

## Chapter – 14: The Universe

- Clear, cloudless night – try to count stars
- Moon, millions of stars – night sky – beautiful, fascinating
- Astronomers believe – universe started – 15,000 million years ago – violent explosion – big bang
- This explosion – scattered hot gases – all directions – galaxies, stars, planets, etc – formed
- All objects in space – natural – celestial bodies
- Astronomers – study universe – understand structure, pattern, movement and their effects

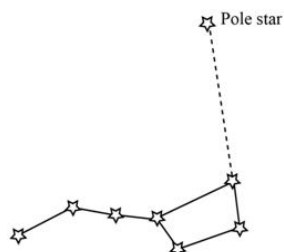
### Galaxy

- Large group – celestial bodies – stars, planets, asteroids, etc – galaxy
- Universe – made of billions of galaxies – uncountable celestial bodies
- Different shapes, sizes – some – regular
- Milky Way (Akash Ganga) – earth part of it – spiral shape – Solar System – on the edge
- Celestial bodies – seen from earth – BUT – very far from it
- Distance so much – metre, kilometre – not sufficient – larger units used – light year
- 1 light year – distance travelled by light in 1 year
- 1 light year = speed of light (m/s) x 1 year (s)  
                   =  $3 \times 10^8$  x  $365 \times 24 \times 60 \times 60$   
                   =  $9.46 \times 10^{15}$  m =  $9.46 \times 10^{17}$  km

### Stars

- Massive balls – burning gases – hydrogen, helium – extremely hot – emit their own light
- Sun – also a star – looks brighter and bigger than others – much closer to earth
- Time taken by light – reach earth – from sun – approx. 8 minutes
- Next nearest star – Proxima Centauri, Alpha Centauri – 4 light years away
- Stars – always present in sky – during daytime – not visible – bright sunlight
- Earth – rotates – west to east – imaginary axis – stars – seem to moving east to west
- Same reason – earth – seems to rise in east and set in west
- On star – northern hemisphere – does not seem to be moving – pole star (Dhruv Tara)
- Pole star – located at point – earth's axis meets the celestial sphere (space)
- Pole star – used by sailors – navigation during night time
- Sometimes – stars – appear in a pattern – recognizable shapes and features – constellations
- Till date – 88 constellations – identified
- Some constellations – visible during summers – some during winters

### Ursa Major or Great Bear



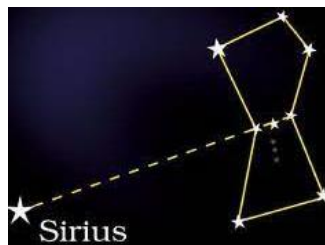
- Saptarishi – Indian name – group of seven stars – arrange in shape of spoon (dipper)
- This shape – reason – also called big dipper
- Out of seven – 4 stars – make the dipper – rest 3 stars – make the handle
- Helps in locating pole star – make a straight imaginary line from last 2 stars of bowl of dipper – this line extends upto the pole star

### Ursa Minor or Little Bear



- 7 stars – make this constellation – not as bright as Ursa Major
- Pole star – part of it – forms the tail

### Orion or the Hunter



- Kalpurush – Indian name – 7 bright stars – other faint (dim) ones
- Together – make the shape of hunter – 4 stars – shoulders and legs – rest 3 stars – its belt (Belt of Orion)
- Visible in winter season
- Helps in locating Sirius – brightest star in the sky – imagine a straight line along the belt towards east – this line leads to Sirius

### Scorpius

- 18 stars – arranged such that – resemble as scorpion
- Visible in summers

### Cassiopeia



- Northern sky – ‘W’ shaped – easily visible – 5 bright stars
- Easily visible in September to early November

### Moon

- Celestial body – revolve around planets – satellites
- Moon – natural satellite – 3,84,000 km away from planet earth

- Much smaller, lighter than earth
- Revolution time – 27.3 days – rotation time – 29.5 days
- Revolution and rotation time – almost equal – only one side visible

### Phases of the Moon

- Moon – non-luminous object – does not have own light – reflects the light of sun
- Moon – travel around earth – different parts shine at different times
- These shiny parts – phases of moon – visible from earth – repeat every month
- Phases of moon – reason – change of relative position of moon
- Full moon – once a month – BUT – night sky – visible best on a new moon day

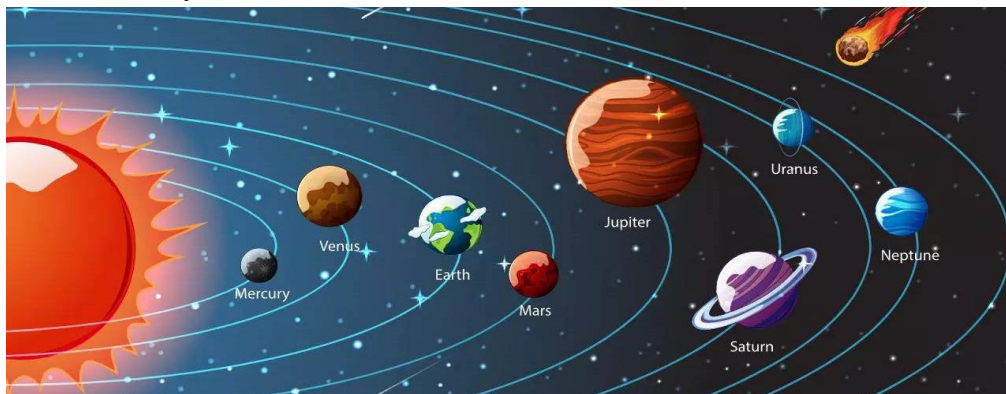


### Surface of the Moon

- Moon – made of rocks – thousands and thousands of craters on the surface
- Large areas – flat, dusty plains – tall mountains
- No atmosphere – no water – no life possible
- Sound – needs a medium to travel – no sound waves travel on moon

