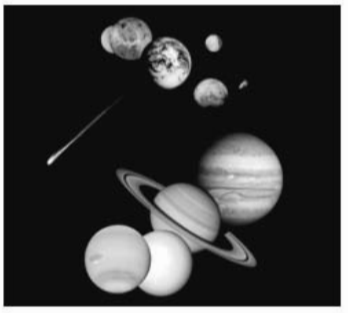
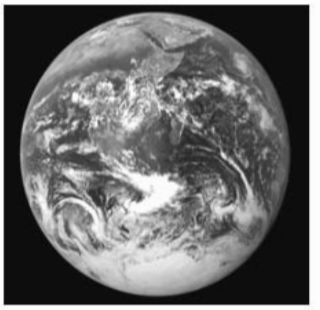
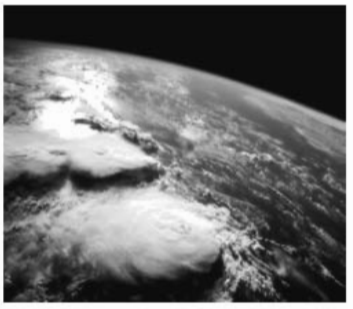
Chapter-3

The Solar System and the Earth

The earth is surrounded by the space. This space includes the stars, galaxy, nebula, comet, planet, minor plant or satellite, aeroliths and other luminaries. The universe has been created with such innumerable luminaries of the stellar sky. The sun is one of the stars of the universe. The solar system or the solar family consists of the sun and its planets, minor planets, asteroids, countless comets and innumerable aeroliths altogether. The sun is the regulator of all planets and minor planets of the solar system. The planets and the minor planets being attracted by the sun as well as their mutual gravitation traverse round the sun through their respective orbits in a particular duration. The solar system is very small in comparison with the vastness of the universe, and the earth is smaller too. The universe is bigger in size by billion fold in comparison with the earth. In this chapter, we will learn about the concept of the solar system, the planets, the formation of subterranean and time schedule of the universe, the rotation of the earth and its effects, the change of seasons, the surmise of ebb and flow and their influences.

After reading this chapter, we will be able to—

- explain the concept of the universe;
- describe the planets of the solar system;
- explain the causes for habitation of the living beings;
- describe the formation of subterranean;
- show the locations drawing the solar system and the planets as well;
- explain the concept of parallels of equator, latitude and meridians of longitude, prime meridian and international date line;
- assess the role of the imaginary lines in respect of the world's time deciding;
- explain the causes resulting the difference between the time of Bangladesh and that of any other country, and specify the time;
- draw the figures of locations of different lines;
- explain the concept of diurnal rotation and annual motion, and their effects on the earth;
- explain the reason causing waning and waxing of day-night;
- explain the causes resulting in changes of seasons in the world;
- analyse the relation between annual motion and the change of seasons in Bangladesh;
- calculate the time by applying mathematical cognition in a new situation;
- explain the surmise of ebb and flow, their causes and classifications as well;
- explain the effects of ebb and flow on the earth;

- explain the concept of motion of the earth;
- establish the relation with the environment and adaptation as well.

Section 3.1: The Solar System

The sun-family comprising the sun and its planets, minor planets, asteroids, comet, aeroliths, is called the solar system. The sun is the centre-point of the solar system. There are 8 planets, more than hundred satellites planets, thousands of asteroids and millions of comets in the solar system.

The Sun

The sun is the regulator of all planets and minor planets or satellites existing in the solar system. It is a bright star. It has a close ties with the earth. It is greater than the earth by 13 hundred thousand-fold. The earth is away from the sun by approximate 150 million kilometers. It is about 13 hundred 84 thousand kilometers in width. The temperature of its surface is 57,000° Celsius. A very light temperature from the sun arrives at the earth since the sun stays very far. Such a light temperature and rays adequately suffice the need of the living beings on earth. The sources of heat and light in other planets and minor planets are the sun itself too. The sun has neither any hard nor any liquid substance.gen, 44% of 1% of other gases. The black spot that is sometimes seen in the sun is called the Sunspot or Solar infamy. The heat of Sunspot is less than that of its other parts. Under the atomic energy generation process, hydrogen existing in the sun transforms into helium gas, and energy is being generated from this gas in a continuous process. The sun revolves on its own axis once in about 25 days, and it strolls around its own galaxy through the long rotund way at a gap of about 200 million years. The vibration of life, plants, and animals could not exist in the earth without the light and heat of the sun, and the world had remained in ever darkness.

