

PHYSICAL GEOGRAPHY

of the World

- Space & Earth
- Lithosphere & Lithosphere Dynamism
- Geophysical Phenomenon
- Questions for Practice



KHAN GLOBAL STUDIES

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UNIT-I: SPACE AND EARTH

1. SPACE ODYSSEY

1.1 Universe

Everything that exists, from the Galactic Superclusters to the tiniest subatomic particles, comprises the Universe. Among the various theories on the origin of universe including the steady state and the pulsating universe theories, the one most widely accepted has been the **Big Bang theory**. This theory traces the origin to a primordial explosion of super-compressed cosmic matter, the energy of which has sustained the continuous expansion of universe. However, some recent theories have questioned the very fundamentals of the Big Bang theory.

The size of Universe is limited only by our imagination. As for the age of Universe, scientists agree that it is about 11 to 17 aeons or billion years.

The Universe comprises **Galaxies** that are huge congregation of stars held together by the forces of gravity. Optical and radio telescope studies indicate the existence of about 100 billion galaxies in the visible universe. Galaxies occur in three structural forms: Spiral, Elliptical and Irregular. Spiral galaxies have a central nucleus with great spiraling arms trailing around them, examples include our Milky Way and the Andromeda galaxies. Elliptical galaxies are without spiraling arms and Irregular ones have no clear shape.

Stars account for most of the galactic mass. They tend to form groups called **constellations**. Lone stars are a rarity. Stars that appear single are often double stars or binaries revolving around a common centre of gravity.

Stars go through a definite **evolutionary sequence**. After a **star is born**, it enters the main sequence stage. This stage is marked by a helium core becoming increasingly heavy, accompanied with expanding outer layers. At this stage, it is considered an **Adult Star**. The process continues until it becomes a massive **Red Giant**. Depending on the mass of the star, one of the two possible sequences of development can occur. One, if the mass is relatively small, like that of our sun, the gases that reach the outer layer are expelled. As these expelled gases cool and contract, the star becomes a **White Dwarf**. Two, if the star is larger, the final stages of its giant star phase end either in a **supernova** explosion which sometimes leaves behind **neutron stars** called pulsars or collapse and compact to form **black holes**.

BLACK HOLES

Black Holes result from the collapse and compaction under gravity, of a star of mass greater than three times that of the sun, at the end of its life-cycle. Its density becomes so great that nothing, not even light, can escape from its gravity. It is so-called because it cannot be viewed directly. **S Chandrashekhar**, the renowned Indian Physicist had predicted an upper limit to the mass of stars, above which they either explode or form a black hole. This is referred to as the **Chandrashekhar Limit**.

Event horizon: The boundary where the velocity needed to escape exceeds the speed of light, which is the speed of light of the cosmos.



Fig. 1.1: Universe

Source: www.esa.int

NAVIGATING THE OUTER SPACE

The units of measurement we use on earth are too small to measure the vast distances of outer space. The units evolved for this purpose are:

- **Light Year** It is the distance covered by light in one year in vacuum travelling at a speed of 3×10^5 km/s
- **Astronomical Unit (A.U.)** It represents the mean distance between Earth and the Sun. It is used to measure distances within the Solar system.
- **Parsec** It is the distance at which the mean radius of Earth's orbit subtends an angle of 1 second of an arc. It is equivalent to 3.26 light years

Distance of Earth from Sun = 8 light minutes » 1 A.U.;

Distance of Earth from Moon = 1.25 light seconds;

Distance of Earth from Proxima Centauri = 4.3 light years

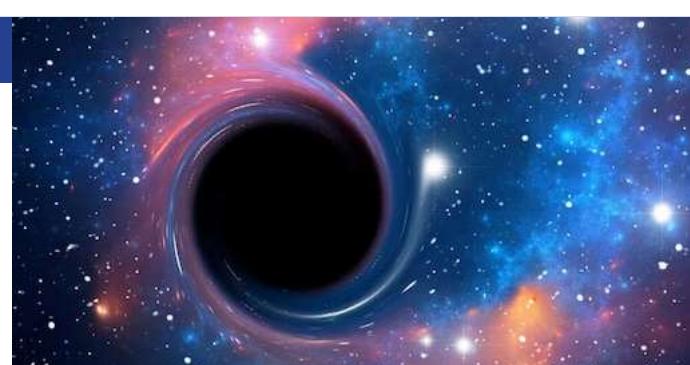


Fig. 1.2: Black Hole

Source: www.news18.com

1.2 The Solar System

The Sun, the eight planets along with their respective satellites, the asteroids, the meteoroids, the comets, the interplanetary dust and the electrically charged gases called plasma, together make up the **solar system**.

The Sun together with the planets were formed essentially at the same time and from the same primordial material. This is evident from the orderly revolution of all eight planets along the Sun's equatorial plane. The most acceptable theory of planetary evolution is **the nebular hypothesis**.