### Solar System

- Sun, planets, comets, asteroids, satellites, other celestial bodies – solar system
- Sun – centre of the system



### The Sun

- Medium-sized star – emits lots of energy – reactions take place inside it
- Resembles – fiery ball – gives out – light, heat, energy – gases burn inside
- Without light, heat from sun – no life on earth
- Also termed as – life and energy giver – worshipped in many culture

### The Planets

- Planets – solid celestial objects – made of rocks, minerals, etc

- Revolve around sun – fixed elliptical paths – orbits – different sizes
- Planets in solar system – Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune
- Inner planets –
  - Closer to sun – much hotter
  - Similar size, composition, density
  - Mercury, Venus, Earth, Mars
- Outer planets –
  - Farther away from sun – much colder
  - Jupiter, Saturn, Uranus, Neptune
- Earth – temperature, presence of atmosphere, distance from sun – everything suitable for life
- Different planets –
  - Mercury (Buddha) –
    - Small planet – nearest to sun – very hot
    - Very bright planet – visible with naked eye – in the east just before sunrise – in the west just after sunset
    - No moons
  - Venus (Shukra) –
    - Brightest object – night sky – except moon – also called evening star
    - Hottest planet – lots of CO<sub>2</sub> – traps the heat
    - Visible – eastern sky – early morning – western sky – early evening
    - Brightest – reason – reflects 75 % of the light
    - Rotates anti-clockwise – no moons
  - Earth (Prithvi) –
    - Only planet – life exists – oxygen exists – needed for life
    - Also, the only planet – lots of water available – appears blue
    - Axis of rotation – imaginary line – fixed in same direction – season – due to tilt in axis
    - 1 moon
  - Mars (Mangal) –
    - Cold planet – known as red planet – appears red – presence of iron oxides (rust)
    - Close to earth – focus of astronomers
    - 1975 – 1<sup>st</sup> spacecraft – sent to mars – the Viking
    - 5<sup>th</sup> September 2013 – Mangalyaan-I – launched by Indian Space Research Organisation (ISRO) – Sriharikota space station
    - 2 moons
  - Jupiter (Brahhaspati) –
    - Biggest planet – made of methane, hydrogen, CO<sub>2</sub>, other gases
    - Visible with naked eye
    - Maximum number of natural satellites (moons) – 63 moons
  - Saturn (Shani) –
    - 2<sup>nd</sup> largest planet – rings around it
    - These rings – made of ice, rocks, dust, etc
    - Light enough to float – place it in an ocean large enough – does not sink
    - 60 moons – most of them – part of the ring
  - Uranus (Arun) –
    - 3<sup>rd</sup> largest planet – 15x heavier than earth

- 1 revolution – 84 earth years
- Made of hydrogen, methane, helium
- Rotates anti-clockwise – east to west
- 27 moons
- Neptune (Varun) –
  - Farthest known planet –  $4.4 \times 10^9$  km from sun
  - 1 revolution – 165 years
  - 8 moons

## Other Celestial Bodies

### Asteroids

- Very small, broken pieces of planets – made of rocks, metals
- Revolve around sun – mainly between – Mars and Jupiter
- Part of belt of debris – asteroid belt – failed to assemble into planet

### Comets

- Celestial bodies – revolve around sun – very large orbits
- Made of – ice, dust, other gases
- Elliptical orbit – large time periods
- Haley's comet – 76 years
- Comet approaches the sun – gas, dust particles – pushed outwards
- These gases – pushed outwards – form a 'tail' – points away from sun
- Length of tail – increases – comet comes near sun

### Meteors and Meteorites

- Rocky remains of planet – split long time ago – fall on earth
- Enter earth's atmosphere – lots of air resistance – burns in air
- These burning pieces – meteors – produce a bright trail – also known as shooting stars
- Meteors – do not burn completely – land on earth – known as meteorites
- Meteorites – create craters – contain – sand, minerals, rocks

### Artificial satellites

- Man-made satellite – revolve around earth – regular time period
- Men – launched many satellites – communication, weather forecasting, monitoring, etc
- Path – satellites move in – orbits
- Satellite – placed in orbit by spacecraft – move around earth like moon
- Satellites – go around earth – 24 hours – geosynchronous satellites
- Earth – goes around axis – 24 hours – geostationary satellites – appear at the same place
- Geostationary satellites – orbit over equator
- Used for –
  - Communication
    - TV signal transmission
    - Always available in a fixed area
  - Monitoring weather

- Take and send pictures – weather conditions
- Also used for – remote sensing – observing from a distance
- Scientists – study areas from distance – search for sites – rich in petroleum, mineral deposits
- India – launched many satellites
- Aryabhata – 1<sup>st</sup> Indian satellite
- 15<sup>th</sup> February 2017 – ISRO made a record – launching 104 satellites – single rocket – Sriharikota Space Station