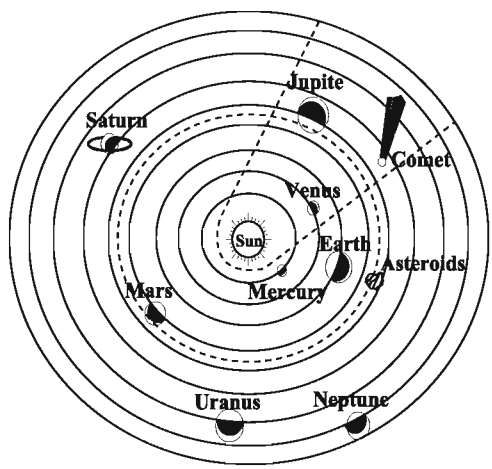


Figure 3.1: The Solar System

The Planets: Some luminaries influenced by the gravitation revolve around the sun in the space through certain orbits maintaining a particular duration are called planets. They have no light or heat of their own. The number of planets in the solar system is 8. They respectively stay from the sun in accordance with their distance, namely Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Jupiter is the largest among the planets and the Mercury is the smallest planet in the solar system.

Mercury: Mercury is the closest planet to the sun and the smallest planet in the solar system. Its diameter is 4,850 kilometers and its weight is equivalent to three-fiftieth of the earth. It orbits the sun once in about 88 earth-days. The average distance of it from the sun is 5.8 crore kilometers. It has no natural satellites. Its temperature is very high since it is the closest planet to the sun. Many holes and mountains with level ground have been noticed on the surface of Mercury. Mercury surface area is 74,800,000 square kilometers.

Venus: Venus is the closest to the Earth and its position is the second from the sun by distance. It is 10.8 crore km away from the sun and only 4.3 crore km from the Earth. We find it in the western sky as the evening star, and at dawn as vesper in the eastern sky. It orbits the sun once in 225 earth days. It has no natural satellites. Like earth, Venus has a substantial atmosphere but has no oxygen in it. The presence of carbon dioxide gas is about 96%. This planet orbits on its own axis very slowly. Therefore, the sun rises and sets twice a year in its sky. Acid rain showers due to the dense cloud of carbon dioxide in this planet. It is much drier than the earth, and the pressure of air is ninety times stronger in its atmosphere than that of the earth. Its surface area is 460,230,000 square kilometers and diameter is 12,104 kilometers.

The Earth: The Earth is the third closest planet to the sun. It has an area of 510,100,422 square kilometers. Its diameter measures 12,752 km in the East-West and 12,709 km in the North-South. The average distance of the earth from the sun is 150 million km. It orbits the sun once in 365 days 5 hours 48 minutes and 47 seconds. This planet has sufficient oxygen and nitrogen as well. The average temperature of the surface of the earth is 13.90°C. It has necessary water on its crust. Of all the planets, the Earth is the only planet which is ideal for living for the creatures and plants. It possesses one natural satellite, the moon, the only large satellite of a terrestrial planet in the solar system. The average distance of the Earth from the Moon is 381,500 km. It orbits the Earth once in 29 days and 12 hours. Holes, mountains, hills have been observed in the rear part of the Moon.

Compare the characteristics of the luminaries in the Solar System in a table

Mars: Mars, after the Earth, stands close to the Sun by distance. Its average distance from the sun is 22.8 crore km and 7.8 crore km from the Earth. Its diameter is 6,779 km and its weight is equivalent to one-tenth of the Earth. It has an area of 144,798,500 square kilometers. It takes 687 days to orbit the Sun, and it orbits once on its own axis in 24 hours and 37 minutes. It has two tiny natural satellites (Deimos and Phobos). Living is impossible here. It possesses an

atmosphere containing 3% of nitrogen and 2% of argon gas. The amount of water is very scant here. It is colder than the Earth and its average temperature is below the freezing point. Its surface is peppered with gorges and vast volcanoes. Its red color comes from iron oxide (rust) in its soil.

