light — doesn't twinkle.

Tip: Use a free mobile app like **Sky Map** to double-check it!

🧠 Spark Your Curiosity!

- ✅ Watch the **Moon change its shape** each night
- ✅ Make a **Sky Journal**! Draw what you see in the sky each night and label the stars, planets, or Moon shape.

So, tonight… **step out, look up, and say hello to the universe!**

Chapter 2.3
The Moving Dome: Observing the Starry Sphere

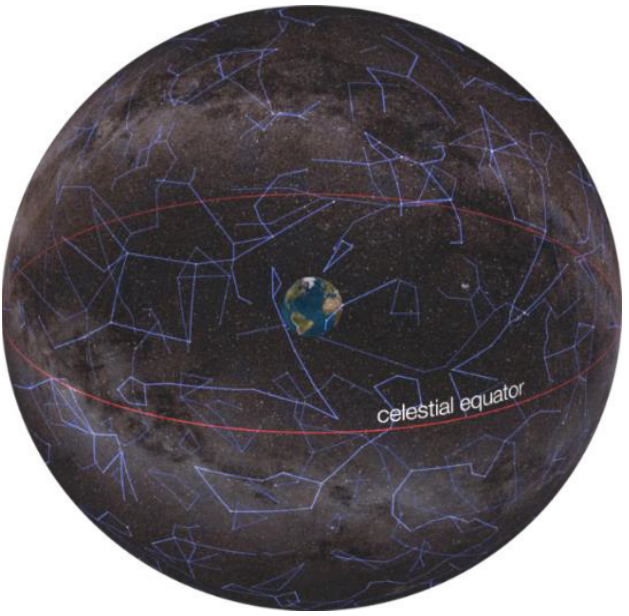
Imagine the Sky as a Giant Dome!

Close your eyes and imagine...

You're lying on your back in a big open field at night. Above you is a huge, magical dome filled with twinkling stars.

It feels like the stars are stuck to the inside of this giant sky dome, slowly moving as if it's turning.

But is the sky really spinning?



🌍 The Sky Isn't Moving… We Are!

It looks like the stars move across the sky — from east to west — but it's actually Earth that's spinning!

Our planet turns like a spinning top. As it turns, it makes the stars appear to move. It's just like when you sit in a moving train and see the trees whizzing past — they aren't moving, but you are!

Let's See an Example!

Go outside at 7 PM and find the Saptarishi (Big Dipper).

Now, come back and look again at 9 PM.

Surprise! The stars have moved across the sky!

But remember — they didn't move, the Earth rotated, giving us the illusion of a moving dome!

🌟 The Pole Star

Most stars appear to rise in the east and set in the west, but there's one special star that hardly moves — Dhruv Tara, the Pole Star!

Dhruv Tara sits right above the **North Pole** of Earth. So when Earth spins, this star looks like it's standing still while all the others spin around it in circles.

Long ago, sailors and travellers used Dhruv Tara to find direction — it always pointed north!

Why Do Some Stars Rise and Set?

Just like the Sun rises in the east and sets in the west, many stars do the same.

This happens because Earth spins in one direction — from west to east — so the stars appear to go the other way. Some stars never rise for people in the Northern Hemisphere (like stars near the Southern Pole), and some stars never set and go round and round (circumpolar!)

Stars That Never Set: Circumpolar Stars

The stars that never rise or set — they circle the Pole Star all night and all year!

These are called **circumpolar stars**.

In India, the Saptarishi constellation (Big Dipper) is a circumpolar constellation, meaning it's always above the horizon and can be seen all year round in many parts of the country!

The Sky Is Always Changing!

If you go out stargazing every night, you'll start to see that the stars are not in the same plac**e** as the night before.

That's because Earth also goes around the Sun, and that changes what part of the starry sphere we see at night.

So some constellations only appear during certain seasons:

Orion shines in winter

Scorpius shows up in summer

🧭 Using the Stars to Tell Time and Seasons

Before watches or calendars, people used the stars!

How did they do it?

Different constellations are visible during different times of the year.

By watching which constellation is in the sky, people knew which season it was! For example, when Orion appears in the sky, people know that winter is coming!

Farmers used the appearance of certain stars to decide when to plant crops.

🧠 Spark Your Curiosity!

✅ Go outside at the **same time** every night and look at the stars. Draw where the bright ones are, then check again the next night. You'll see how the whole dome of stars seems to **move** — like a giant cosmic show just for you!

Chapter 2.4
Stellar Compass: Using the Stars as Guides

How explorers, animals, and even YOU can find your way with the stars!

Imagine you're lost in the middle of a desert... no GPS, no map, no signs. Just sand and sky. But wait — the sky is full of stars. And guess what? The stars *can guide you home!*

Welcome to the ancient art of celestial navigation — using stars as your very own cosmic compass!

Long Before Google Maps…

Long ago, sailors, travellers, and desert nomads didn't have phones or compasses. So how did they find their way?

They followed the stars!

Vikings used the North Star to sail across oceans.

Caravan leaders in deserts looked up at the stars to steer their camels through the night.

Sailors used star maps called star charts to cross the world's oceans.

Try This at Home: Make a Star Compass!

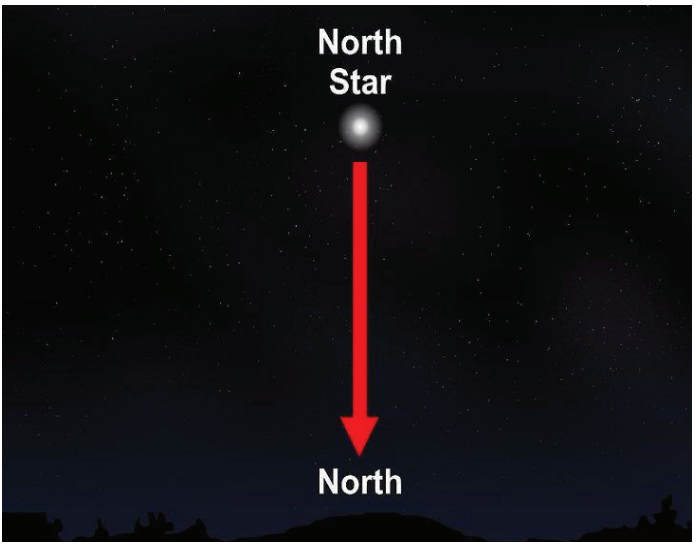
Go outside and face the Big Dipper.

Find the two stars pointing to the North Star.

Now face Polaris.

Draw a circle and label North, East, South, and West.

You just made a **stellar compass**!



In the Southern Hemisphere

If you're in Australia, South Africa, or South America, you can't see the North Star. But don't worry — there's a southern sky trick!

Find the **Southern Cross** constellation (Crux).

Use it to find the **South Pole** in the sky!

Stargazers in the south also use bright stars like **Alpha Centauri** and **Beta Centauri** as guides.