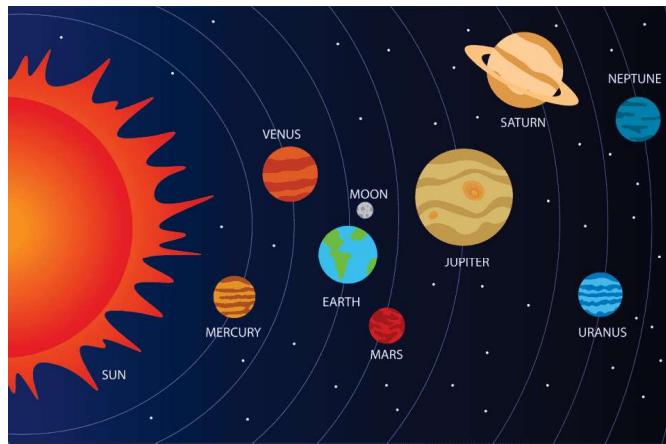


Fig. 1.3: The Solar System

Source: pixabay.com

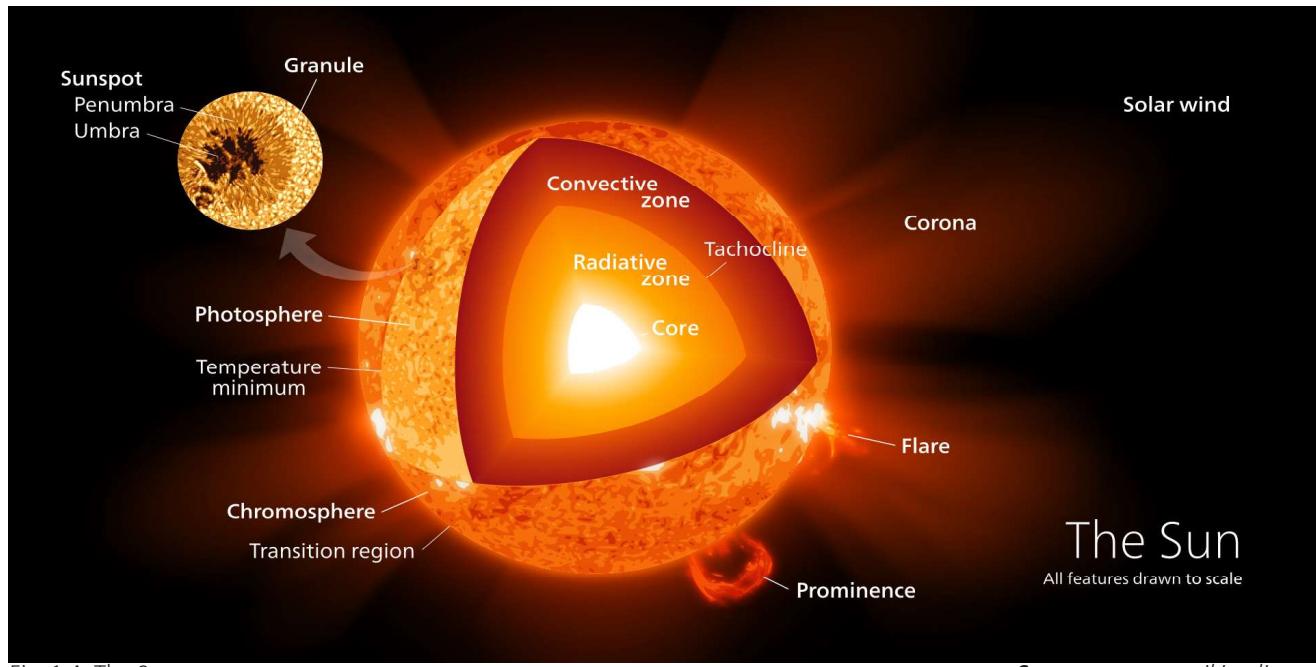


Fig. 1.4: The Sun

Source: www.en.wikipedia.org

1.2.1 The Sun

The Sun accounts for 99.85% of mass of the solar system. The immense gravitational pull of the Sun keeps the planets rotating around it in definite orbits.

- It continuously gives off energy in the form of visible light, infra red, ultra violet, X-rays, gamma rays, radio waves and plasma.
- The period of revolution of the Sun around the galactic centre is 250 million years. This period is called a **Cosmic or Galactic Year**.
- Like all other stars, the Sun is mainly composed of **hydrogen and helium**. Nuclear fusion in the core of the Sun is source of all its energy.
- The glowing surface of the Sun, that we see, is called the **Photosphere**. Above the photosphere is the red coloured **Chromosphere** and beyond it is the magnificent **Corona**, which is visible during eclipses.

SOLAR STATISTICS

Distance from Earth	150 million km*
Diameter	100 earth diameters
Core Temp.	15 million ⁰ C
Surface Temp.	6000 ⁰ C
Rotation Time	25 days
Age	» 5 bn yrs
Composition	H2 71% He 26.5% Others 2.5%

*Distance of Earth from Sun

Aphelion (max) - 152mn km on July 4

Perihelion (min) - 147mn km on Jan 3

- The Sun is continuously emitting streams of protons in all directions either as persistent spiral streams called **Solar Winds** or as bouts of incandescent material called **Solar Flares**.
- The constituent particles of solar wind are trapped by the earth's magnetic field and enter the earth's upper atmosphere as auroral displays described as **Aurora Borealis** in the northern hemisphere and **Aurora Australis** in the southern hemisphere.
- Solar flares being **hot ionised gases** pose danger to satellite communication.
- The surface of the sun changes continuously. Bright spots called **Plages** and dark spots called **Sunspots** frequently form and disappear.

1.2.2 The Planets

Planets redefined: The definition for a planet is modified by the **International Astronomical Union (IAU)** in 24 August, 2006 and is now officially known as "a

SOLAR ECLIPSE

Solar Eclipse occurs when the moon's shadow falls on the Earth. For this, the moon must be in between and in line with the sun and the earth.

A total solar eclipse is seen in the small area within the moon's umbra (the region from which all direct sunlight is excluded). A partial solar eclipse occurs in the larger penumbra (the region of diffused sunlight) where the sun's disc is covered partially by the moon.

The countdown to totality is truly dramatic. Just before it, the only visible parts of the Sun are those that shine through the lower valleys in the moon's irregular profile. This gives one the impression of watching a brilliant beaded necklace, known as **Bailey's Beads**. The final flash of sunlight through a lunar valley produces a brilliant flare, known as the **diamond ring effect**. As the sky darkens during the eclipse, wildlife, especially birds, exhibit nocturnal behaviour.

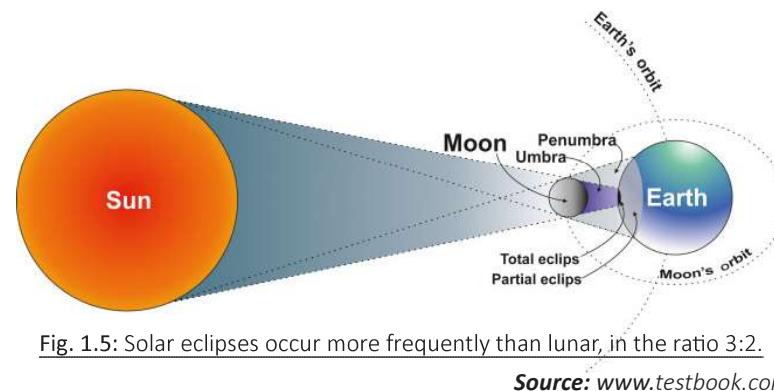


Fig. 1.5: Solar eclipses occur more frequently than lunar, in the ratio 3:2.

