Topic 4.3 — How Technology Expands Our View of the Universe

Title

Space Technology: Seeing Farther and Understanding More

Big Question

How does technology help us learn things about space that our eyes cannot see?

Technology Helps Us See More



Naked Eye	Technology	More Detail
You can see only a few bright stars	Telescopes collect more light and reveal much more	Advanced technology shows amazing detail in the universe

Easy Explanation

Our eyes can see some objects in space.

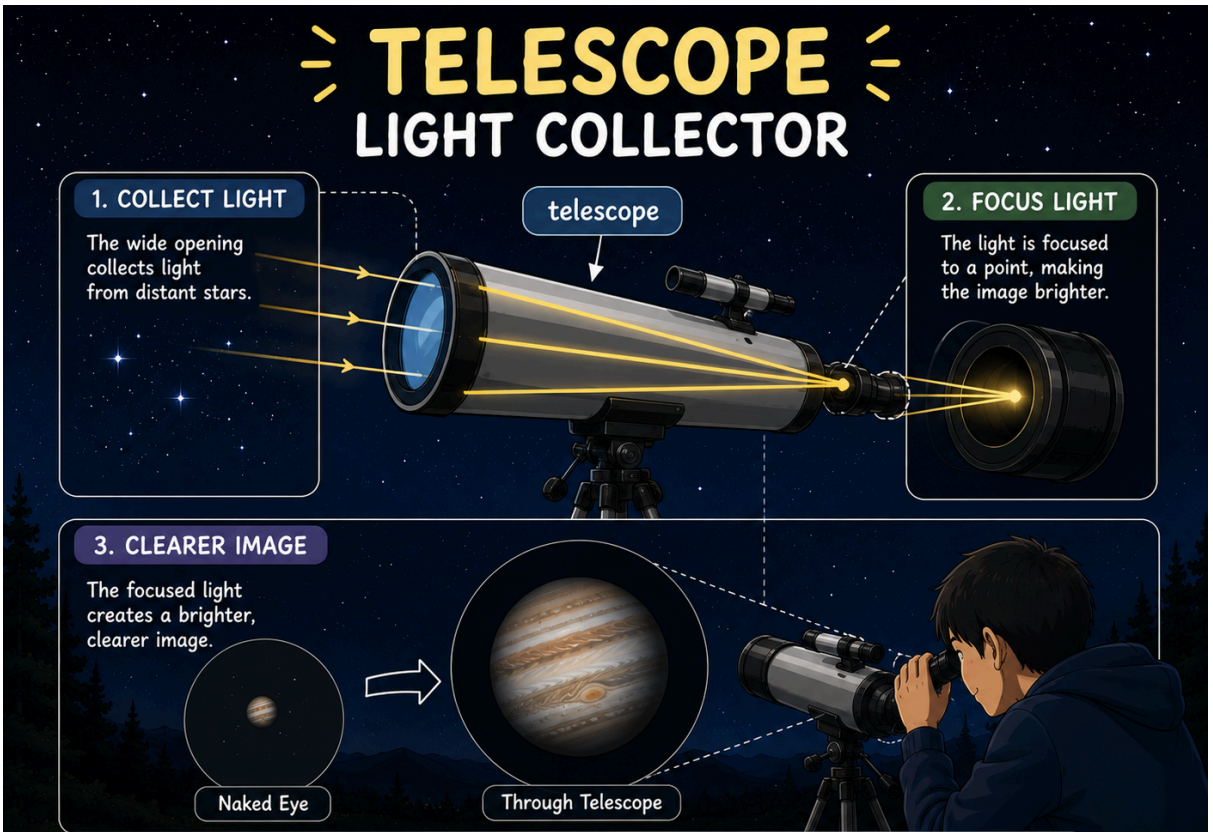
But our eyes cannot see everything.

Technology helps us see farther.

Technology also helps us see different kinds of light.

This gives us more information about the universe.

Telescopes



Vocab	What it means
Telescope	It collects light It makes for objects look brighter and clearer

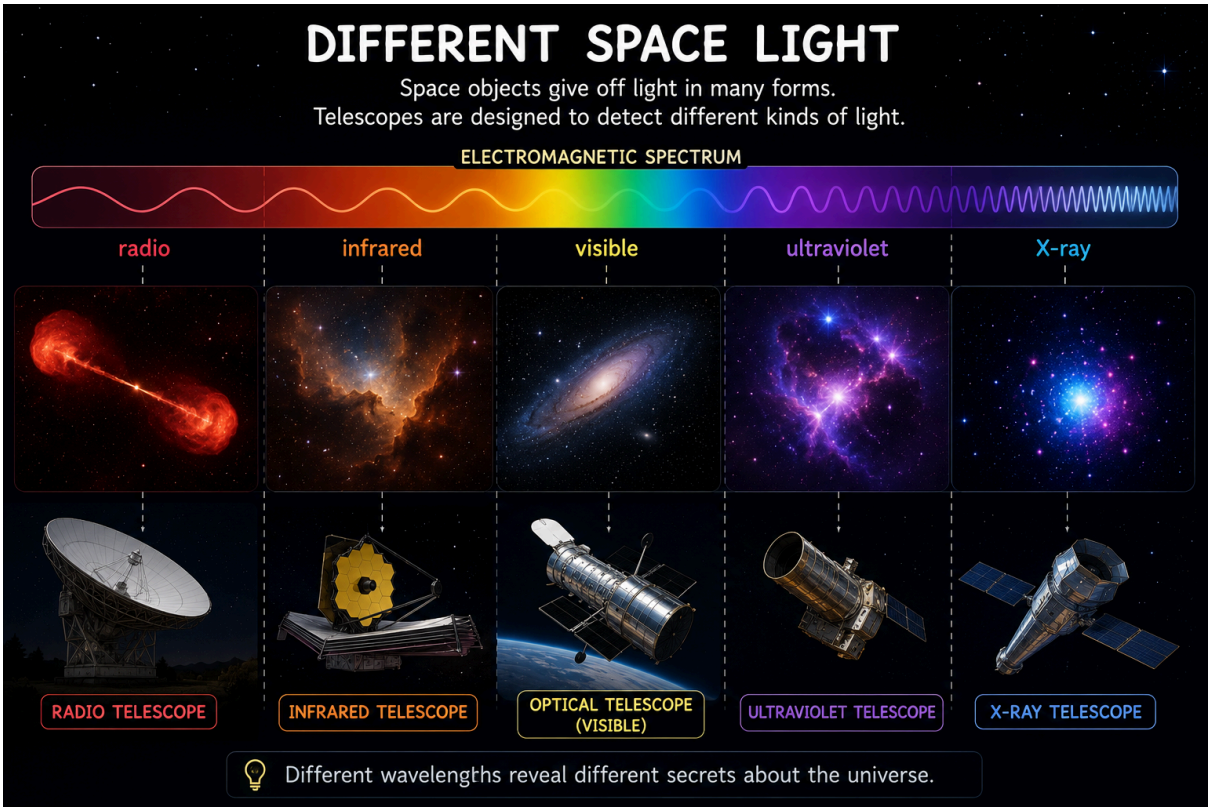
Easy Explanation

Galileo used a telescope to see things people could not see with eyes alone.

He saw moons around Jupiter.

He also observed Saturn in more detail.