Asteroids: Numerous small planets are orbiting together in between Mars and Jupiter. There is no other planet in this extent. A luminary with a diameter less than 1.6 km to 805 km is called 'asteroid'. They are called asteroids in a body.

Jupiter: Jupiter is the largest planet of the solar system. It stands fifth from the sun by distance. Its measure is equivalent to about1300-fold of that of the Earth that is, it has an area of 61,419,000,000 square kilometers. Its diameter is 139,822 km. It is about 77.8 crore km away from the sun. Jupiter orbits the sun once in 12 years and on its own axis in 9 hours and 53 minutes. The sun rises and sets in this planet twice in one earth-day. It possesses a dense atmosphere. The up-level temperature of this planet's surface is very low and its internal temperature is very high. It has 67 satellites of which Ganymede, Callisto, Lo and Europa are the most important.

Saturn: Saturn is the second largest planet of the solar system. It has an area of 42,700,000,000 square kilometers and diameter of 116,464 km. It is 143 crore km away from the sun. It orbits the sun once in 29 years and 5 months and on its own axis once in 10 hours and 40 minutes. Saturn is larger than the Earth by 9-fold approximately, and it can be watched with open eyes. It possesses an atmosphere containing mixture of hydrogen and helium, methane and ammonia gases. Three bright belts have surrounded Saturn. It has 62 satellites of which Capitas, Tethis, Hua, Titan, Enceladus are to be mentioned.

Uranus: Uranus is the third largest planet. It is 287 crore km away from the sun. It orbits the sun once in 84 years. Its average diameter is about 49,000 km. Its volume is larger than Earth by 64-fold and its weight is heavier than that of the Earth by 15-fold only. Its atmosphere possesses a vast amount of methane gas. It has 27 satellites of which the largest ones are Miranda, Ariel, Oberon, Unbriel and Titania, etc. It is discovered that Uranus has belts like Saturn.

Neptune: Neptune's average diameter is 49,244 km. It is 450 crore km away from the sun. It has an area of 17,618,300,000 square kilometers. This planet is cold since it stays much far away from the sun. It is largely bluish to look at. It orbits the sun once in 165 years. It has 14 satellites -Triton and Nereid are its significant satellits. Neptune is accompanied in its orbit by a number of minor planets termed Neptune Trojans.

The Causes for Habitation of Living Beings in the Planet Earth

All sides of Earth are surrounded by miscellaneous gaseous elements. Such invisible gaseous covering is called the atmosphere of Earth which is implicated in the surface of the Earth being attracted by the gravity, and being rotated along with the Earth. Its density is most on the sea-surface due to air-pressure, and its up-level density is comparatively less. Nitrogen and Oxygen have supremacy in the atmosphere. Oxygen is a must for all kinds of creature. The extent of other elements other than that of carbon dioxide gas remains almost invariable, but some elements like dust, smoke, aqueous vapour, etc. remain at particular places in different extent. The atmosphere plays a vital role in order to help all creatures live in the Earth. It protects the fauna from the harmful rays of the sun, and its gaseous element namely carbon dioxide(CO_2) saves plants and oxygen (CO_2) saves the fauna as well. Troposphere is a level adjacent to earth-surface and the lowest level of the atmosphere. This level possesses an average depth of about 13 km. It is the most essential level for human beings, because moistness, clouds, fogs, rains, steams of air, etc. are noticed at this level. Due to the increase of height, the velocity of air gets enhanced at this level, and air moves up and down. Most of all the processes of the climate and weather happen at this level of atmosphere. The atmospheric boundary between the troposphere and the stratosphere is called Tropopause. The depth of Tropopause is narrow, and the air remains standstill there, and spacecraft routinely pass through this level without any trouble for not having any prevalence of rainstorms. Ozone gas possesses a level in the atmosphere known as Ozone level. Its depth is approximate 12-16 km. Since it absorbs the ultra-violate ray of the sun, temperature reaches at about 40°C. This level of the atmosphere has made the Earth habitable for the living beings.

Individual work: Make a list showing reasons why other planets are not suitable for habitation except the Earth.