Finding directions with the help of southern cross constellation

Find the Southern Cross (Crux)

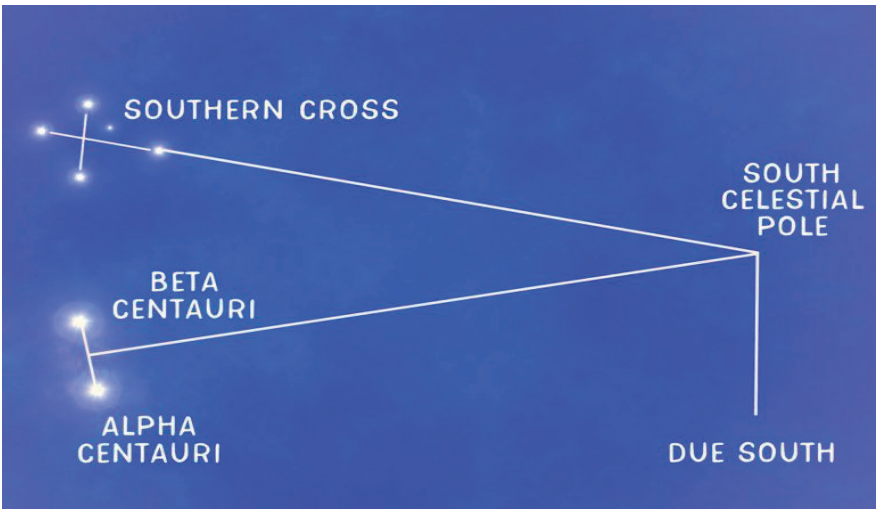
Near the Southern Cross, find two bright stars in a line. These are called the Pointer Stars. They help you make sure you're looking at the true Southern Cross, not a lookalike!

Now draw an imaginary line along the longer arm of the cross (from the top star through the bottom star).

Draw another imaginary line from the middle line of the pointers towards the first line.

Where the imaginary lines end, that's the **South Celestial Pole**.

Mark the South Point 🧭



Who Else Uses the Stars?

Humans aren't the only ones who follow stars!

🐢 Baby Sea Turtles

When they hatch at night, they look for the brightest light — the moon and stars over the ocean — to find the water.

Light pollution from cities can confuse them.

Migrating Birds

Birds like the Indigo Bunting fly thousands of kilometres using the stars as a map!

Scientists also proved it with an experiment:

Birds in a planetarium flew in the right direction…

Until the fake stars were moved — then the birds got lost!

So yes — birds *literally* read the sky!

Penguins and Whales

Scientists think **penguins** and some **whales** may use stars too, especially during long ocean swims in the dark!

Did You Know?

- Polaris hasn't *always* been the North Star! Thousands of years ago, a star called **Thuban** had that job.
- In 12,000 years, **Vega** will be the new North Star!
- The stars move *very* slowly over thousands of years. This is called **precession**.

The sky is always changing — just like Earth!

Spark Your Curiosity!

Draw a simple compass on paper and mark directions using real constellations—like Orion in the east and the Big Dipper in the north. Compare it with a real compass!

UNIT 3
(LOOKING DEEPER– TOOLS OF AN ASTRONOMER)

Chapter 3.1
The Magic of Binoculars and Telescopes

"Look up, and you'll see the stars. But look closer, and you'll discover a whole new universe!"

When you look up at the night sky with your eyes, you might see a few bright stars, maybe the Moon, and if you're lucky, a planet or two. But what if you could **zoom in** and see the Moon's craters, Saturn's rings, or even galaxies millions of light-years away?

With **binoculars and telescopes**, this becomes possible! They turn your stargazing into a real-life space adventure—right from your balcony or backyard!

What's the Difference?

Binoculars: These are like two mini-telescopes side-by-side. You hold them with your hands and look with both eyes. They're light, easy to carry, and perfect for beginners. You can see the moon's creators and shadows, star clusters more clearly, some planets like Mars or Jupiter. Even **basic binoculars** like 10x50 (10 times closer, 50 mm lenses) work wonders!

Telescopes: These are bigger tools specially designed for stargazing. They can zoom much more and show details that even binoculars can't. Some even come with motors to follow stars!

🔭 Telescopes: A Window to the Deep Sky

A telescope is a powerful sky-watching machine. Unlike binoculars, telescopes can zoom in more, gather more light, and reveal things your eyes can never see alone.

Types of Telescopes:

Refractor Telescopes: Use lenses to bend light. Great for viewing the Moon and planets.

Reflector Telescopes: Use mirrors. Better for deep-sky objects like galaxies.

Catadioptric Telescopes: Combine both lenses and mirrors. Portable and powerful.

What Can You See?

With a small telescope (even 70mm–100mm), you can spot:

Moon craters and mountains

Saturn's rings and Jupiter's stripes

Venus in phases like the Moon

Mars and its reddish glow

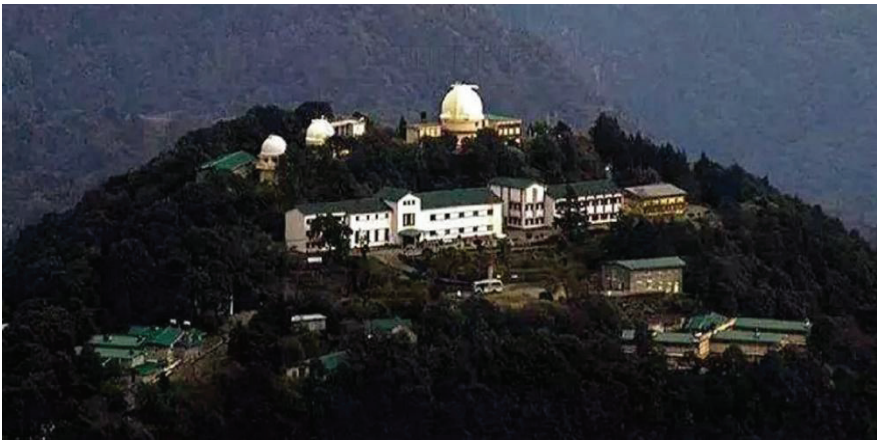
Deep-sky objects: galaxies, star clusters, and nebulae

Comets and eclipses!

India and Modern Stargazing: India's Powerful Telescopes Today

In India, we **study** the space with world-class **telescopes and observatories**. Let's explore them.