Different Wavelengths



Easy Explanation

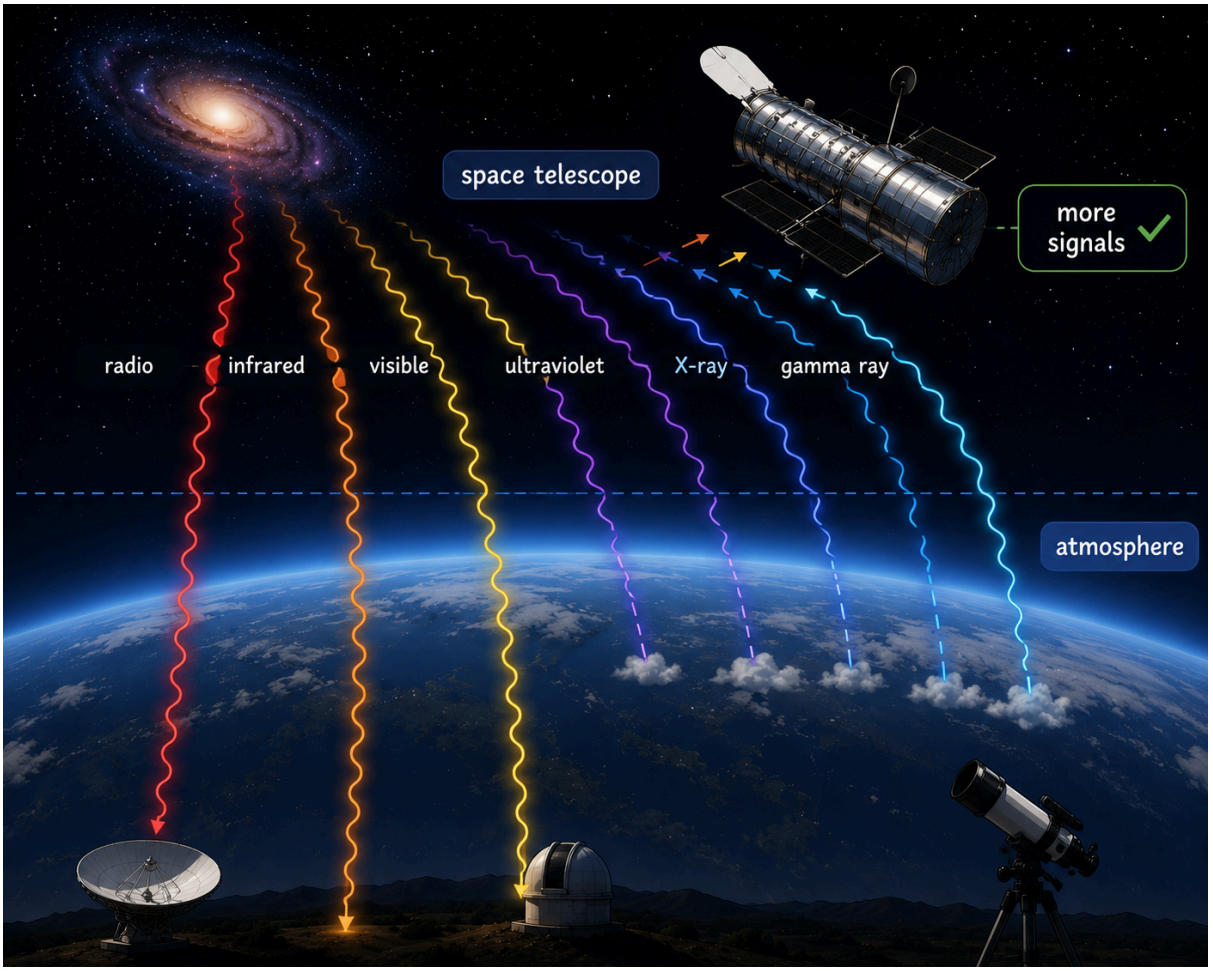
Visible light is only one kind of light.

Space objects also give off radio waves, infrared, ultraviolet, X-rays, and gamma rays.

Different telescopes detect different wavelengths.

Each wavelength can show different information.

Telescopes in Space



Easy Explanation

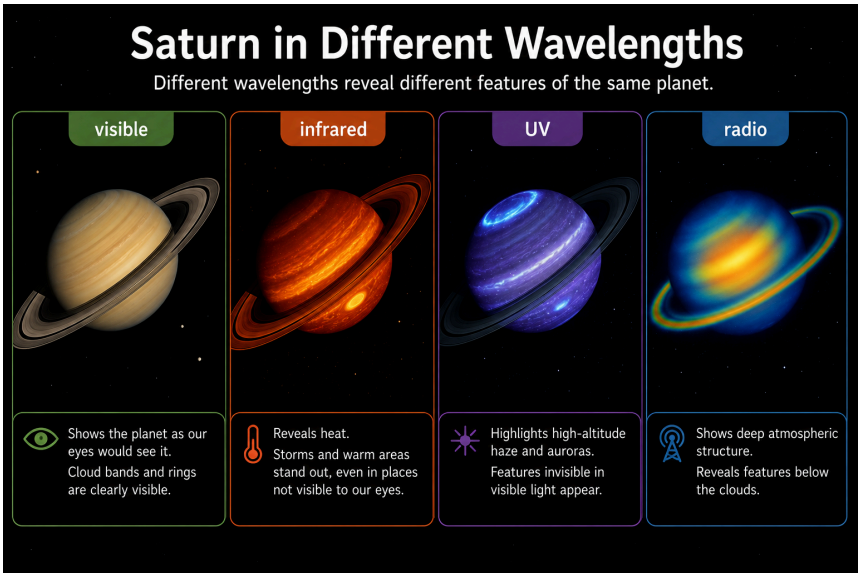
Earth’s atmosphere blocks some radiation from space.

Some telescopes work better above the atmosphere.

That is why some telescopes are placed in space.

Space telescopes can collect information that ground telescopes may miss.

Same Object, Different Views

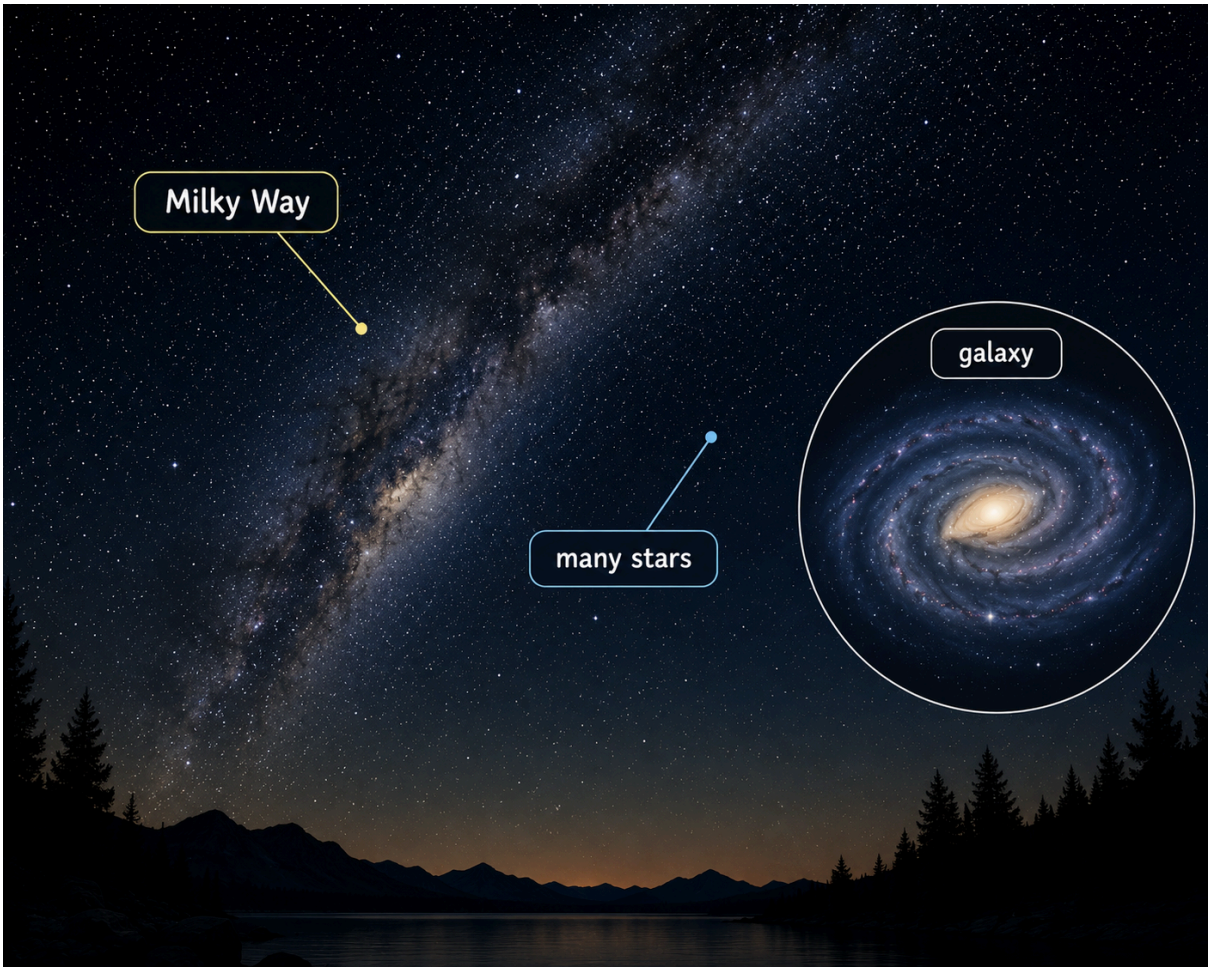


Saturn in different wavelengths	Different wavelengths reveal different features of the same planet
visible	It shows the planet as our eyes would see it. Cloud band and rings are clearly visible
infrared	It reveals heat. Storms and warm areas stand out, even in places not visible to our eyes
UV	It highlights high-altitude haze and auroras. It features invisible light.
Radio	It shows deep atmospheric structure. It reveals features below the clouds.