The Earth receives light and heat from the sun. This Earth would remain ever dark without the light of the sun. No life vibration could remain in the Earth, and all creatures, plants and fauna could not live. The human activities on Earth help form the atmosphere and bring about changes in the elements. For example, deforestation, smokes emitted from the mills and industries, and burning of fuels, coals and natural gases enhance the pollution of the atmosphere. It is necessary to keep the atmosphere fresh for the sake of existence of the living beings.The humans and animals need light, air and water in abundance. The average temperature on the surface is 13.90°C. Its surface possesses sufficient water. The heat and light that reaches the Earth from the sun are also endurable by the fauna. These are very essential and suitable elements for the existence of the flora and fauna as well. That is why the humans and animals can live comfortably live on Earth.

Interior Structure of the Earth

It is very difficult to collect actual information about interior structure of the earth and its various layer. But earth's interior rock's density-variation and different layer's characteristics known by various seismic wave velocity of interior earth. So the Geologists have divided interior structure of the earth into three layers on the basis of velocity and nature of seismic wave of interior of earth. These layers are- (1) Core, (2) Mantle and (3) Crust.

(1) Core: The radius of round shape earth is 6371 km (approx.). Around the earth's centre, there is a spherical object having 3486 km (approx.) radius. This spherical object is defined as core. Specific gravity of this layer is 10 to 13.6. According to the scientists, core is composed of some solid and heavy materials such as iron, nickel, mercury, lead etc. This layer is called Nife because of excess nickel and iron portion. It is 10/12 times dense more than water and two times than other portion of the earth. Probably it is not in solid form because of excess heat and pressure. Based on seismic wave core is divided into two part- external part and internal part. It is assumed that outer part of core is liquid and inner part is solid. The extent of outer portion of the core is near about 2270 km. Inner portion of core is still solid having 1216 km radius from earth centre and it is mainly composed of iron and nickel.

(2) Mantle: The surrounding up to 2885 km. radius from upper level of the core is defined as mantle. This layer contains heavy metals like silicon and magnesium. As its upper layer 1448 km. composed of basalt like materials, it is called basalt region. This layer is also named as Sima because of its composition of silicon and magnesium.

(3) Crust: The upper part of the mantle is called crust. It is composed of various rocks and minerals. Its depth is the highest in the beneath of continental region and the least in oceanic region. There is a debate about its actual depth. Its depth is considered up to 30 to 64 km. according to location. The mentionable elements of the composition of this layer are oxygen, silicon, aluminium, iron, calcium, sodium, potasium, etc. It is mentionable that Silicon and Aluminium are abundant at this layer. That is why this layer is called SiAl layer. The upper part of

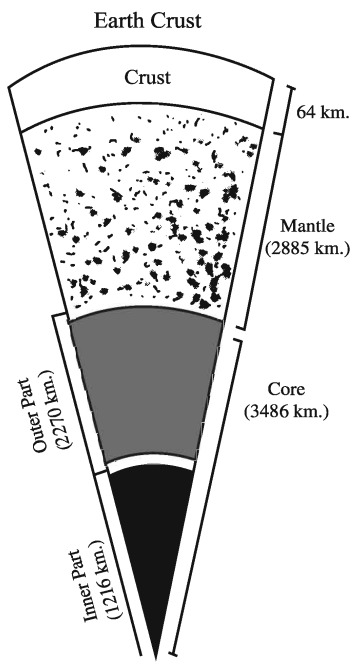


Fig. 3.1: Inerior Structure Of the Earth

the crust is called earth-crust and lower part of the crust is called substratum. Earth-crust is hard portion of the earth. Its depth is 3km.(beneath the ocean) to 40 km.(beneath the mountain) but average depth is 1 7 km.

Section 3.2 : The Method of Calculating Time at Different Regions of the World

A few imaginary lines are drawn in the world's map across the East-West and the North-South in order to decide location of any region in it. These are respectively called Axis and Meridians of Longitude. The location of any region can be known through the Axis and the meridians of longitude. Any regional time can be known from the position of the meridians of longitude. As the locations in the North and South can be known from the equator through the axis, the meridians of longitude is used to know about the locations in the East or West from the prime meridian as well. Though the Earth's surface seems level, it is an approached globe in fact. That is why the distance from the prime meridian can be easily demonstrated in an angular measure as the Earth is almost round.