ARIES (Nainital, Uttarakhand)

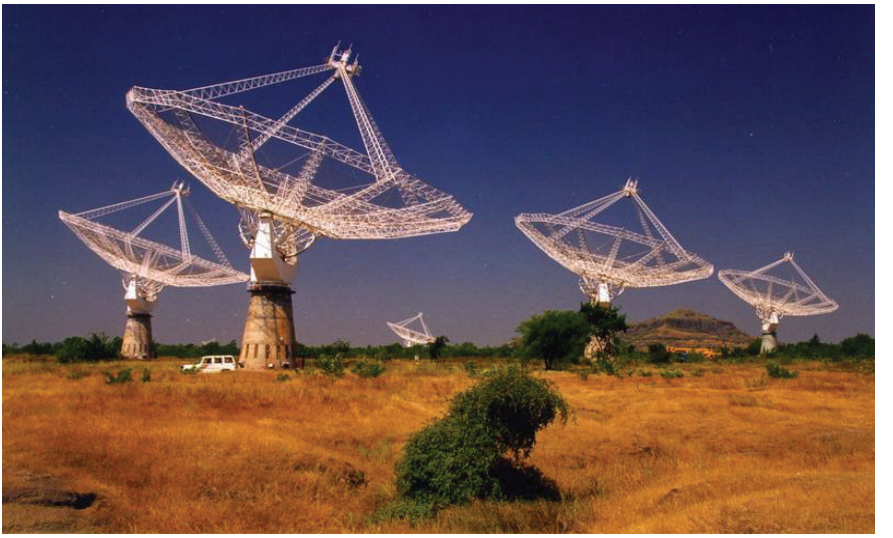


The Aryabhatta Research Institute of Observational Sciences (ARIES) is located at a height of about 2,500 meters above sea level. It is home to the 3.6-meter Devasthal Optical Telescope, which is India's largest optical telescope! Scientists at ARIES study fascinating space objects like galaxies, exploding stars, and distant quasars to understand the universe better. The institute also plays an important role in training young astronomers, helping them explore the wonders of the sky and develop future space research skills.

Himalayan Chandra Telescope (Hanle, Ladakh)

The Indian Astronomical Observatory at Hanle is one of the world's highest observatories, located at 4,500 meters above sea level! It is operated by the Indian Institute of Astrophysics (IIA) and is used to study X-rays from space, distant galaxies, and mysterious black holes. The observatory is remote-controlled all the way from Bengaluru. Hanle's sky is so dark, clear, and pollution-free, So the region has been declared India's first Dark Sky Reserve, making it a perfect place for stargazing and space research.

GMRT – Giant Metrewave Radio Telescope (Pune, Maharashtra)



The Giant Metrewave Radio Telescope (GMRT) looks like a field full of 30 huge satellite dishes, each working together to explore the universe. Its specialty is that it "listens" to radio waves coming from stars, galaxies, and even the early universe! This makes it one of the most powerful radio telescopes in the world. Scientists use the GMRT to study pulsars (fast-spinning neutron stars), distant galaxies, and other mysterious cosmic signals that help us understand how the universe began and how it continues to evolve.

Vainu Bappu Observatory (Kavalur, Tamil Nadu)

The **Vainu Bappu Observatory**, named after **Vainu Bappu**, one of India's most brilliant astronomers, is home to a **2.3-meter optical telescope**. This powerful telescope has made some exciting discoveries, including a **bright comet in 1987** and a **supernova in a distant galaxy**! The observatory continues to help scientists explore the skies and uncover new secrets about the universe.

Start you stargazing journey

You don't need a fancy telescope to begin. You can start your own star adventures using binocular and free astronomy apps. You can even build your own DIY Telescope.

Quick Box: Binocular Tips for Beginners

Use **10x50** binoculars for a great start

Keep your **arms steady** or rest elbows on a wall

Start with the **Moon**, then try star clusters

Use a **sky map app** to guide you

Be patient – the sky surprises every night!

Did You Know?
India's first satellite, **Aryabhata**, was named after the ancient astronomer. It helped scientists learn about the Earth and space. Now, telescopes on Earth and satellites in space work together to explore the universe!

🧠 Spark Your Curiosity!

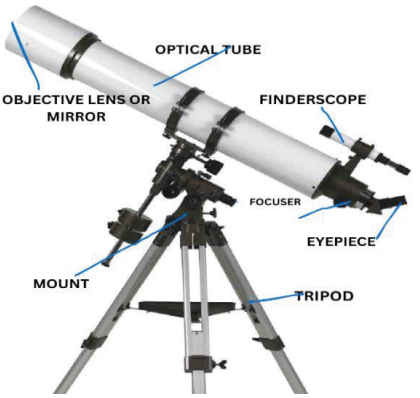
Next time the Moon is bright, point your binoculars at it and draw what you see. Are there mountains? Dark patches? Can you see shadows?

Chapter 3.2
Inside the Telescope - Understanding its Parts and Functions

So, you've seen a telescope and maybe even peeked through one. But have you ever wondered how it works? Let's take a look *inside* a telescope to see what magical parts help it turn tiny dots in the sky into giant, glowing wonders!

🧩 Meet the Telescope Team!

Just like a superhero team, each part of a telescope has a special job to do. Let's meet the telescope's trusty team:



1. **Objective Lens or Mirror – The Big Light Catcher**

   This is the most important part! It's the **first thing that collects light** from stars, planets, or galaxies. In **refracting telescopes**, it's a big **lens**. In **reflecting telescopes**, it's a big **mirror**. The bigger it is, the more light it can catch — that means brighter and clearer views!

2. **Eyepiece – Your Window to the Stars**

   This is where you put your eye. The eyepiece **magnifies** the image made by the big lens or mirror. It's like a **zoom button** for space! You can even switch eyepieces to zoom in or out more.

3. **Tube – The Telescope Body**

   This is the long part that connects everything. It **keeps light from bouncing around** and helps it travel in a straight path. It holds the lens or mirror at one end and the eyepiece at the other.

4. **Focuser – The Sharpness Knob**

   Ever looked through a blurry telescope? This is what fixes that! The focuser **moves the eyepiece closer or farther** from the light path to make the image sharp. Just turn the knob until the stars sparkle clearly!

5. **Mount – The Telescope's Stand and Steering Wheel**

   The mount holds the telescope steady. It also lets you **move the telescope smoothly** to follow stars as they move across the sky. There are two main types:

   Altazimuth Mount – moves up-down and left-right like a joystick.

   Equatorial Mount – moves along the sky's path (great for tracking stars).

6. **Tripod – The Telescope's Legs**

   This is the stand that holds everything up. A strong tripod keeps your telescope from wobbling, especially on windy nights.

BONUS PARTS (Some telescopes have these too!)

Finderscope: A tiny mini-telescope on top that helps you aim at things before using the big telescope.

Diagonal Mirror (in some telescopes): Bounces the light to make it easier to look through without bending down.

Motor Drive: Automatically moves the telescope to follow stars.

How It All Works – A Light Adventure!

Light from a distant star enters the telescope through the objective lens or mirror.

That light gets **focused into a smaller image** inside the telescope tube.

The **eyepiece magnifies** that image, so you can see it up close.

The **mount and tripod** keep the telescope steady and help you move it to find new sights.

Fun Fact!

Telescopes don't just work with visible light! Some special telescopes use X-rays, radio waves, or infrared light to "see" parts of the universe our eyes can't!

The Hubble Space Telescope orbits Earth and takes pictures of galaxies billions of light-years away!

🧠 Spark Your Curiosity!

✅ DIY Refracting Telescope (Galileo-style)

What You Need:

2 magnifying lenses (one big, one small)

Big lens = **objective lens**

Small lens = **eyepiece**

Long cardboard tube (from a gift wrap roll or two joined tubes)

Tape, scissors, ruler

Paper and pencil

Steps:

Tape the **big lens** at one end of the tube. This is the part that collects light.