Easy Explanation

The same object can look different in different wavelengths.
Visible light shows what our eyes might see.
Infrared can show heat or hidden features.
Radio waves and X-rays can show other invisible information.
Using many wavelengths gives a fuller picture.

The Milky Way Galaxy



Vocab	What it means
Galaxy	A huge collection of stars, gas, and dust held together by gravity

Easy Explanation

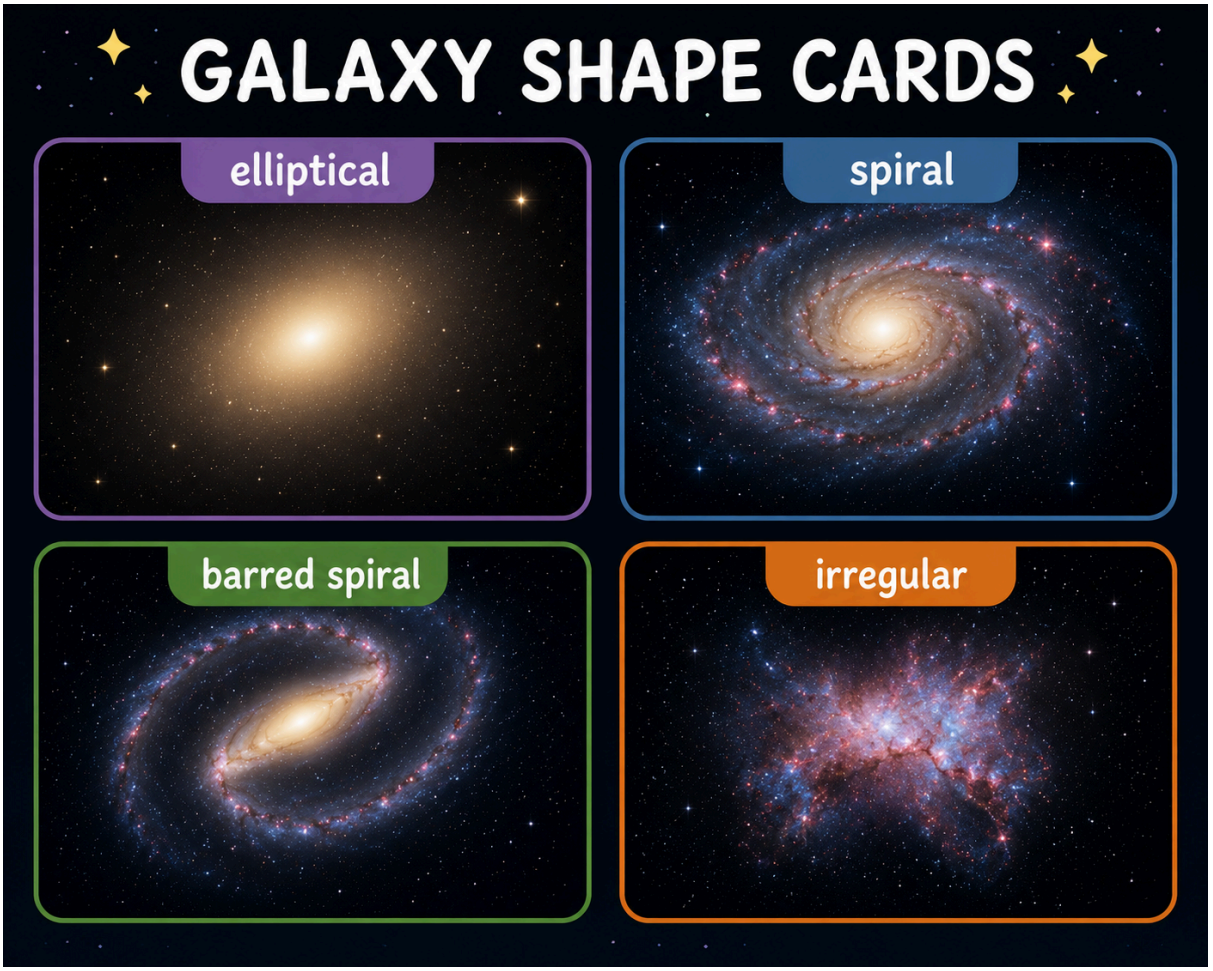
The Milky Way is our galaxy.

The Milky Way looks like a cloudy band in a dark sky.

It is not a cloud.

It is made of many stars, gas, and dust.

Shapes of Galaxies



Easy Explanation

Galaxies come in different shapes.

Some are round or oval.

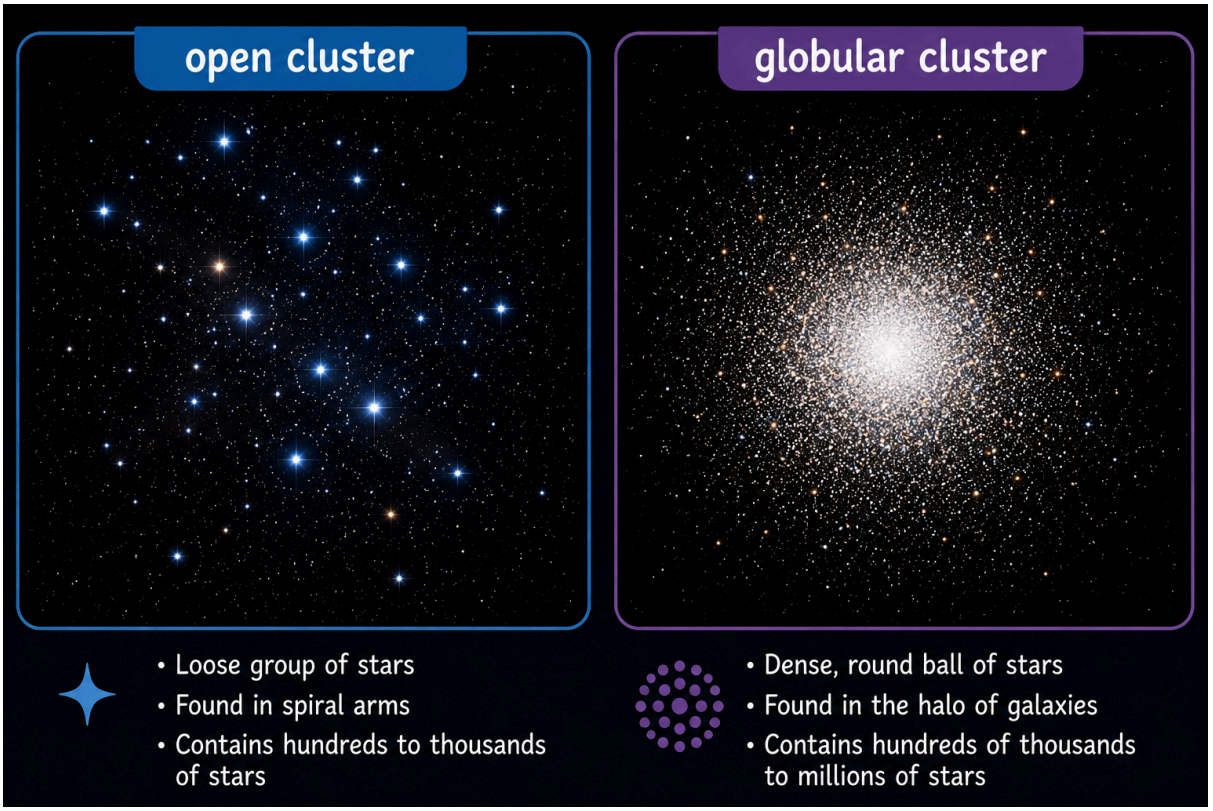
Some are spiral.

Some have a bar across the middle.

Some have no clear shape.

Our Milky Way is a **spiral** galaxy.