The Axis, Equator, Latitude, Meridians of Longitude and Prime Meridian

The Axis and Equator: The line imagined at the North-South over the center of the Earth is called Axis. Its northern end point is called the North Pole or the Arctic, and its southern end point is called the South Pole or the Antarctic. The line that is imagined hemming the Earth across the East-West by keeping the same distance from both the poles is called Equator or Equinoctial Line. This line is circular in size for round shape of the Earth. So it is also called Equinoctial Circular. The Equator has divided the Earth equally into two parts across the North-South. A half of the Earth existing at the North to the Equator is called northern hemisphere, and the other half of the Earth at the South to the Equator is called southern hemisphere. An angular distance of any region within northern or southern hemispheres can be decided through the Equator. A unit of latitude measure like the geometrical angle is called Degree.

The Parallel of latitude: An angle of 360° originated at center of the Earth's circular is divided into Degree (0), Minute (') and Second ("). Angular distance of each pole from the Equator is 90°. A parallel line of the Equator which is imagined by dividing this angle into degrees and minutes is called a parallel of latitude. These parallels of latitude are stretched out towards the East-West, reciprocally parallel, each is a full circle, if latitude increases, the circumference also increases, and the maximum latitude is 90°. The well-known parallels of latitude are 23.5° north latitude known as the Tropic of Cancer, 23.5° south latitude known as Tropic of Capricorn, 66.5° north latitude known as The Arctic Circle, and 66.5° south latitude known as The Antarctic Circle. The angular distance of any region

situated either at the North or the South from the Equator is called the latitude of that region. In order to know the location of any region, it is necessary to identify where the region exists and how far it is in the North or South from the Equator, or in the East or West from the prime meridian. All regions situated at one Axis have the unique latitude.A latitude possessing 0° to 30° is called the Lower Latitude, 30° to 60° the Middle latitude and 60° to 90° the upper latitude.

The Meridians of Longitude

By dividing the Equator into Degrees, Minutes and Seconds, the lines that have been imagined throughout from the North Pole to the South Pole over each of division points are called the Meridians of Longitude. It is also named the meridian. The Meridians are semi-circle and not parallel. Each of the meridians of longitude possesses the equal length. The highest meridian becomes 180°. Considering any of the meridians of longitude a particular prime meridian, an angular distance of the other meridians of longitude from this line, can be measured. The Local time is decided through the meridian.

The Prime Meridian

There is an international agreement that the meridian running through Greenwich, London of the UK over the Royal Observatory in Greenwich at a vicinity of London city, which is spread out over the North Pole and the South Pole is considered the official Prime Meridian. Any line of the longitude (a meridian) can serve as the 0° longitude line. The other meridians can be drawn from the Prime Meridian by the angle originated at the Earth's centre. The meridian existing at the East by 45° from the Greenwich Prime Meridian, meridian

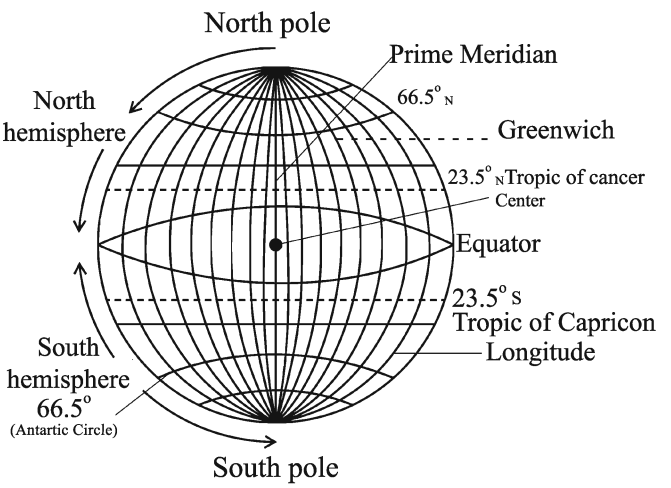


Figure 3.2 : Important Geographical meridians

Individual Work: Note the situations of the important imaginary lines (in 0 degree) in a table.

of all region over it is 45^0 Eastern Meridian. we can say that an angular distance of any region in the East or West from the Greenwich Prime Meridian is the Meridian of that region. We also know that Greenwich meridian serves as the O degree. Any angle originated with the diameter of the Earth possesses 360 degrees. The Prime Meridian has divided these 360 degrees equally into two divisions after every one degree i.e. by 180° in the East and 180° in the West. Since the Earth possesses a round shape, both the 180° East Meridian and the 180° West Meridian remain within the same meridian. Like the Latitude, the meridian is divided into minutes and seconds as well. Each minute meridian is equal to 60/1 of a degree. Where there the Equator and the prime meridian intersect each other lengthways, both the latitude and meridian fall in Zero (0) degree. That is the region of the gulf of Ginny. It is possible to determine the meridian of any region from the Local time and the Greenwich Mean Time.