Source: www.testbook.com

THE PLANETARY SYSTEM: VITAL STATISTICS

Planet	Mean Distance from Sun (in mn km)	Relative Period of Revolution	Relative Period of Rotation (Earth =1day)	Diameter (x1000 km)	Relative Mass (Earth =1)	Acc. to NASA, known Satellites	Surface Temp. (in °C)	Density (Water = 1)
Mercury	58	88d	59d	4.9	0.06	0	167°C	5.43
Venus	108	224d	243d	12	0.8	0	464°C	5.24
Earth	150	365d/366d (LP)*	23h56m04s	12.8	1	1	15°C	5.52
Mars	228	687d	24h37m23s	7	0.1	2	-65°C	3.94
Jupiter	778	12yr	~9h50m	143	318	80	-110°C	1.33
Saturn	1427	29.5yr	~10h25m	121	95	83	-140°C	0.70
Uranus	2871	84yr	~17h20m	51	15	27	-195°C	1.30
Neptune	4498	165yr	~19h	49	17	14	-200°C	1.60
Pluto**	5913	248yr	6.4d	2.4	0.01	5	-225°C	1.1

*Leap Year. **Now our solar system has eight planets, viz, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune and three 'dwarf planets' - Pluto, Eris and Ceres.

celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium, (c) has cleared the neighborhood around its orbit."

All the planets except Pluto are grouped into two classes:

- Terrestrial (Earth like) planets which have dense rocky bodies and include Mercury, Venus, Earth and Mars. These are also called inner planets.
- **Jovian (Jupiter like) planets** which are gaseous, gigantic, with large satellite families and high rotational velocities. These include Jupiter, Saturn, Uranus and Neptune. These are also called outer planets.
- a. **Dwarf Planet:** A “dwarf planet” is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium, (c) has not cleared the neighborhood around its orbit, and (d) is not a satellite.

In 2006, the IAU passed a resolution that define planets and established a new category, **dwarf planets** recognised by the IAU.

- Eris
- Pluto
- Ceres
- Haumea
- Makemake

- b. **Mercury:** The Innermost Planet is also the **swiftest** planet. It has no atmosphere and has a cratered surface, much like the moon's. It has the maximum diurnal range of temperature and the **shortest year**.
- c. **Venus:** The **Veiled Planet** is second only to the Moon in brilliance in the night sky and is better known as the **Evening or the Morning Star**. It is also called the **Earth's twin** because of its similar size, density and mass. Unlike other planets it rotates from **east to west**. It is the **hottest** planet and also has the **slowest** rotational velocity with a period of rotation nearly the same as that of revolution.
- d. **Earth:** The **Blue Planet**, called so because of the presence of water. It is the third planet from the Sun and the fifth in size. It is the **densest** of all and is unique for the presence of higher forms of life, as we viewed above the North Pole, the Earth rotates counter-clockwise, from the **west to east**. This is also called a **Prograde rotation**.
- e. **Mars:** The **Red Planet** has evoked greater interest than any other planet, in astronomers and laymen alike. Interest in Mars, with its polar ice caps, stems mainly from its accessibility to observation. Through the telescope, Mars appears as a reddish ball and hence, is also called the **Red Planet**. It has two moons, **Phobos** and **Demos**. The angle of inclination and the length of the day are nearly the same as that of Earth. The possibility of life on Mars and its habitability by humans are being extensively probed.
- f. **Jupiter:** The **Lord of the Heavens** is the largest planet in our solar system with a mass $2\frac{1}{2}$ times greater than the combined mass of all the remaining planets, satellites, and asteroids put together. It has the fastest rotational velocity, completing one rotation in slightly less than ten hours. Jupiter's satellite system, consisting of sixty three moons, resembles a mini solar system. Among its moons, Europa, Io, Callisto and Ganymede are prominent due to their large size. **Ganymede** is the largest and heaviest of all satellites in the solar system.

Interesting Astronomical Facts

- In about 5 b yrs, Sun will burn out its stock of hydrogen and will turn into a Red Giant.
- The **Great Wall of China** is the only man-made structure visible from the Moon
- **Great Red Spot** on Jupiter is an enormous eddy in turbulent cloud cover
- Brightest star outside solar system is Sirius, also called the **Dog Star**
- Closest star to our solar system is **Proxima Centauri**, also called Alfa Centauri at a distance of 4.3 light years
- Largest constellation is **Hydra**. It covers 3.16% of the whole sky and has atleast 68 stars visible to the naked eye
- Altitude of **North Star** at a given place gives the latitude of the place
- **Ecliptic** is an imaginary annual path of Sun across the sky
- **Heliocentric** view was first suggested by **Copernicus**
- Galaxies are also called **Island Universe**
- Existence of galaxies beyond Milkyway was first demonstrated by **Edwin Hubble**
- **Comets** in Latin mean ‘Long Haired’, and not all comets have ‘hair’

LUNAR STATISTICS

Distance from Earth*	3.84 lakh km
Diameter	3500 km
Circumference	11,000 km
Surface Temp.	120°C to -170°C
Revolution time	27 1/3 days
Revolution Velocity	3,700 kmph
Age	» 4.6 b years
Gravitational pull	1/6th that of the Earth

* The distance from the Earth: Apogee (max) 405,500 km, Perigee (min) 363,300 km

- g. **Saturn:** The **Elegant Planet** is the second largest and is surrounded by a set of **seven rings** which are made up of primordial dust and ice particles. It has 83 moons, the largest moon being Titan.
- h. **Uranus and Neptune:** The **Jovian Twins**. If any two planets in the solar system can be considered twins, then Uranus and Neptune come closest. Besides being similar in size, they appear pale greenish blue in color, attributable to the presence of methane in their atmospheres. Their structure and composition are believed to be similar as well, but because of its greater orbital distance, Neptune experiences somewhat lower temperatures.

Uranus is unique as its axis of rotation is inclined at only 80 to its orbital plane. So, unlike other planets which spin on their axis, **Uranus actually rolls**, apparently from north to south.

Neptune, the **penultimate planet**, has a dynamic atmosphere which contains an Earth-sized blemish called the **Great Dark Spot** that is reminiscent of Jupiter's Great Red Spot. Its largest moon is Triton.