Star Clusters



Open Cluster	**Globular Cluster**
Loose group of stars	Dense, round ball of stars
Found in spiral arms	Found in the halo of galaxies
Contains hundreds to thousands of stars	Contains hundreds of thousand to millions of stars

Easy Explanation

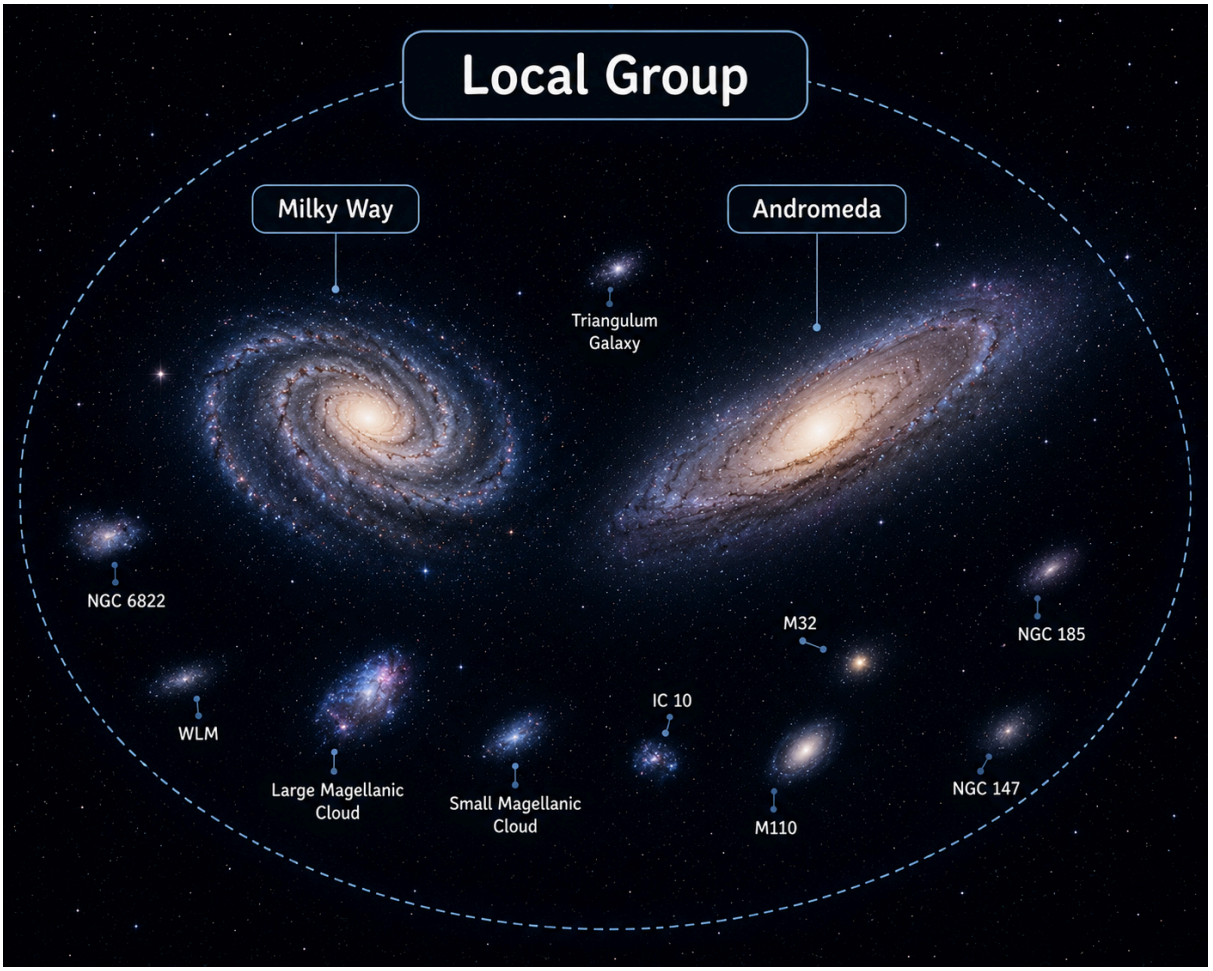
A star cluster is a group of stars held together by gravity.

Open clusters are loose groups of stars.

Globular clusters are round and very crowded.

Astronomers used star clusters to learn about the shape and centre of the Milky Way.

Local Group



Vocab	What it means
Local Group	A group of galaxies

Easy Explanation

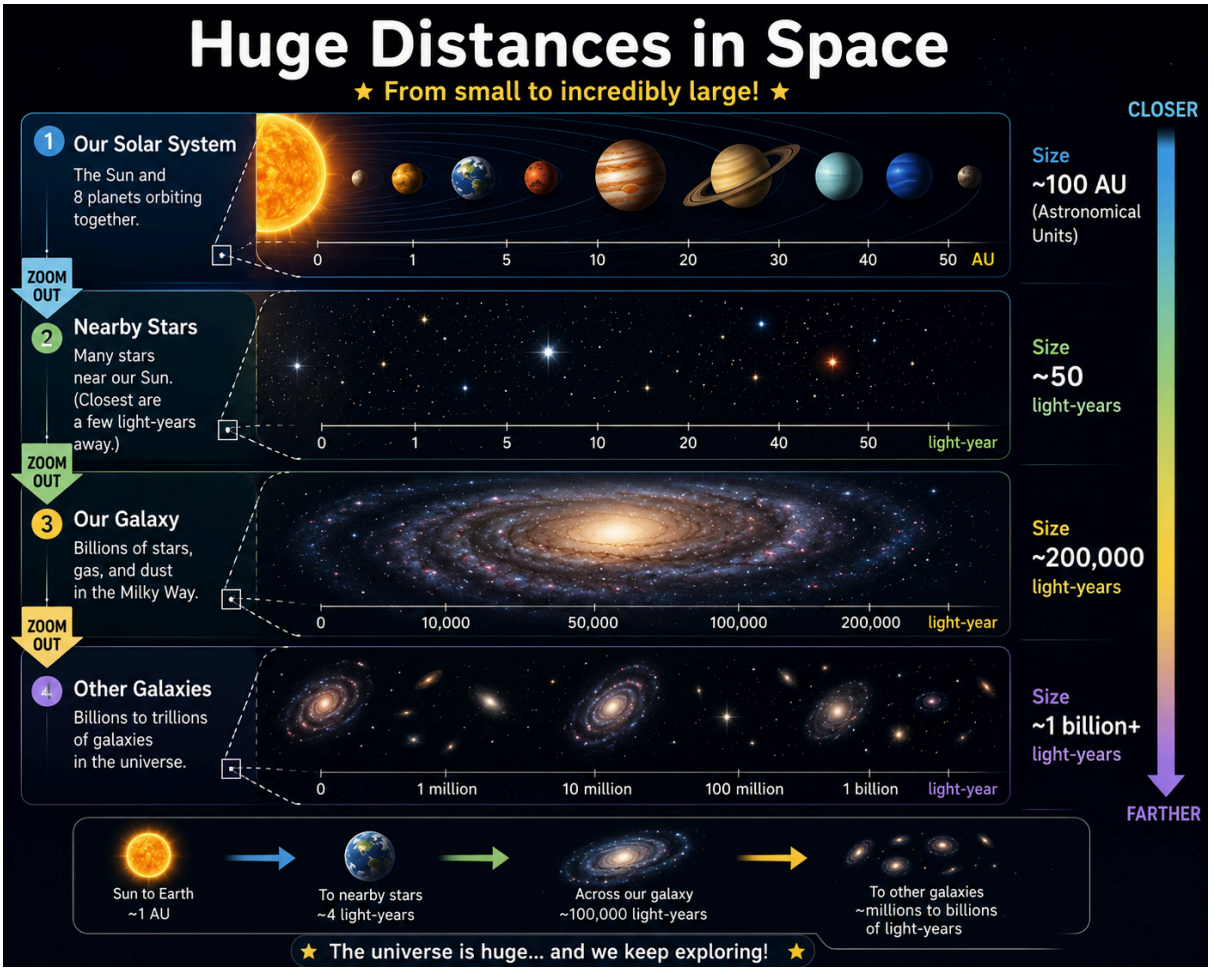
The Milky Way is not alone.

It belongs to a group of galaxies called the Local Group.

The Andromeda Galaxy is another large galaxy near us.