The Difference in Local Time: The earth is round and it continuously moves around its own axis from the West to the East. So the different regions of the Earth face the sun at different duration. When the prime meridian of any region reaches just the front of the sun, the sun is found exactly overhead at that region, and then, the midday occurs at that region and it is 12 o'clock by watch over there. The other timings of the day are decided in accordance with the midday. We know that one degree of meridian difference results in difference of time by 4 minutes, and the distance of one minute meridian results in difference of time by 4 seconds. When it is 12 o'clock at any place or region, the time of any region existing 5° East to that place or region, will be 12+(5x4) minute or 12 hours 20 minutes. The time of any region existing at 5° West to the same region, will be 12 o'clock (5x4) minute or (12H-20M) 11 hours and 40 minutes.

Through Greenwich Mean Time: The Greenwich Meridian serves Zero (0) degree. The exact time of Greenwich can be known by the Chronometer watch. The meridian of a place is calculated by the sextant apparatus, and the midday of that region at that time is determined by observing the highest position of the sun in the sky. The meridian of such region is ascertained from the difference of time between Greenwich Mean Time and the time of that region at a particular duration. If any region is situated to the eastern side of Greenwich, the local time of that region will be more than that of Greenwich, and if it is situated to the western side thereof, its local time will be less than that of Greenwich.

The Local Time and the Standard Time

Local Time: Every day the Earth orbits its own axis from the West to East regularly. Consequently, the sun rises earlier in the regions located at the eastern part of the Earth. In the course of Earth's rotation, when the sun remains overhead or at the highest site, midday occurs at that region and it is 12 o'clock by watch over there. The other timings of the day are determined from such meridian while. It is termed as the local time of that region. The local time is decided by the sextant apparatus too. The measure of angle at the Earth's centre is 360 degrees. The earth orbits such 360° angular distance once in 24 hours or (24x60) = 1,440 minutes. So the Earth orbits 1 degree in (1,440-360) = 4 minutes i.e. time differs by 4 minutes due to the difference of every one degree meridian.

The Standard Time: If the local time is determined by ascertaining the duration of midday sun over the meridians of longitude, the calculation of time faces confusion in the same country. For that reason, a separate standard time for each country is determined where necessary. In every country, the time that is determined as per the meridian at any region of its center is called the standard time for that country. If the country is larger, it may have several standard times itself. Such as The United States of America have 4 standard times, and Canada has 5. The local time of Greenwich (0° meridian) has been accepted as the standard time for the whole of Earth. The Standard Time of Bangladesh is +6 hours from the Greenwich Mean Time. 90° East meridian is situated almost Individual work: Decide local above the middle of Bangladesh territory. For this time and standard time. For this reason, the local time of this meridian is considered the standard time of Bangladesh accordingly.

Individual work: Decide local time and standard time.

The difference of time between Dhaka and Seoul is 2 hours 32 minutes. What is the meridian of Seoul while it is situated at the 90° East to the meridian of Dhaka (Seoul is situated to the East of Dhaka)?

The meridian of Seoul will be more since it is situated in the East of Dhaka.

The difference of time between Dhaka and Seoul is 2 hours 32 minutes = 152 minutes.

The Meridian differs by 1° at a difference of 4 minutes.

So the meridian differs at a difference of 1 minute by $(^1/_4)^\circ$

So the meridian differs at a difference of 152 minutes by $\left(\frac{1x152}{4}\right)^\circ = 38^\circ$

So the meridian of Seoul stands $90^\circ + 38^\circ = 128^\circ$

Answer: The meridian of Seoul stays at 128° East.