Hold the **small lens** near your eye and slowly move it forward or backward until the image comes into focus.

Once it works, tape the small lens in place at the other end.

Decorate your telescope with stickers or paint if you like!

You've made a **Galilean telescope**, just like the one used in the 1600s!

Chapter 3.3
Using a Telescope at Home - Your First Steps as a Stargazer

You've learned what's *inside* a telescope. Now it's time to go outside and *use* it!

Where to Set Up Your Telescope?

Before you even look through the eyepiece, you need a good spot! Here's what makes the perfect telescope place:

✅ **Find a "Dark Sky" Spot:**

Turn off nearby lights to reduce **light pollution**.

The darker it is, the more stars you'll see!

✅ **Flat and Steady Ground:**

Use a flat surface, like a patio or open field.

Make sure the tripod legs are **secure and stable**.

✅ **Clear View of the Sky:**

Avoid trees, buildings, or walls blocking your view.

Try to face **south or east**, where many stars and planets rise.

Step-by-Step: How to Use Your Telescopes

5. Explore!

Once you've focused, stay still and enjoy the view.

Slowly move the telescope to follow your target as it drifts.

Try different eyepieces for close-up views.

Extra tips:

Start before dark: Set up during twilight so you're ready when the stars come out.

Use a red flashlight: It helps you see your gear without ruining your night vision.

Let the telescope cool down: If it's been inside, give it 20–30 minutes outside so the lens doesn't fog up.

Be patient: Your eyes need time to adjust to the dark — after 10 minutes, you'll start to see more stars!

Fun Fact!

The Moon is so bright in a telescope that it can almost feel like looking at a flashlight! Some people use a special "Moon filter" to make it softer on the eyes.

When you look at stars, you're seeing light that left them years ago. Some of the stars you see tonight may have exploded long ago — their light is just arriving now!

🧠 Spark Your Curiosity!

✅ Set up your telescope and focus on the Moon. Look closely at its craters and shadows. Sketch what you see and notice how it changes each night. Can you find where the light ends and darkness begins?

Chapter 3.4
Apps and Star Maps - Tech that Helps us Explore

Imagine having a space guide in your pocket — one that tells you what stars are twinkling above you, when the Moon will rise, or where to spot Mars tonight. Thanks to technology, stargazing is now easier and way more fun! Let's explore how **apps** and **star maps** can turn you into a sky expert — right from your terrace in India.

These apps and maps help you:

Know *when* and *where* to look

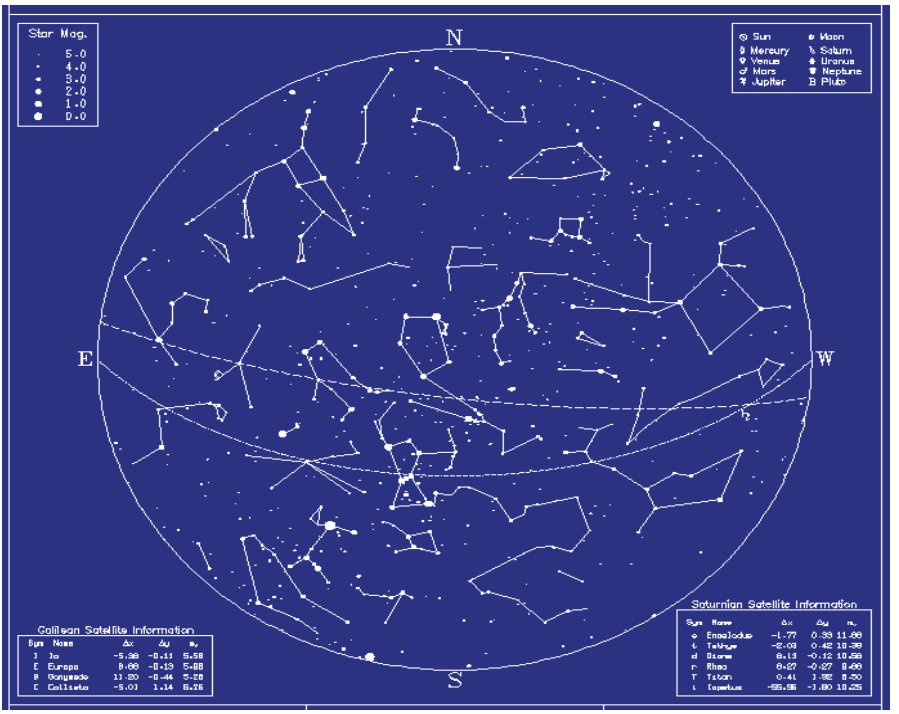
Learn names and stories of stars and constellations

Understand where the Moon and planets will be

Track **eclipses**, **meteor showers**.

What Are Star Maps?

A star map (also called a star chart or sky chart) is like a treasure map of the night sky. It shows the positions of stars, constellations, planets, and the Moon. Some are paper maps, while others are digital apps that change as the sky changes. In India, you can use Indian sky maps that are aligned with the local time and direction.



Tip: North is usually marked on star maps. Use a compass or app to find north in real life!

Some good Stargazing Apps

Here are some super helpful (and free or low-cost!) astronomy apps you can try:

1. SkyView Lite (iOS / Android)

Point your phone at the sky — it shows you what stars and planets you're looking at in real-time!

Fun, glowing graphics.

Works even during the day!

Try this: Point it at the Moon and see which constellation it's near.

2. Star Walk 2 (iOS / Android)

Animated 3D sky map.

Tell you what's visible **from your city in India** right now.

Great for learning **constellation stories** and planet names.

Try this: Tap on **Saptarishi** (Big Dipper) and read the story behind it.

3. Stellarium Mobile (iOS / Android)

Super detailed — used by amateur astronomers too!

You can fast-forward time to see how the sky will look later.

See deep-sky objects like galaxies and nebulae.

Try this: Search for **Andromeda Galaxy** and track its position tonight!

4. Google Sky Map (Android only)

Simple and free!

Great for quick sky tours.

Shows constellations, planets, and stars when you point your phone at the sky.

Try this: Use it to find **Jupiter** and follow it for a week!

5. ISRO's Geo portal Bhuvan

Not just for astronomy, but you can explore **space and Earth** the Indian way.

Developed by ISRO (Indian Space Research Organisation).

Helpful Astronomy Websites

Besides apps, websites help too! These work well with Indian time zones and festivals:

www.timeanddate.com/astronomy/ – See sunrise / sunset, Moon phases, eclipses (works for Indian ciies).

www.skyandtelescope.org – For slightly older kids and teens who want to go deeper.

Paper Star Maps

Even in the age of smartphones, a good old **printed star map** is a wonderful tool:

You can:

Print free maps from websites like **Skymaps.com**

Buy Indian sky charts from bookstores or planetariums (like **Nehru Planetarium** in Delhi or Mumbai)

🤔 Spark Your Curiosity!

✅ **DIY idea**: Make your own rotating star wheel called a **planisphere**. Cut, pin, and spin to match your sky!