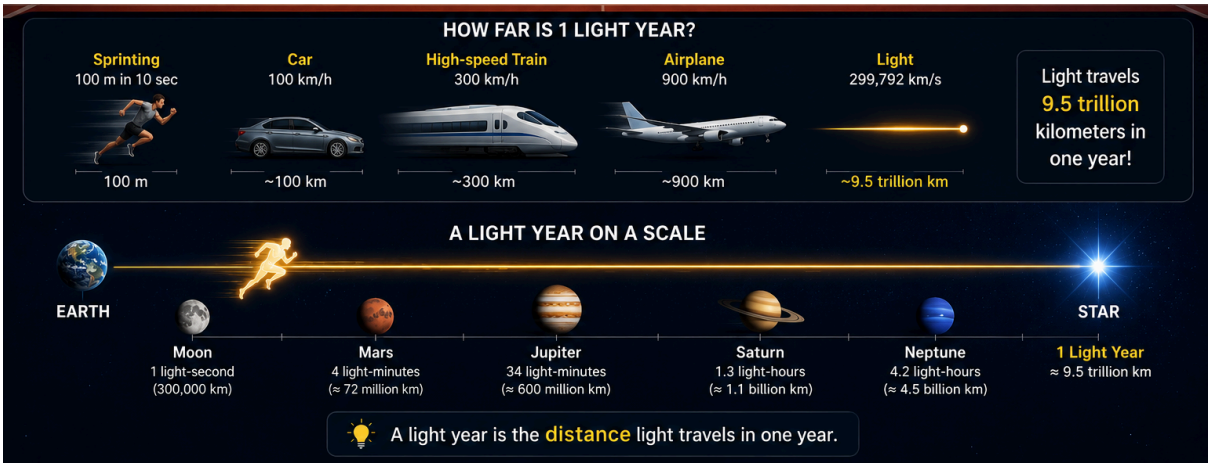
The universe contains many groups and clusters of galaxies.

Huge Distances in Space



Vocab	What it means
Light Year	It is a measurement of distance, not time. It is the total distance that a beam of light travels through space in one Earth year.





Easy Explanation

Space distances are very large.

Kilometres are useful on Earth.

Astronomical units, or AU, are useful in the solar system.

Light-years are useful for stars and galaxies.

A light-year is a distance, not a time.

Light-Year



Easy Explanation

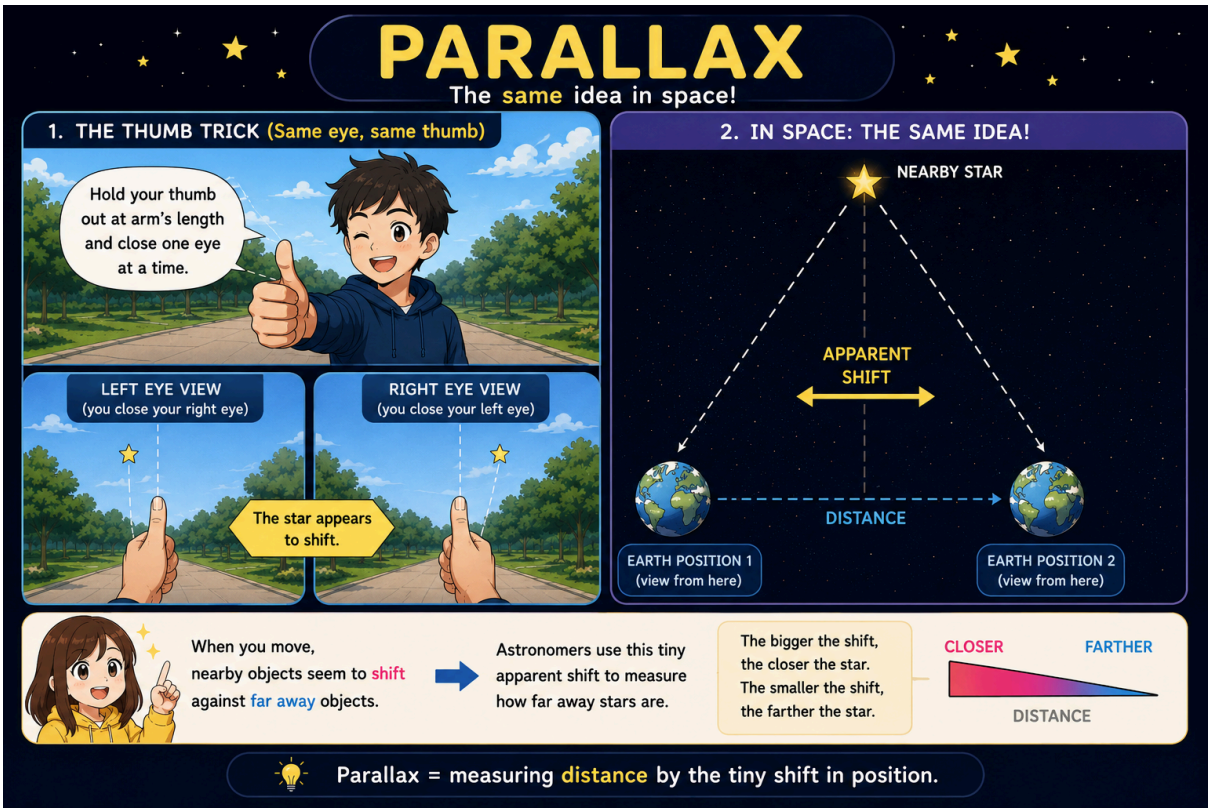
Light takes time to travel.

The farther a star is, the older its light is when it reaches us.

When we look at distant stars, we are seeing the past.

This is why astronomy is like looking back in time.

Parallax



Vocab	What it means
Parallax	An apparent shift in position

Easy Explanation

You can see it by holding your thumb out and closing one eye at a time.

Astronomers use a similar idea to measure distances to nearby stars.

A larger parallax shift means the object is closer.

Star Brightness



Vocab	What it means
Luminosity	The total energy a star gives off each second (Total energy)
Apparent brightness	How bright it looks from Earth (Brightness)

Easy Explanation

A star can look bright for two reasons.

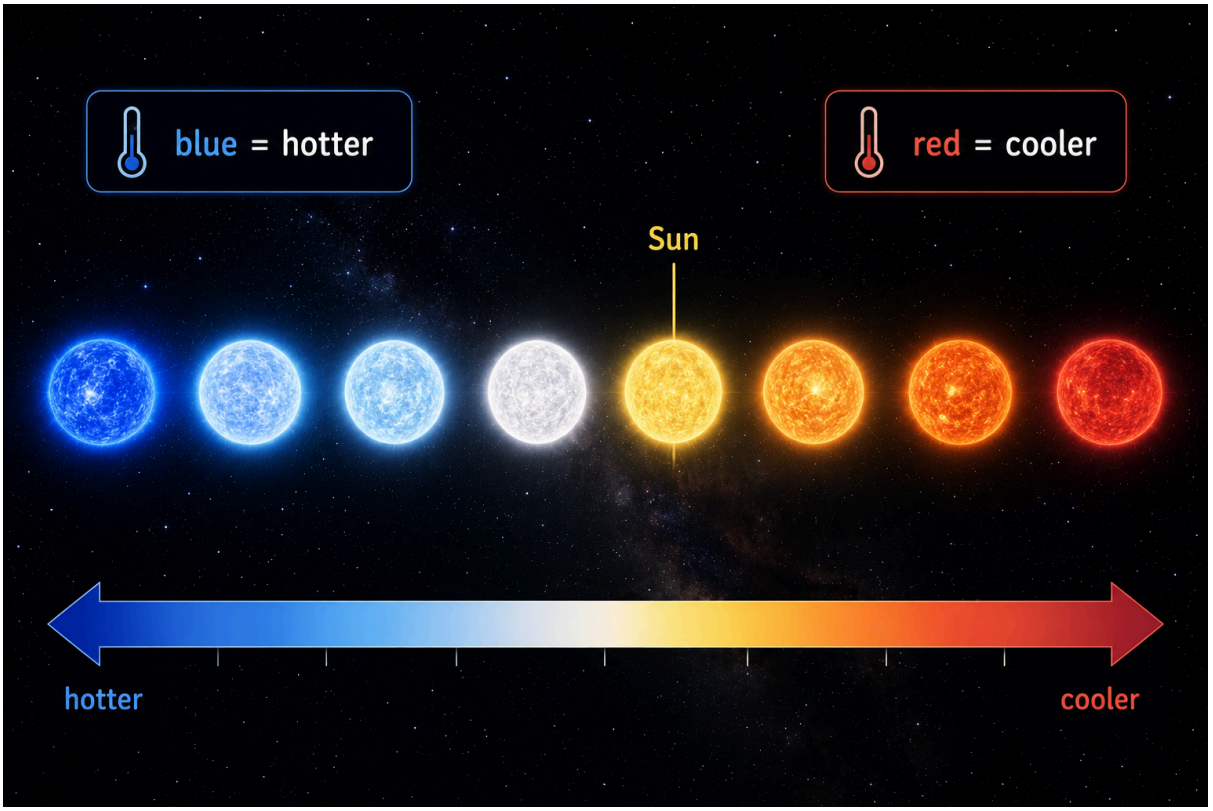
It may be very close.