Pluto*: The Planet X is a 'dwarf planet' with eccentric orbit. It has the slowest orbital velocity and hence, the longest year. Its satellite, Charon, is nearly half its size, because of which Pluto is also called a bi-planet or a double planet.

*August 24, 2006 the IAU decided on a new definition of "Planet" which does not include Pluto. Pluto is now classified as a "dwarf planet", a class distinct from "Planet".

1.2.3. Satellites

Satellites are heavenly bodies revolving around the planets in definite orbits. There are at least 66 known satellites in our solar system.

The Earth's Moon revolves around the Earth in 27 days 7 hours 43 minutes and 11.47 seconds and rotates on its own axis in exactly the same time. That is why only one face of the Moon is seen from Earth.

- The different phases of the Moon are caused by the changing position of the moon with respect to the Earth and the Sun.
- The tidal forces of the moon and the sun are in the ratio of 9:4.
- **Neil Armstrong** and **Edwin Aldrin** were the first humans to set foot on the moon's surface in 1969. The landing spot was later called **The Sea of Tranquillity**.

Blue Moon is a rare celestial phenomenon marked by the occurrence of the second full moon within one month. It is rarer still for two blue moons to occur in the same calendar year as was witnessed in 1999 in the months of January and March.

IMPORTANT SATELLITES	
PLANETS	SATELLITES
Mars	Phobos and Deimos
Jupiter	Ganymede, Europa, Io, Callisto, Metis, Thebe
Saturn	Titan, Tethys, Atlas, Pandora,
Uranus	Miranda, Juliet
Neptune	Triton
*Pluto	Charon
Earth	Moon

**Pluto is now consider as a "dwarf planet" alongwith Ceres and Eris, Haumea and Makemake*

Lunar eclipse takes place when moon passes through the shadow of earth, i.e. earth is in between Sun and Moon. A partial eclipse occurs if only a part of the moon passes through the shadow. Rather than becoming completely dark during lunar eclipse, the moon becomes reddish because the other colours present in sunlight are scattered by the atmosphere in greater amounts than red.

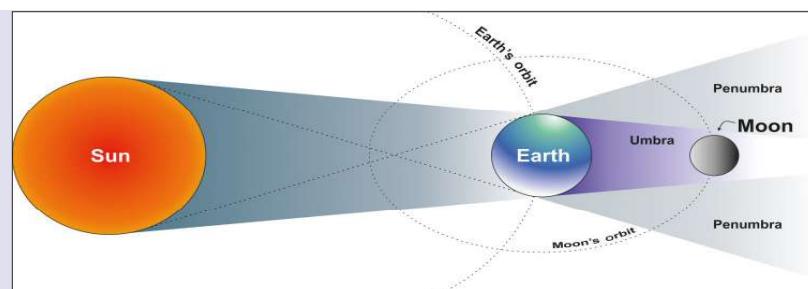


Fig. 1.6: Lunar Eclipse

Source: www.testbook.com

1.2.4 Other Solar System Members

Asteroids, Meteoroids and Comets are interstellar debris which failed to accrete to form planets. Some suggest, they might be remnants of an exploded planet or star.

- **Asteroids** or **Planetoids** are rocky bodies upto 800 kilometers in diameter, although most are much smaller with diameters less than a kilometre. They orbit the Sun in the asteroid belt, which lies between the orbits of Mars and Jupiter.
- **Meteoroids** are small fragments of rock and metal travelling through space. When drawn into the Earth's

gravitational field, they become white-hot through friction as they fall through the atmosphere, and are seen as Meteors or Shooting Stars. Upon reaching the Earth's surface they are called **Meteorites**. Most meteors burn up by the time they reach 75 km above the Earth. Some 8000 million meteors enter the Earth's atmosphere every day, many no larger than sand grains.

- **Comets** may originate in a huge cloud called the Oort cloud that is thought to surround the solar system. They are made of frozen gases and dust. The tail of the comet always points away from the sun because of the force exerted by the solar wind and the radiation pressure. The comets have an extremely eccentric orbit but a definite periodicity as the Halley's comet which is spotted every 76 years. The collision of comet Shoemaker-Levy-9 with Jupiter was one of the most spectacular events in space.

- **Meteor showers:** When earth's atmosphere encounters many meteoroids at once its called a meteor shower.

Quadrantid meteor showers peaks on the night between 3rd Jan and 4th Jan 2023.

- **Leonids showers:** The debris that forms this meteor showers originates from a small comet called 55P/Tempel-Tuttle in the constellation Leo, which takes 33 years to orbit the sun. Leonids are called fireballs and earthgrazer meteors.

The last leonids meteors storm took place in 2002.



Fig. 1.7: Other Solar System Members

Source: www.nisenet.org

Earth's position with respect to Moon

- **Apogee:** The period of the farthest distance between the moon and the earth (405,500km) is called apogee.
- **Perigee:** The period of the nearest distance between the moon and the earth (363,300 km) is called perigee.

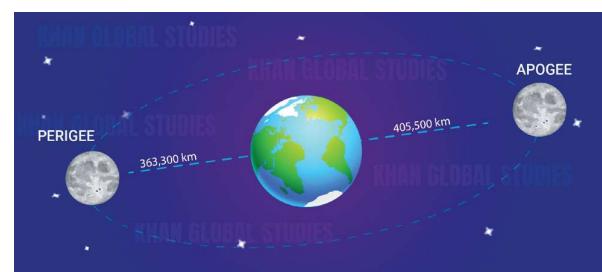


Fig. 1.8: Apogee and Perigee

Earth's position with respect to Sun

- **Perihelion:** The period of the nearest distance between the earth and the sun (147.1 million kilometres) is perihelion. It happens on January 3.
- **Aphelion:** The period of the farthest distance between the earth and the sun (152.1 million kilometres) is aphelion. It happens on July 4.