UNIT 4
(LIGHT COLOUR AND SKY WONDERS)

Chapter 4.1
Colours of Planets, and What they tell us about Universe

What Do Planets Teach Us About the Universe?

Every time we look at a planet, we are seeing more than just a ball floating in space. The light it reflects, the colours it shines, the rings that circle it, and even its distance from the Sun tell us important things about how the universe works.

Let's break it down:

1. Light

What we see: Planets don't make their own light—they reflect sunlight.

What we learn: By studying how light bounces off a planet, we can:

Tell how smooth or rough the surface is

Find out what the planet is made of

Discover if it has clouds, water, or ice.

Measure its temperature (hot planets reflect more infrared light)

2. Colour

What we see: Different planets have different colours—red, blue, yellow, gray.

What we learn: Colours help scientists know:

If the planet has gases like methane or ammonia

If its surface has rocks, dust, or ice

Whether the planet has clouds, storms, or volcanoes

What the atmosphere is made of

Example: Blue colours (like Neptune's) come from methane gas. Red colours (like Mars) come from rusty iron-rich soil.

3. Rings

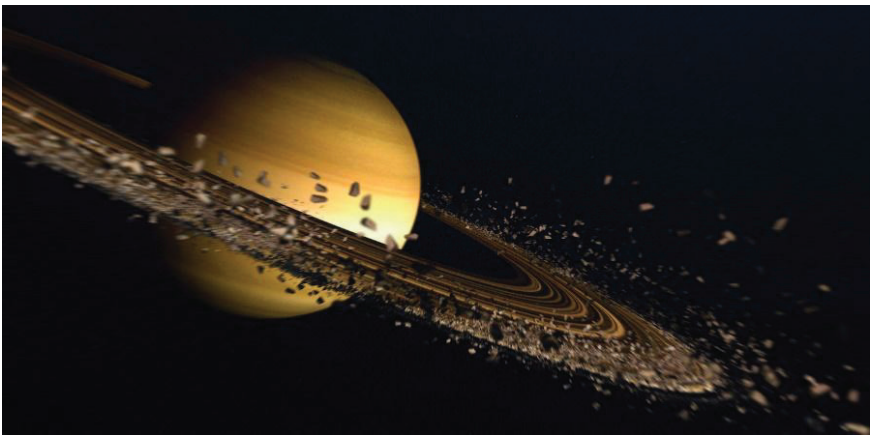
What we see: Saturn has huge rings. Jupiter, Uranus, and Neptune have smaller ones.

What we learn: Rings help us study:

How planets and moons formed (rings are made of pieces of rock and ice)

The effects of gravity—how planets pull objects into orbit

How moons interact with rings and change their shape



Picture credit: NASA

4 Distance from the sun

What we see: Mercury is closest to the Sun. Neptune is the farthest.

What we learn: The distance from the Sun affects:

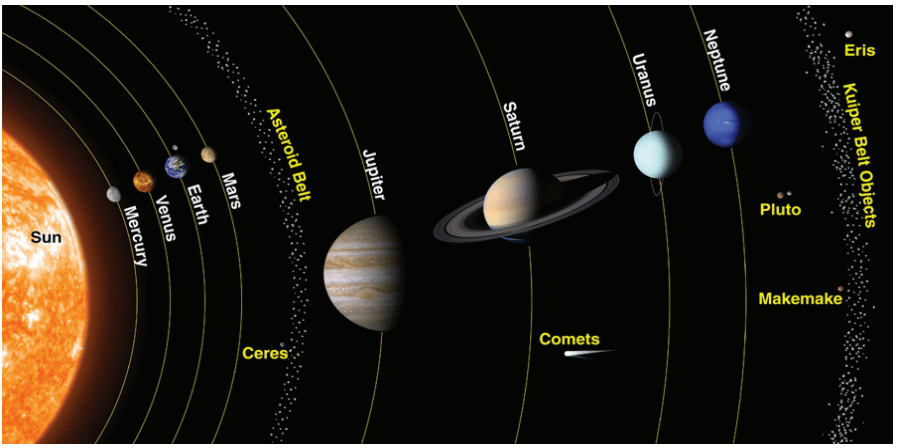
The planet's temperature (closer = hotter, farther = colder)

The planet's year length (how long it takes to orbit the Sun)

What the planet is made of:

Rocky planets (Mercury, Venus, Earth, Mars) are closer to the Sun

Gas giants (Jupiter, Saturn) and ice giants (Uranus, Neptune) are farther away



Picture credit: NASA

A Sky Full of Colourful Secrets: Colours of planets

When you look at the night sky with your own eyes, most planets look like bright white dots. But with a telescope—or even binoculars—those dots come alive in amazing colours!

Let's explore the colourful planets one by one—and unlock the secrets they're hiding.

🌍 Earth – The Bright Blue Marble

Colour: Blue, white, green, and brown

Why it looks like that: Earth's blue oceans, white clouds, green forests, and brown mountains all reflect sunlight. The mix of these colours makes Earth one of the most beautiful planets in the solar system.

Earth (Picture credit: NASA)

What it tells us: Earth is alive! The colour blue means there's water—which is needed for life. The green and brown land shows forests and soil, and the clouds are part of our weather system.

🔴 Mars – The Rusty Red Planet

Colour: Reddish-orange

Why it looks like that: Mars is covered in dusty rocks that contain iron. When iron is exposed to oxygen, it rusts, just like an old bicycle.

What it tells us: The red colour is a clue that Mars once had oxygen and possibly water. This makes scientists wonder—was there ever life on Mars?

Fun fact:

Mars has huge dust storms and the largest volcano in the solar system—**Olympus Mons**.

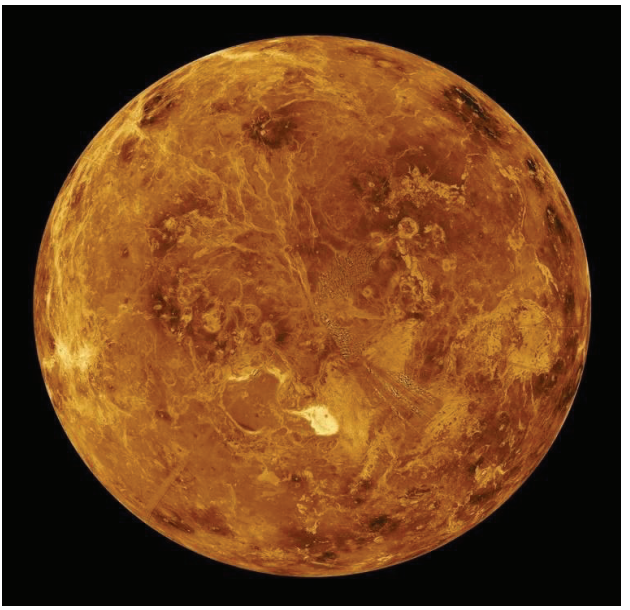
Mars (Picture credit: NASA)

Venus – The Pale-Yellow Planet

Colour: Yellowish-white

Why it looks like that: Venus is covered in thick clouds made of toxic gases like sulfuric acid. These clouds reflect a lot of sunlight, giving it a bright, golden glow.