Or it may give off a lot of energy.

Luminosity means the total energy a star gives off each second.

Apparent brightness means how bright it looks from Earth.

Star Colour and Temperature



More blue	Hotter
More red	Cooler

Easy Explanation

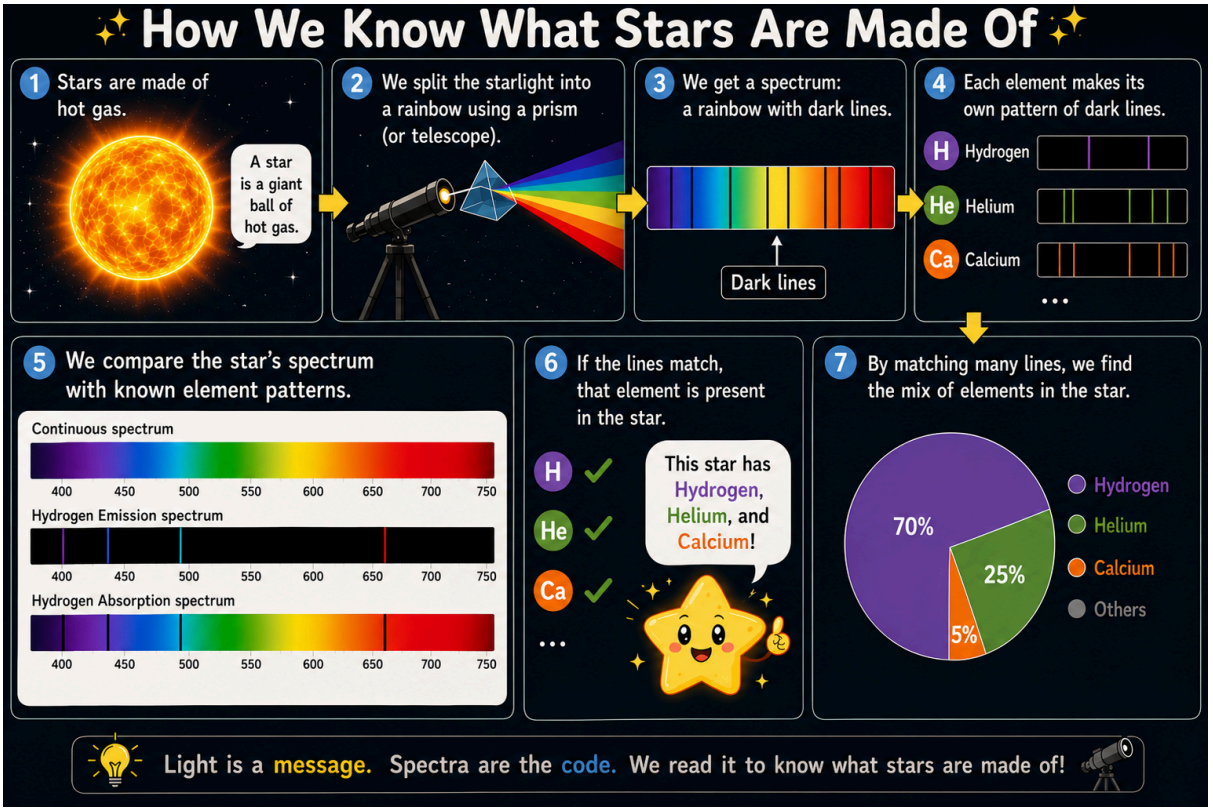
A star’s colour tells us about its temperature.

Blue stars are hotter.

Red stars are cooler.

The Sun looks yellowish because it is in the middle range.

Star Composition



How We know What Starts Are Made Of

1) Stars are made of hot gas
2) We split the starlight into a rainbow using a prism (or telescope)
3) We get a spectrum : a rainbow with dark lines
4) Each element makes its own pattern of dark lines
5) We compare the star's spectrum with known element patterns
6) If the lines match, that element is present in the star
7) By matching many lines, we find the mix of elements in the star

→ Light is a message. Spectra is the code. We read it to know what stars are made of!

Easy Explanation

Astronomers use a spectroscope to study star light.

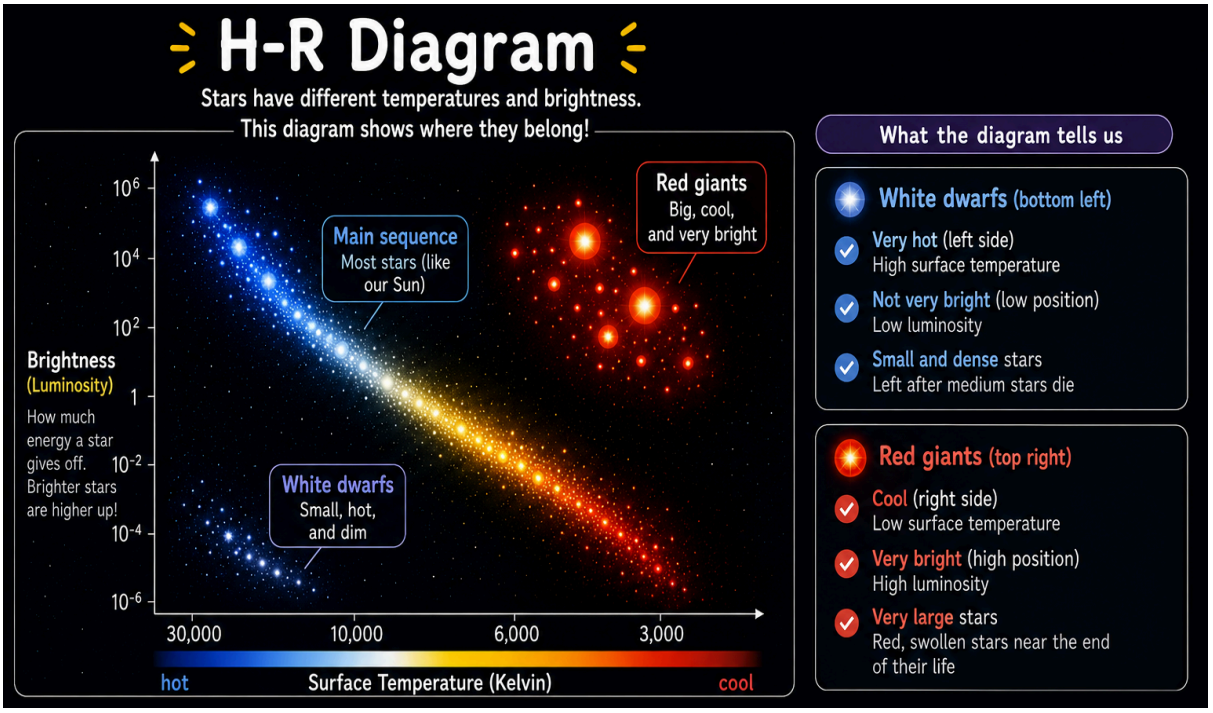
A spectrum has special lines.

Each element makes a unique pattern of lines.

The pattern works like a fingerprint. (Each star has different set of patterns)

This helps scientists know what stars are made of.