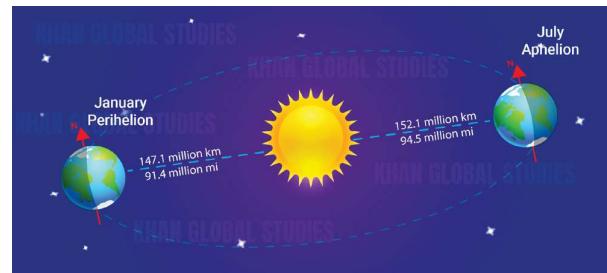


Fig. 1.9: Perihelion and Aphelion

2. GEODESY & EARTH MOVEMENTS

2.1 Our Planet Earth

Earth is the third planet from the sun, the **densest** planet in the solar system with only one satellite – the Moon, but it also has a couple of temporal artificial satellites. It is the fifth biggest planet in the solar system, its uniqueness lies in its habitability because air and water. It also boasts of a gravitational pull that binds the atmosphere and hydrosphere, making life possible on Earth. Surface area is covered with two-third of water that is why we call it a **blue planet**.

2.2 Earth's Shape

Geodesy is the science that studies the shape and size of the Earth. The true form of Earth resembles a sphere that has been compressed along the polar axis and made to bulge slightly around the equator. Therefore, the distance from pole to pole is less than the distance around the equator (middle). This form is known as an **oblate ellipsoid**.

- The **oblateness** is caused by the centrifugal force of the Earth's rotation, which deforms the somewhat plastic Earth into a form that is in equilibrium with respect to the forces of gravity and rotation.
- The shape of Earth is best described as a '**geoid**', meaning Earth-shaped.

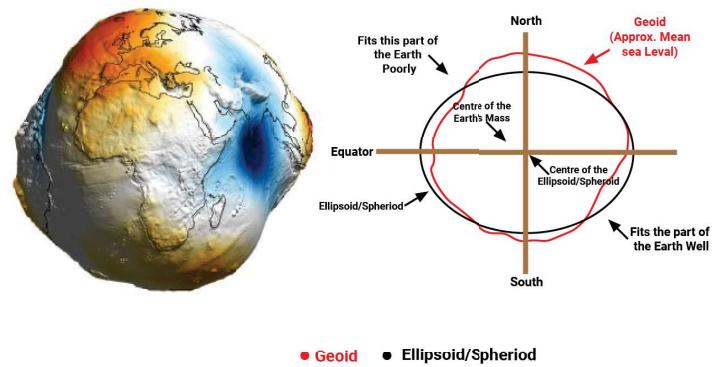


Fig. 2.1: Geoid Shape Of The Earth

2.3 Tilt of the Earth's Axis

The axis of the Earth is **inclined to the plane of ecliptic** (the plane in which the Earth orbits round the sun) at an angle of $66\frac{1}{2}^\circ$, giving rise to different seasons and varying lengths of day and night. If the axis were perpendicular to this plane, all parts of the globe would have had equal days and nights at all times of the year.

- The sun is vertically overhead at the equator on two days each year, i.e., on March 21st and September 23rd. These days are called **equinoxes** meaning 'equal nights' because on these two days all places on Earth have equal days and nights.
- After the March equinox, the sun appears to move northwards and is vertically overhead at the **Tropic of Cancer** on June 21st. This is known as the **summer solstice**, when the northern hemisphere will have its longest day and shortest night. Southern hemisphere will have shortest day and lowest day, so they celebrate Christmas during summer time.
- By December 22nd, the sun is overhead at the **Tropic of Capricorn**. This is the **winter solstice** when the southern hemisphere will have its longest day and shortest night.

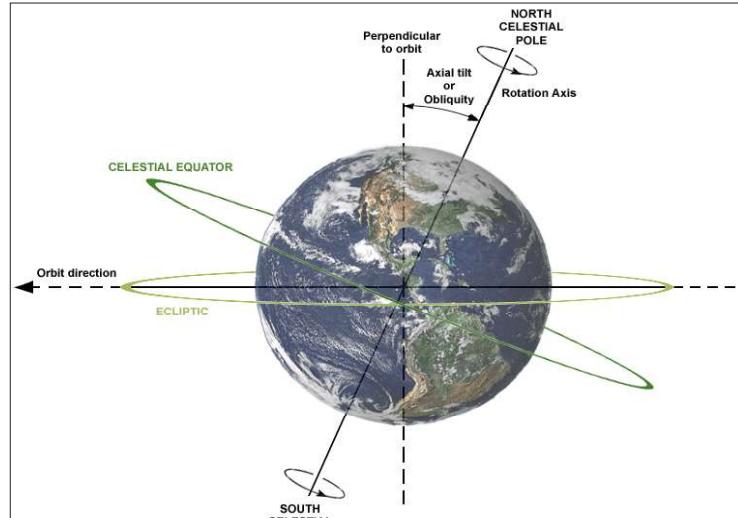


Fig. 2.2: Axial Tilt Of The Earth

Source: www.en.wikipedia.org

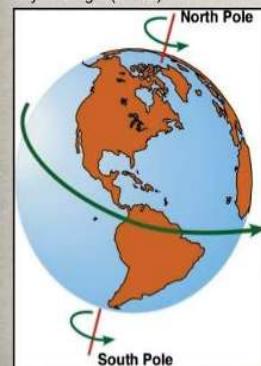
Why Earth's axis is tilted?

Earth's axis is tilted at an angle of 23.5 degrees relative to our orbital plane. It looks like it probably collided with another small planet and in the process, it was tilted, which is very important. It is perfectly positioned so that it gives us the seasons

2.4 Movement of Earth

- The earth moves in space in two distinct ways. It **rotates** on its own axis from west to east once in every 24 hours causing day and night.
- It also **revolves** round the sun in an orbit once in every 365 1/4 days causing the seasons and the year.
- The earth revolves round the sun in an **elliptical orbit** at a speed of 18.5 miles per second.
- A **normal year** is taken to be 365 days, and an extra day is added every four years as a **Leap Year** because 1/4th day of every year becomes 1 day.

Rotation – earth spins on its axis and one complete rotation equals day and night (24 hrs)



Revolution – earth revolves around the sun and completes one revolution in 365 and one quarter days; leap year adds a day to the calendar every 4 years.

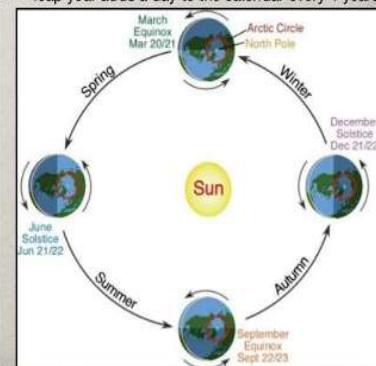


Fig. 2.3: Earth Rotation And Revolution

Source: www.pinterest.com

2.5 Latitudes and Longitudes

- Latitude** is the angular distance of a point on the Earth's surface, measured in degrees from the centre of the Earth.
- Longitude** is the angular distance, measured in degrees along the equator, east or west of the **Prime Meridian** (the meridian that passes through Greenwich near London).