What it tells us: Venus has an extremely thick atmosphere of carbon dioxide that traps heat. This causes a greenhouse effect, making it the hottest planet, even though it's not the closest to the Sun.



Venus (Picture credit: NASA)

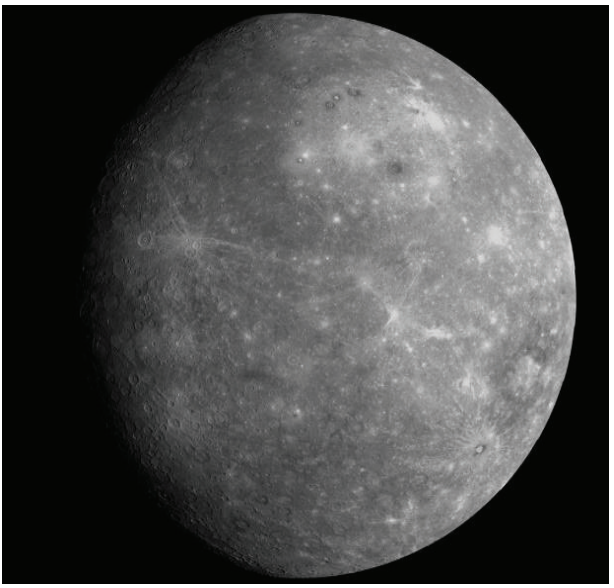
Mercury – The smallest planet

Colour: Greyish brown

Why it looks like that: Mercury has no atmosphere, so its surface is exposed. It's full of dusty rocks and craters, just like our Moon.

What it tells us: Mercury is a dry, airless, rocky world that hasn't changed much in billions of years. It gives us a peek into the past—what young planets looked like.

> ***Fun fact:***
> *Because it has no air, Mercury's surface can go from super-hot to freezing cold in one day!*



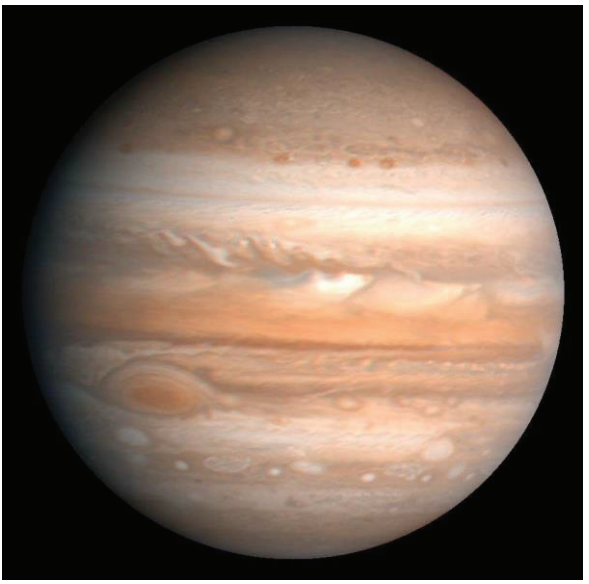
Mercury (Picture credit: NASA)

Jupiter – The Striped Giant

Colour: Swirls of orange, brown, white, and red

Why it looks like that: Jupiter is made of gas. Its colourful stripes are actually bands of clouds made of gases like hydrogen, helium, ammonia, and methane. The red and brown colours come from chemicals reacting under the Sun's light.

What it tells us: Jupiter's colours show us its storm systems and weather patterns. The famous Great Red Spot is a giant storm larger than Earth that's been raging for over 300 years!



Jupiter (Picture credit: NASA)

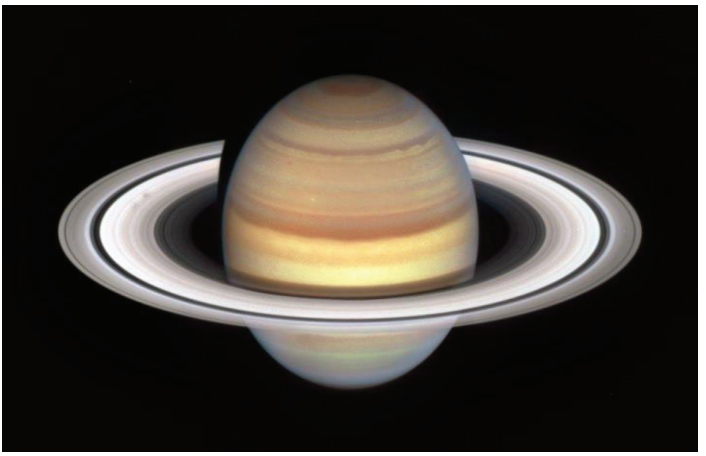
Fun fact:
Jupiter is so big that more than 1,300 Earths could fit inside it.

Saturn – The Ringed Planet

Colour: Pale gold with soft brown bands

Why it looks like that: Like Jupiter, Saturn is made of gas. Its atmosphere contains ammonia crystals, giving it a soft golden glow.

What it tells us: Saturn's colour and cloudy layers show that it's a cold, calm giant with gentler storms than Jupiter. Its iconic rings, made of ice and rock, reflect sunlight and sparkle beautifully.



Saturn (Picture credit: NASA)

> **Fun fact:**
> If you could find an ocean big enough, Saturn would float—it's the least dense planet!

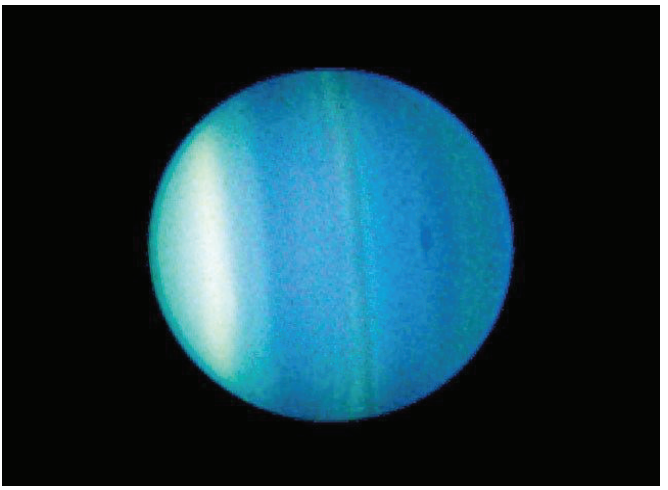
🔵 Uranus – The Ice-Cold Planet

Colour: Light blue-green

Why it looks like that: Uranus has an atmosphere filled with methane gas, which absorbs red light and reflects blue and green.

What it tells us: Uranus is made mostly of icy materials, like water, ammonia, and methane. Its weird sideways spin tells scientists a lot about planetary collisions.

> **Fun fact:**
> Uranus spins on its side like a rolling ball—it may have been knocked over by a giant space crash long ago!