H-R Diagram



White dwarfs(bottom left)	**Red giants (top right)**
Very hot (left side) : High surface temperature	**Cool** (right side) : Low surface temperature
Not very bright : Low luminosity	**Very bright** (high position) : High Luminosity
Small and dense stars : Left after medium stars die	**Very Large stars** : Red, swollen stars near the end of their life

Easy Explanation

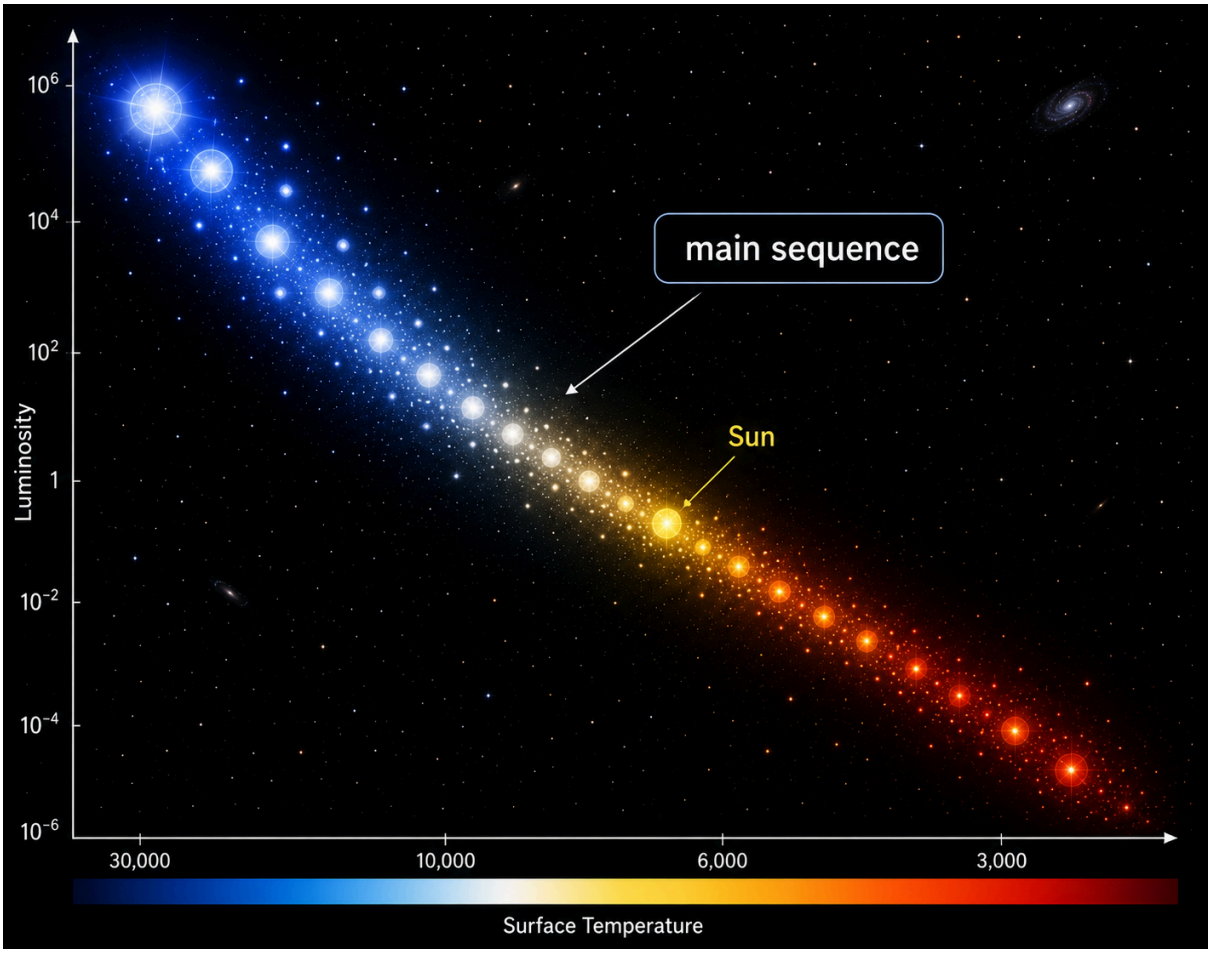
The H-R diagram is a graph about stars.

It compares star temperature and brightness.

Most stars are in a band called the main sequence.

The H-R diagram helps astronomers understand star types and star life cycles.

Main Sequence Stars



Easy Explanation

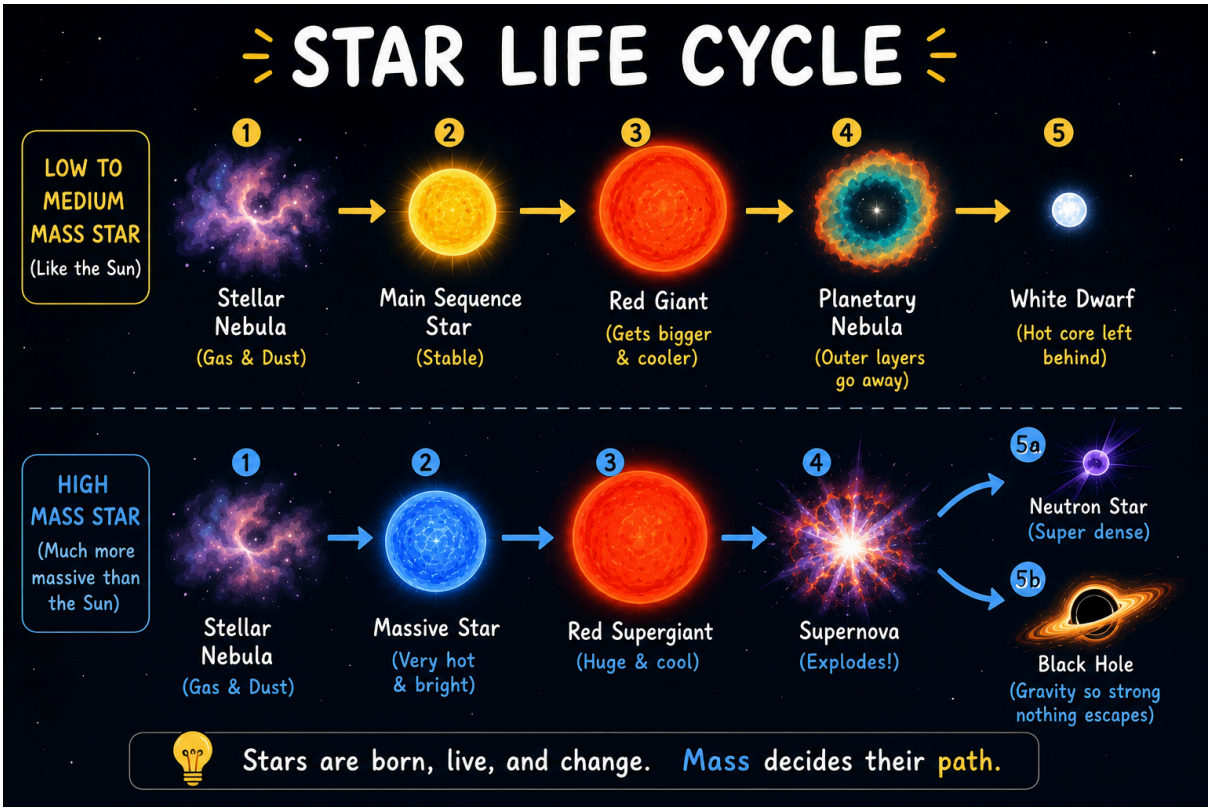
Most stars are main sequence stars.

Main sequence stars make energy by nuclear fusion.

The Sun is a main sequence star.

A star’s mass affects how hot, bright, and long-lived it is.

Star Life Cycle Overview



Vocab	Definition
Nebulae	Clouds of gas and dust where stars are born

Easy Explanation

Stars are born in clouds of gas and dust called nebulae.

A star's life cycle depends mostly on its mass.

Sun-like stars become red giants and then white dwarfs.

Massive stars can explode as supernovae.

After a supernova, the core may become a neutron star or a black hole.