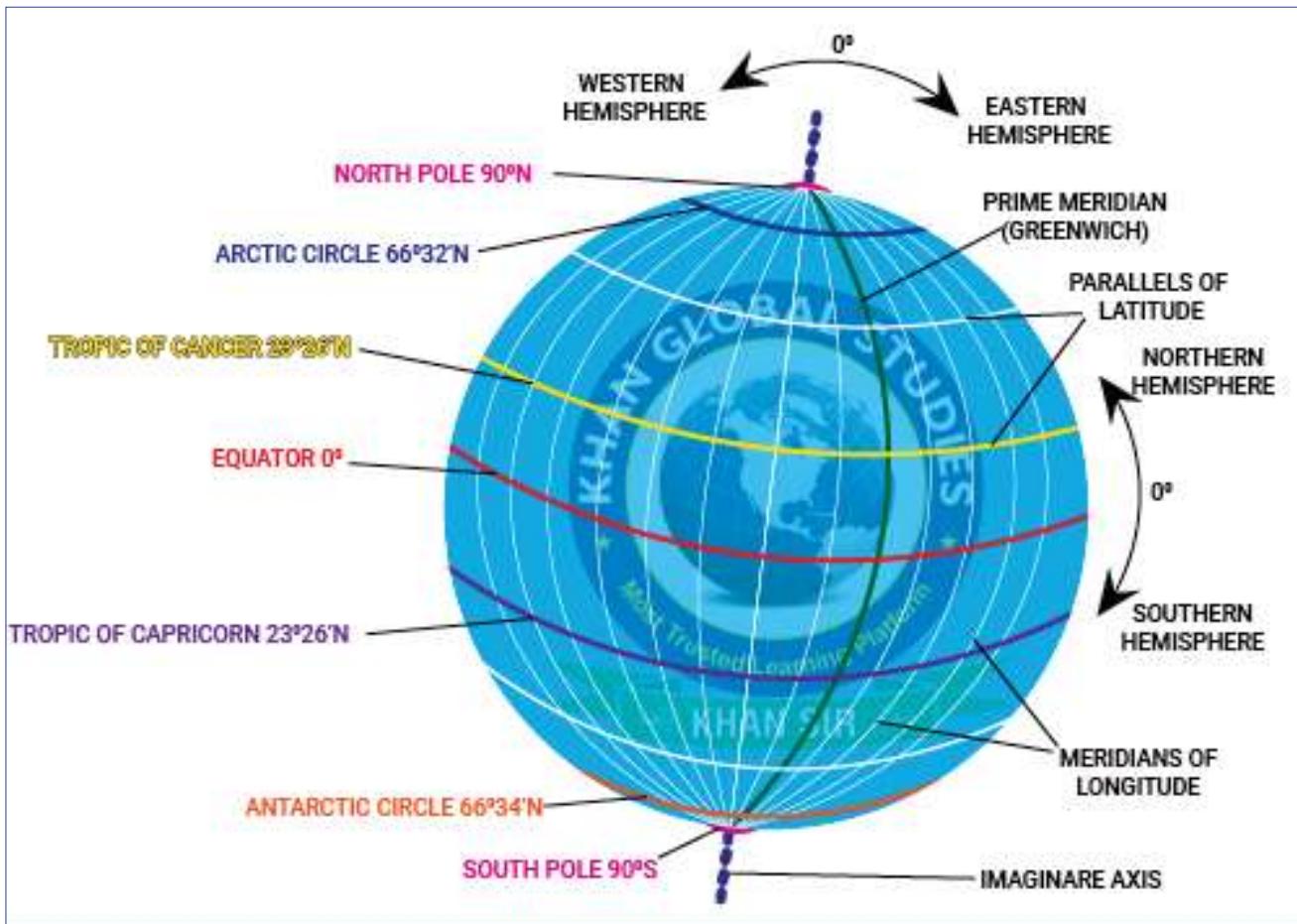


Fig. 2.4: Latitudes And Longitudes

2.5.1 Latitudes

The Parallel of Latitudes extends from the Equator to 90 degrees North 180- and 90-degrees South Pole. If the latitude are drawn at an interval of 1 degree, then in each of the hemispheres there will be 89 latitude lines that will add up to 179 total lines.

- They are mainly the east-west circles that connect all the locations of the Earth.
- The distance between two parallel latitudes is 111km.
- All the latitudes are parallel to the Equator.

LATITUDES				
Arctic Circle (66°34'N)	Tropic of Cancer (23°26'N)	Equator (0°)	Tropic of Capricorn (23°26'S)	Antarctic Circle (66°34'S)
<ul style="list-style-type: none"> Out of the five parallel latitudes, Arctic Circle is the Northernmost circle in north of the Equator. The position of the Arctic is not always fixed. As per updates, the Arctic is drifting towards the North about 14.5 m (48 ft)/year. The Arctic Circle is 16000km long which covers 4% of the Earth's surface. 	<ul style="list-style-type: none"> It is also known as Northern Tropic and the Sun is directly overhead at this position in June. The position of the tropic of cancer is fluctuating because of the longitudinal alignment. But the distance between the tropic of cancer and the Antarctic Circle remains the same as they move at the same speed. The length of the Tropic of Cancer is 36,788 km. 	<ul style="list-style-type: none"> Equator is the imaginary line that divides the earth into two hemispheres. The northern hemisphere and the Southern hemisphere. It is the longest line of latitude. The Equator covers 40075km out of which 78.8% covers the water area while 21.3% covers the surface area. 	<ul style="list-style-type: none"> The length of the Tropic of Capricorn is the same as the Tropic of Cancer. The Southern Tropic covers 3% of the total world's population. The sun is overhead once a year in December and therefore experiences the maximum heat. 	<ul style="list-style-type: none"> Antarctic Circle is the Southernmost circle which is south of the Equator. Like the Arctic Circle, the Antarctic Circle is also shifting southward about 14.5 m (48 ft)/year. The Antarctic Circle is also 16000km long which covers 4% of the Earth's surface towards the south.