Uranus (Picture credit: NASA)

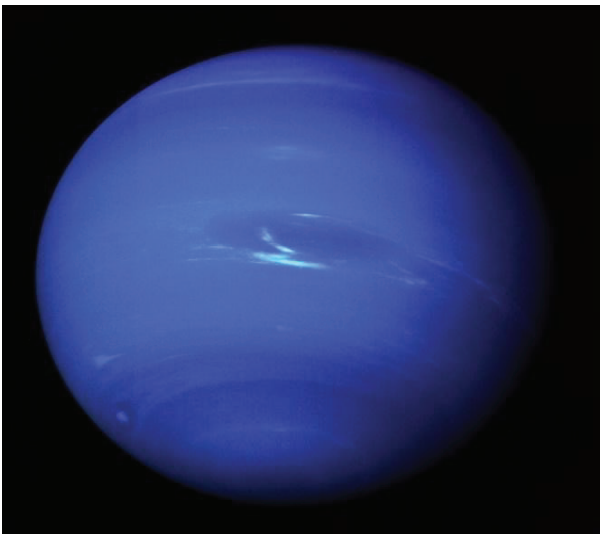
🔵 Neptune – The Deep Blue Stormy Planet

Colour: Deep blue

Why it looks like that: Neptune also has methane in its atmosphere, but something else makes it even bluer than Uranus—a mystery scientists are still trying to solve!

What it tells us: Neptune's colour and patterns tell us it has super-fast winds, huge storms, and a cold, stormy atmosphere.

> **Fun fact:**
> Neptune's winds are the fastest in the solar system—up to 2,000 kilometres per hour!



Neptune (Picture credit: NASA

🧠 Spark Your Curiosity!

✅ Draw or paint the planets using their real colours — Mars red, Neptune blue, Venus yellowish-white! Then, label what gives each planet its colour (like rust on Mars or clouds on Venus).

Chapter 4.2
Star Colours: What they tell us about the Universe

When you look up at the night sky, all stars might look white at first. But if you take your time—or use binoculars or a telescope—you'll start to notice something magical: stars, come in different **colours**! Some are **red**, some are **blue**, others are **yellow** or **orange**.

But these colours aren't just for show—they're full of clues about what stars are like, how they live, and even how the universe itself is changing.

1. Star Colour Tells Us: Temperature

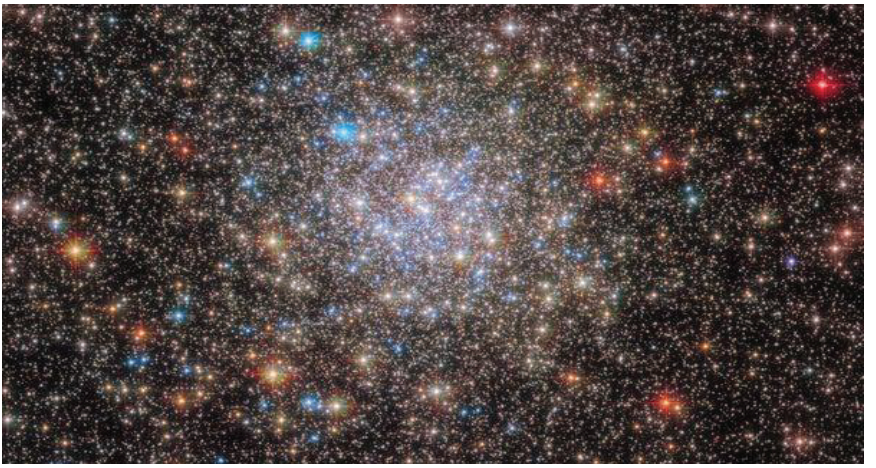
As we studied in some earlier chapter, we know that the first and most important thing a star's colour tells us is how hot it is on the outside.

You might think red is the hottest (like fire), but in space, it's the opposite!

Just like metal glows red, orange, white, then blue as it gets hotter, stars do the same.

Colour	Surface Temperature	What it means	Example Star
Blue	25,000°C and up	Very hot and energetic	Rigel, Spica
White	~10,000°C	Hot	Vega
Yellow	~6,000°C	Medium-hot (like the Sun)	Our Sun
Orange	~4,500°C	Cooler	Arcturus
Red	~3,000°C	Coolest of all	Betelgeuse, Antares

So, if you see a blue star, it's blazing with energy, and if you see a red one, it's cooler and more relaxed!



1. Star Colour Tells Us: Age and Life Stage

Stars change colour as they grow older—just like people change as they grow up.

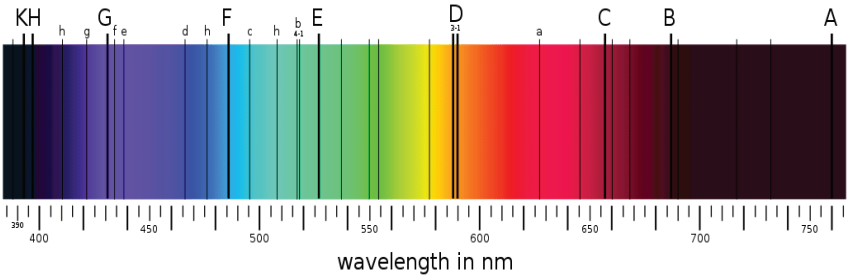
Young stars are often blue or white. They burn bright, fast, and hot!

Middle-aged stars, like our Sun, are yellow and stable.

Older stars become red giants. That's when they swell up and cool down before fading away.

So, a star's colour is also a clue about how far it is on its cosmic life journey.

2. Star Colour Tells Us: Ingredients (Spectroscopy)



Each star is made of gas—mostly **hydrogen** and **helium**. But how do we know that?

Astronomers use a tool called a **spectroscope**, which splits a star's light into a rainbow called a **spectrum**. Some colours are missing from the rainbow, and those missing lines tell us what elements are in the star!

These are like fingerprints. Every element—hydrogen, oxygen, calcium—leaves a different pattern of lines.

By looking at those lines, we can tell:

What is a star made of?

How old is it ?

Whether it's making new elements inside .

3. Star Colour Tells Us: Movement (The Doppler Effect!)

Now here's where it gets super cool—we can use a star's colour to find out if it's moving, and how fast!

Let's learn about the **Doppler Effect**.

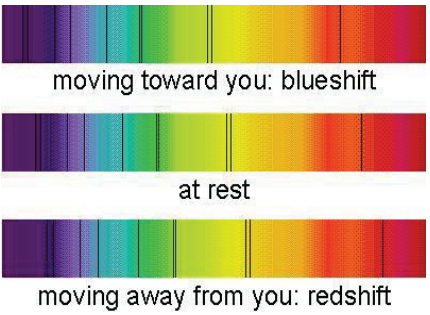
What's the Doppler Effect?

Imagine a police car driving past you with its siren on. As it comes closer, the siren sounds higher, and as it drives away, the siren sounds lower. That's because the sound waves are getting squished when the car moves toward you, and stretched when it moves away.

Well, light waves do the same thing!