Supernova



Vocab	What it means
Supernova	• A huge explosion of a massive star • It spreads heavy elements into space

Easy Explanation

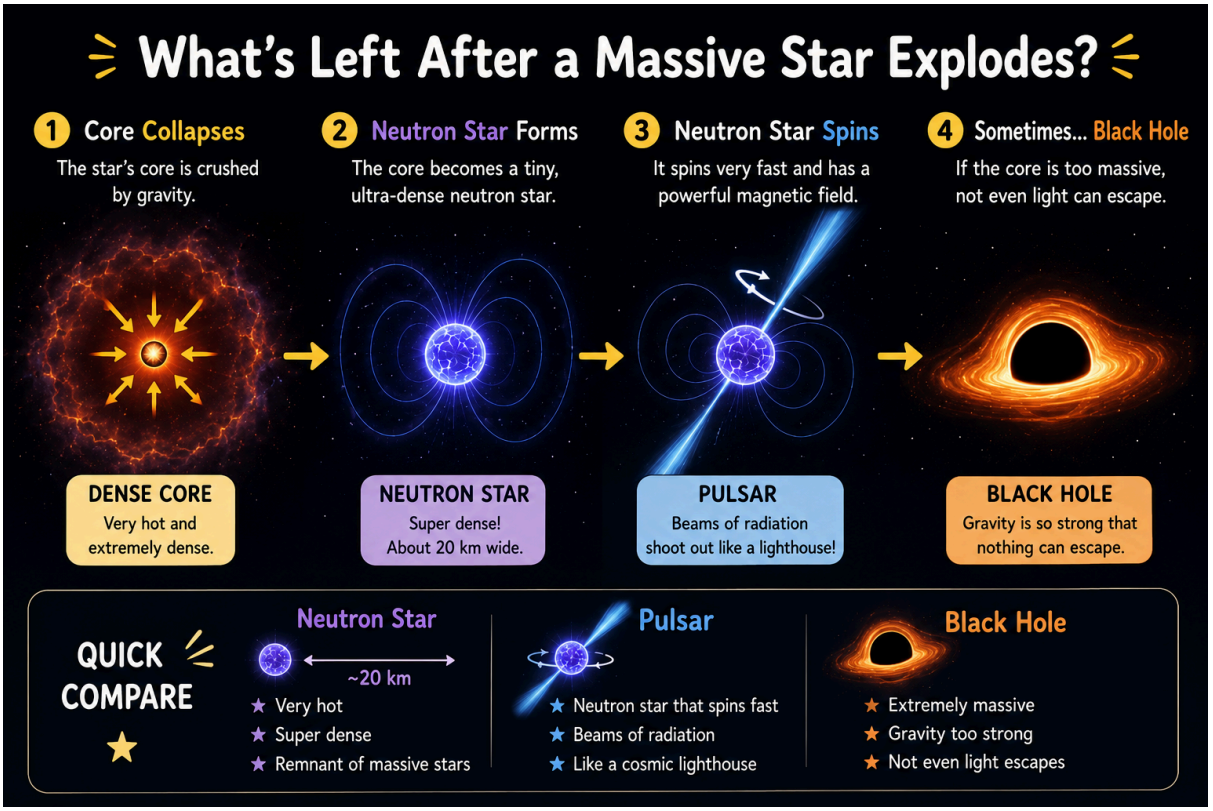
A supernova is a huge explosion of a massive star.

It spreads heavy elements into space.

Some of these elements later become parts of new stars, planets, and living things.

This means many atoms in our bodies were made in old stars.

Neutron Stars



What's Left After A Massive Star Explodes?			
Core Collapses The star's core is crushed by gravity	**Neutron Star Forms** The core becomes a tiny, ultra, dense neutron star	**Neutron Star Spins** It spins very fast and has a powerful magnetic field	Sometimes… **Black Hole** If the core is too massive, not even light can escape
Dense Core very hot and extremely dense	**Neutron Star** Super dense! About 20km wide	**Pulsar** Beams of radiation shoot out like a lighthouse	**Black Hole** Gravity is so strong that nothing can escape

Neutron Star	**Pulsar**	**Black Hole**
● very hot ● super dense ● remnant of massive stars	● Neutron star that spins fast ● Beams of radiation ● Like a cosmic lighthouse	● Extremely massive ● Gravity too strong ● Not even light escapes

Vocab	What it means
Neutron Star	the dense core left after some supernovae (A huge explosion of a massive star)
Pulsar	beams of radiation like a lighthouse

Easy Explanation

A neutron star is the dense core left after some supernovae.

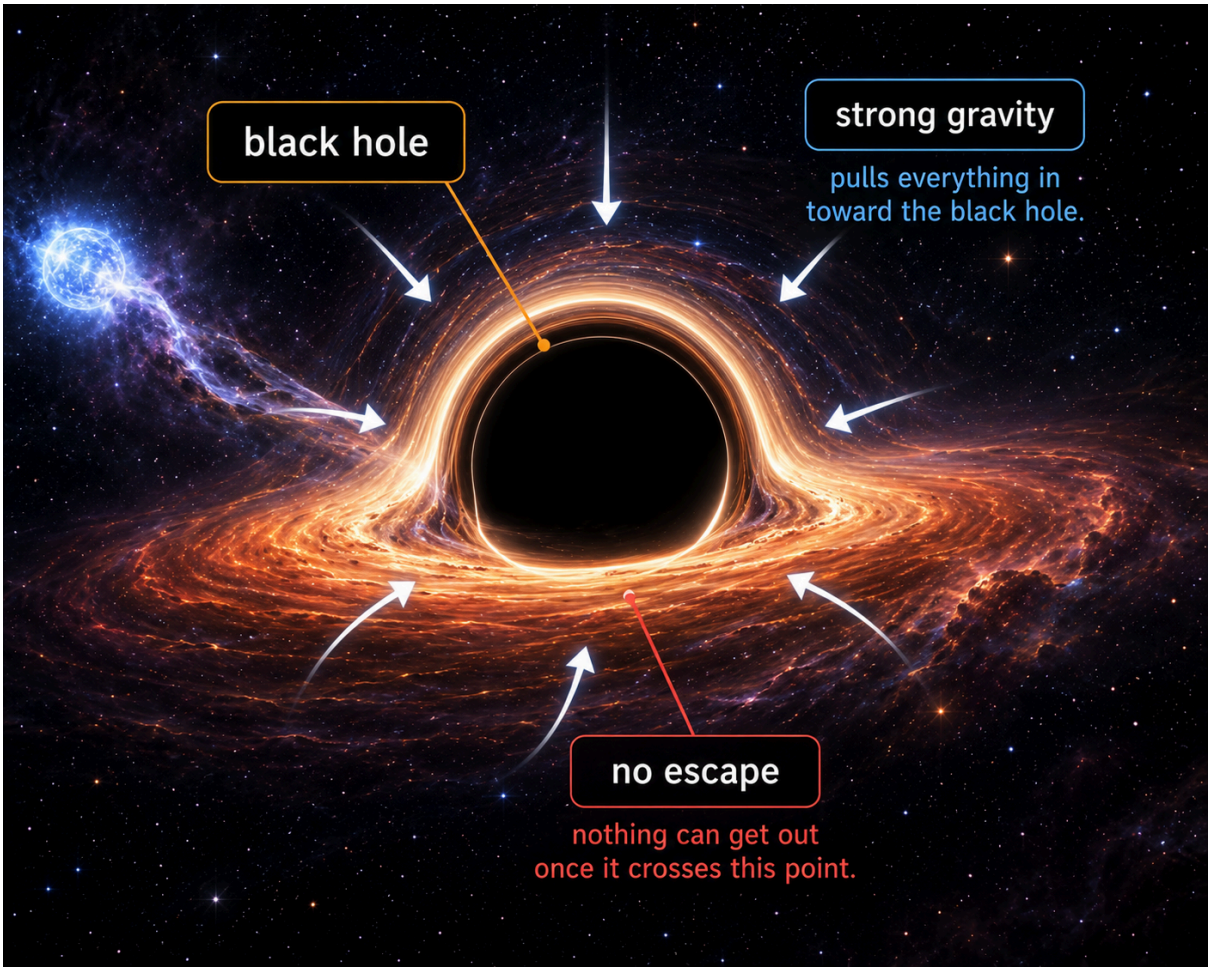
It is very small but extremely dense.

Some neutron stars spin quickly.

They send out beams of radiation like a lighthouse.

These are called pulsars.

Black Holes



Vocab	What it means
Black Hole	A very dense object with extremely strong gravity

Easy Explanation

A black hole is a very dense object with extremely strong gravity.

It pulls everything in toward the black hole.

Nothing can escape from inside it.

Even light cannot escape.

Scientists usually detect black holes by their effects on nearby gas, stars, and radiation.

Final Summary

Final Explanation

Technology helps us learn more than our eyes can see.

Telescopes collect light.

Different wavelengths reveal hidden information.

Astronomers use light-years and parallax to measure distance.

They study star brightness, colour, temperature, composition, and mass.

These properties help explain how stars live and die.