2.5.2 Longitudes

Longitude is the east-west measurement of the prime meridian. There are 180 vertical east longitudes of the Prime Meridian and 180 vertical west longitudes of the Prime Meridian.

LONGITUDES		
Western Hemisphere	Prime Meridian	Eastern Hemisphere
<ul style="list-style-type: none"> It is the west of the Prime Meridian that covers North and South America and some parts of Africa, Europe, Antarctica, and also Asia. The center of the Western Hemisphere is at the Pacific Ocean whose nearest land is Genovesa Island. 	<ul style="list-style-type: none"> The line that passes through the Greenwich, British Royal Observatory is regarded as Prime meridian. It is the base Longitude which is 0 degrees from where 180 degrees east and west directions are considered. Hence, Prime of Meridian is the base of world time. The Prime Meridian divides the Earth into two halves, Eastern and Western hemisphere. 	<ul style="list-style-type: none"> It is the east of the Prime Meridian that covers the country like Africa, Asia, Europe, Australia, and the islands of Oceania. The landmass of the Eastern Hemisphere is larger than the western part. Therefore, 80% of the human population survives in the Eastern Hemisphere. Eastern Hemisphere is also termed as Oriental Hemisphere.

2.5.3 Longitude and Time

- Prime Meridian is the meridian from which all other meridians radiate eastwards and westwards up to 180°.
- Longitudes are not used for calculating distances, since there is so much difference in the length of degrees of longitude outside the tropics.
- But they have one very important function- they help in determining local time in relation to Greenwich Mean Time (GMT).
- $10 = 4\text{min} ; 150 = 1 \text{ hour} ; 3600 = 24 \text{ hours}$.
- East is Ahead of GMT & West is Behind GMT

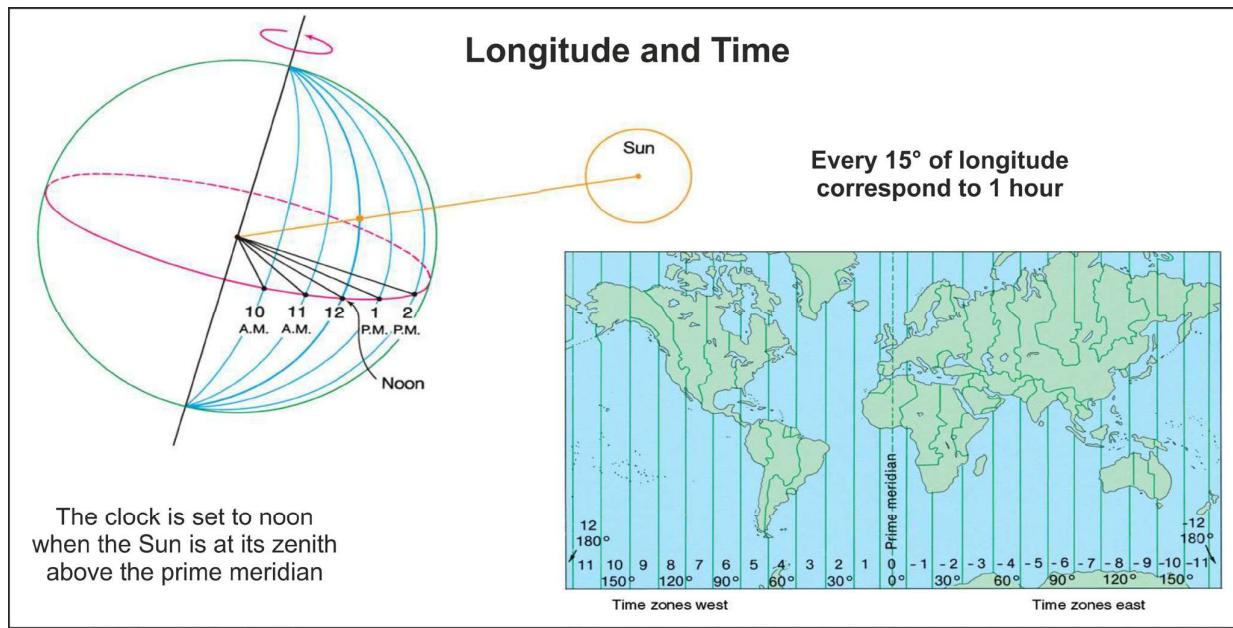


Fig. 2.5: Longitude And Time

Source: www.slideplayer.com

2.6 Standard Time and Time Zones

2.6.1 Standard Time

- Most countries adopt their standard time from the central meridian of their countries.

2.6.2 Time Zones

- The whole world has been divided into 24 Standard Time Zones.
- Each zone, therefore, is separated by 150

- longitudes or by one hour or 1° for 4 minutes.
- Larger countries like USA, Canada and Russia having greater east-west stretch have to adopt several time zones.
- Both USA and Canada mainland have five time zones each- the Atlantic, Eastern, Central, Mountain and Pacific.
- Russia has 11 time zones.
- Interestingly, despite a considerable east-west stretch, India has only one time zone.