When a star or galaxy moves toward us, its light waves are squished, and the light becomes slightly bluer. This is called a blueshift.

When a star or galaxy moves away from us, its light waves are stretched, and the light becomes slightly redder. This is called a redshift.



What Does This Tell Us About the Universe?

When astronomers looked at the light from distant galaxies, they saw that almost all of them were redshifted. That means most galaxies are moving away from us. So, the whole universe is expanding! This discovery was one of the biggest in astronomy—it's how we know the universe had a beginning (the Big Bang), and it's still growing like a balloon being blown up.

🧠 Spark Your Curiosity!

✅ Fun Activity: Make Your Own Spectroscope!

You can build a simple spectroscope at home using:

A cardboard tube (like from paper towels)

A CD or DVD

Black tape

A small slit cut in the tube

Point it at different lights (never the Sun directly!), and you'll see rainbows. Try looking at a streetlight or a lamp—you'll start spotting spectral lines just like astronomers do!

Chapter 4.3
Halos and Auroras: Colours in the Sky

Have you ever seen or heard about rings around the Sun, flashing stars, or a silky band of light stretching from one side to the other? These glowing wonders are like nature's magic tricks in the sky! From ringed halos around the Sun in Delhi… to meteor showers in Bengaluru… to the shimmering Milky Way in Ladakh… the Indian sky is full of magical lights if we just look up.

Let's explore the most amazing sky lights you can see in India, from the Himalayas of Ladakh to the plains of Rajasthan, the hills of the Northeast, and even the cities and coasts!

Ladakh: India's Stargazing Heaven

Ladakh is known for its clean air, high mountains, and ink-black night skies. This makes it one of the best places in the world to see space wonders with your own eyes!

When the Sun goes down, the sky turns into a magical dome filled with:

1. Shooting Stars (Meteors)

They are tiny space rocks that burn up and make bright streaks of light. We can observe meteor showers like **Perseids** in August and **Geminids** in December.

2. The Milky Way Galaxy – A Star River in the Sky!

The Milky Way is the galaxy we live in. It's made of billions of stars!

It looks like a glowing path — we in India call it **"Akash Ganga"**, which means the river of the sky.

A view of the Milky Way galaxy behind the Indian Astronomical Observatory at Hanle in Ladakh, (Image credit: The Hindu)

You can see the Milky Way in India from many other places too. Look up between 10 PM and 4 AM on a moonless night — you might just see the Milky Way flowing above you!

3. Planets and Nebulae

Planets like Venus, Jupiter, Saturn shine brightly.

Star clusters and nebulae can be seen with binoculars or telescopes .

4. Halos – The Sun and Moon Wear Crowns!

Have you ever looked up and seen a bright ring around the Sun or the Moon? That's called a halo!

What causes it?

High up in the sky, tiny ice crystals in clouds bend the light like a giant glass prism. That makes a circle of light around the Sun or Moon!

Sometimes the halo is white, and sometimes it even has rainbow colours 🌈!

The sun Halo seen in Bengaluru, India

You can see halos from many places just look up on cold or cloudy days, especially in winter!

4. Northern Lights – Do We See Them in India?

The Northern Lights (or Aurora Borealis) are one of the most beautiful sky wonders in the world!

They look like dancing green, pink, or purple lights in the sky — like curtains made of magic!

They happen near the North and South Poles, in places like Norway, Canada, and Alaska.

Northern lights (Aurora Borealis) seen in Alaska (Picture credit: NASA)

Rare stable auroral red arc sight in Ladakh's skies (Picture credit: The times of India)

But what about India?

India is too far south, so auroras are not normally visible here.

BUT! Very rarely, when the Sun sends a huge solar storm, a faint green aurora might be seen from: Ladakh, Jammu and Kashmir and Arunachal Pradesh.

In 2024, some scientists in India spotted a soft green glow from Ladakh during a giant solar storm!

🧠 Spark Your Curiosity!

✅ **Activity:** Make Your Own Sun Halo!

What You Need:

A flashlight or sunlight

A glass of water

A mirror

What To Do:

Place the mirror in the water at an angle.

Shine the flashlight at the mirror in a dark room.

Watch the light bend and form a circle or rainbow on the wall or ceiling!

This is how halos happen in the sky — light bending through tiny ice crystals!

Chapter 4.4
Light Pollution: Why are Stars Disappearing?

Where Did All the Stars Go?

Have you ever looked up at the night sky and seen only a few stars twinkling? Maybe you've even wondered, "Where did all the other stars go?" Long ago, people could see thousands of stars just by looking up at the sky. Today, in many cities, we can only see a few. The reason? **Light pollution**.

Let's find out what light pollution is and why it's making our stars disappear!

What Is Light Pollution?

Light pollution happens when too much artificial light — like from streetlights, car headlights, buildings, or advertisements — brightens the night sky.

Just like smoke can hide a beautiful sunset, too much light hides the stars from our eyes.

There are different types of light pollution:

Skyglow: A bright haze over cities that blocks starlight.

Glare: Harsh lights that hurt your eyes, like bright headlights.

Light trespass: Light that spills into places it shouldn't — like your bedroom window at night!

Clutter: Too many lights bunched together, like in busy city centres.

Sky without and with light pollution

A Tale of Two Skies

Imagine two kids: Aarvi lives in a big city, and Arnav lives in a small village.

Aarvi looks up and sees maybe 10 stars. The sky looks greyish-blue.

Arnav looks up and sees thousands of stars, the Milky Way, and even shooting stars!

Aarvi's sky is full of light pollution. Arnav's isn't. That's the big difference.

Why Does Light Pollution Matters?

Light pollution doesn't just make it hard to see stars. It affects:

Astronomy– Telescopes can't "see" well through bright skies.

Animals– Birds, turtles, insects, and other creatures use the moon and stars to find their way. Too much light confuses them.

Humans– Bright lights at night can disturb our sleep and health.

Energy Waste– Lights that shine up into the sky waste electricity and money!

Can We Bring the Stars Back?

Yes! If we reduce light pollution, the stars will shine for us again. Here's how you can help:

Shield your lights– Use outdoor lights that point down, not up.

Turn off lights– When you don't need them, switch them off.

Choose soft lights– Use bulbs that aren't too bright or harsh.

Say no to sky beam lights– These big moving lights waste lots of energy.

Join a "lights out" night– Some cities have special nights when they turn off lights to enjoy the stars!

🧠 Spark Your Curiosity!

✅ Try This Nighttime Experiment!

Step Outside Tonight:

Look up at the sky. Count how many stars you can see in one minute. Write down where you are and if there are any bright lights around you.

Now Try This:

Gently cover your flashlight with red paper or cloth (ask an adult for help). This makes a red light that helps you see in the dark without blinding your eyes.

Wait and Watch:

Stand in the dark for a few minutes with your red light. As your eyes adjust, can you see more stars?

Remember: keep asking questions, keep observing, and keep wondering about the universe. who knows - one day you might discover a new star, study distant planets or help solve the mysteries of space. Remember, every great astronomer once started as a curious child who loved the stars. All the best!