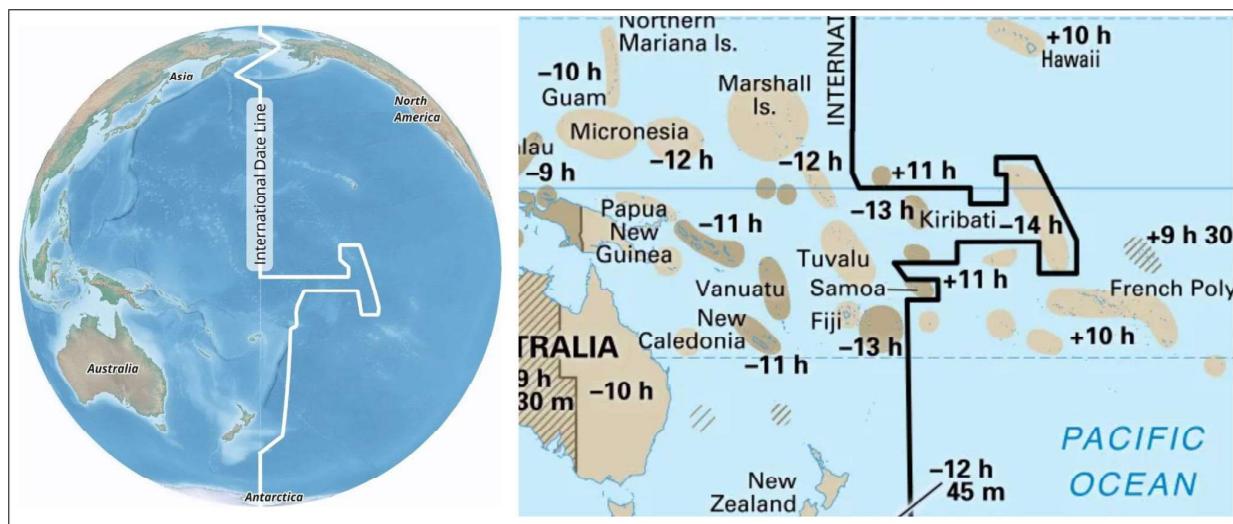
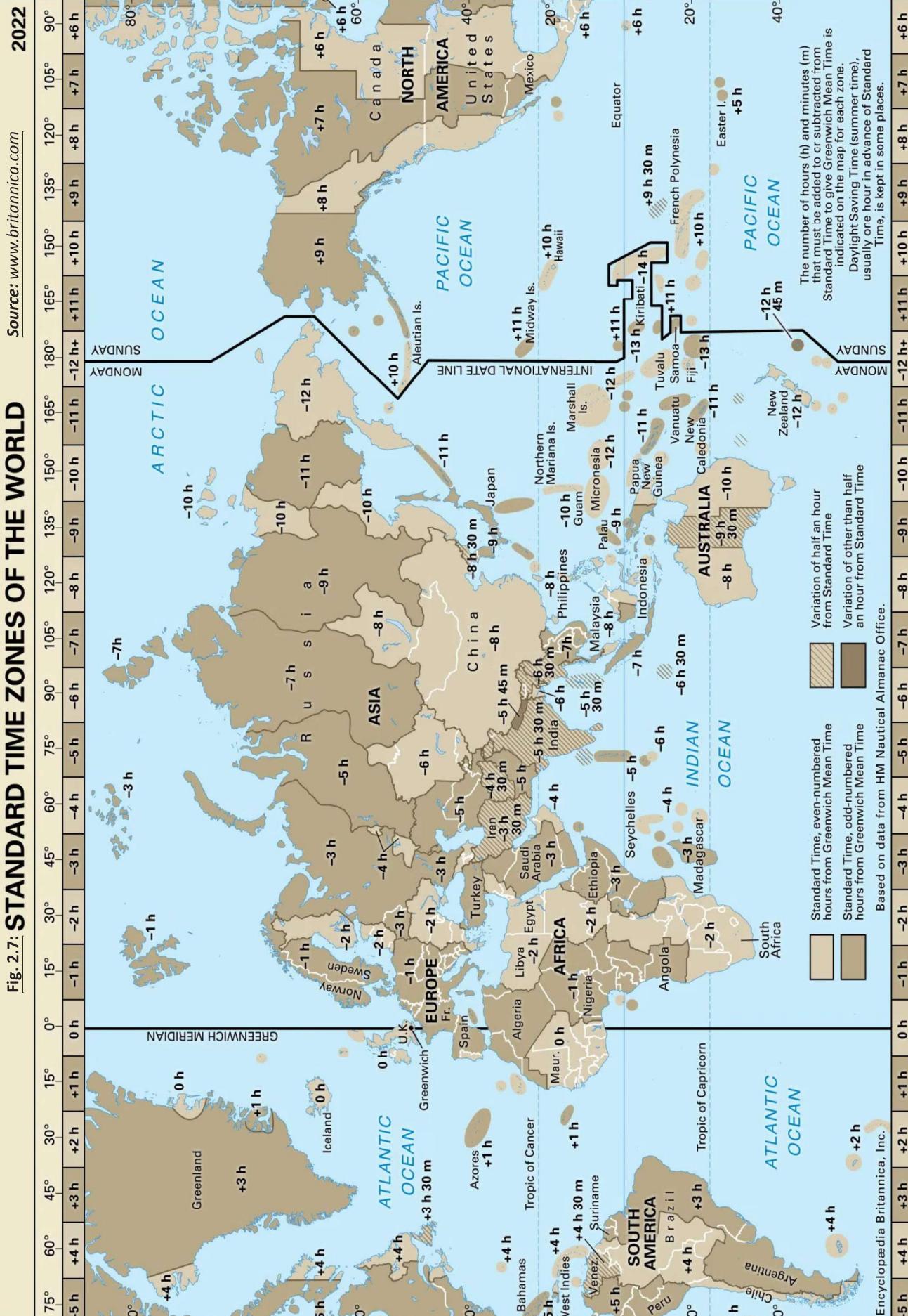


Fig. 2.6: Longitude And Time

Source: www.geographyrealm.com

Fig. 2.7: STANDARD TIME ZONES OF THE WORLD

2.6.3 International Date Line

- A traveller going eastwards gains time from Greenwich until he reaches 180° E meridians, where he will be 12 hours ahead of GMT. Similarly going westwards, he loses 12 hours till he reaches 180° W.
- There is, thus, a total difference of 24 hours or a whole day between the two sides of the 180° meridian. This is the International Date Line where the date changes by exactly one day when it is crossed.
- This is the International Date Line where the date changes by exactly one day when it is crossed. A traveller crossing the dateline from east to west loses a day (because of the loss in time he has made), and while crossing the dateline from west to east he gains a day (because of the gain in time he encountered).



Fig. 2.8: International Date Line

- The International Date Line in the mid-Pacific curves from the normal 180° meridian at the Bering Strait, Fiji, Tonga and other islands to prevent confusion of day and date in some of the island groups that are cut through by the meridian.

Why is the international dateline drawn in a zig-zag manner?

The time difference on either side of this line is 24 hours. So, the date changes as soon as one crosses this line. To avoid any confusion of date, this line is drawn through where the sea lies and not land. Hence, the IDL is drawn in a zig-zag manner.

Indian Standard Time

The Indian Government has accepted the meridian of 82.5° east for the standard time which is 5 hours 30 mins, ahead of Greenwich Mean Time.