♦ The Meridians of Dhaka and Chennai are respectively 90° East and 80° 15' East. What is the local time in Chennai when the midday occurs in the sky of Dhaka?

The difference of meridian between Dhaka and Chennai is 90° - 80°15'= 9°45'. Time will vary for 9°45' meridian, and the time differs by 4 minutes for 1 ° meridian's difference.

So, the time variation for 9°meridian is 9°X4" = 36 minutes. Time differs by 4 seconds due to 1 °meridian's difference.

So the time difference due to 45' of the meridian by 45'X4" = 180 seconds = 3 minutes. So the time difference due to 9°45' meridian by 36 minutes + 3 minutes =39 minutes.

Chennai is situated at the West of Dhaka (Chennai's meridian is less). Accordingly, its time is less.

So, when the midday occurs in Dhaka, i.e. 12 o'clock at noon, the local time of Chennai will be 12 hours 39' minutes - 11 hours 21 minutes a.m.

Answer: The local time of Chennai is 11 :21 a.m.

The Antipode

A point that stands opposite to any point existing on the Earth's surface is called the Antipode of that point. The Antipodes exist entirely to the opposite of one another. In order to decide antipode, an imaginary line from any point of the surface through the Earth's center is drawn towards the side contrary to the Earth. The point where the so supposed line reaches at the opposite side of the surface, the very same point is the Antipode to the previous point (see figure). If a latitude of any region is known, its Antipode's latitude is also known as well. The degree of a latitude of any region is the degree of its antipode's latitude. Either of both the regions will be situated at the North and at the South of the Equator. Both the regions will be in both the hemispheres. If one region's latitude stands at 70° North, its Antipode's latitude will be at 70° North as well. If a meridian of any region is added to its antipode's meridian, the summation will be 180°. So, if the meridian of one region is deducted, its antipode's meridian is got. If the meridian of one region stands at the East, its antipode's meridian will be at the West. For example, a meridian of antipode of a region

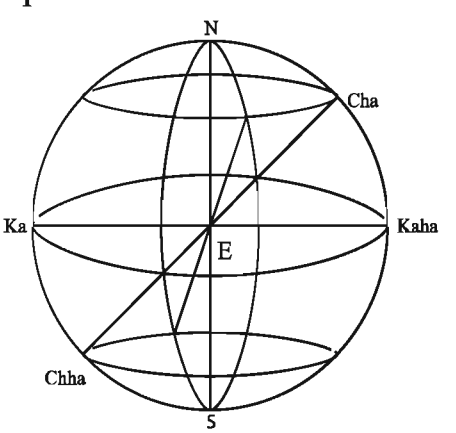


Figure 3.3 : The Antipodes
Antipode of place Ka is Kha
Antipode of place Cha is Chha

situated at 40° of the East meridian, its will be 180-40° = 140° to the West. The time will differ in between both the regions by 12 hours. In the figure 4.6, the antipode of Chapoint is Chha point (see figure). The antipode of Dhaka is situated over the Pacific Ocean near Chile within the territory of North America.

The International Date Line

While traveling a long way from any particular region to the East or West, days of weeks sometimes get confused along with the local time difference. Problems arise to pass through 180° meridians of longitude to the East or West from any specific venue. In order to solve such problems, a line extending across the North-South over the water surface is imagined by having the recourse to 180° meridians of longitude. This imaginary line is named 'The International Date Line'.

The Importance of the International Date Line: We know that the time differs by 4 minutes for 1 ° of difference in the meridian. So, the time difference will be 1 hour for 15° of difference in the meridian. If it (the meridian of Greenwich) advances forward from the prime meridian to the East, 12 hours will be more at 180° meridian, and if it gets ahead towards the West, 12 hour time will be less at 180° meridian. So, when it is 10 o'clock on Monday at the prime meridian, the local time will be 10 o'clock night on Monday at 180° East meridian as well. Accordingly, if the meridian of longitude is calculated by the Wes tern side, the local time will be 10 o'clock at night on Sunday, i.e. the previous day at 180° West meridian instead. But the line at 180° East and 180° West is the same. So, it is observed that the local time differs at the same meridian by 24 hours or a whole day. At the same region, where there is Sunday, there is Monday elsewhere, but at the same meridian, 10 o'clock on Sunday

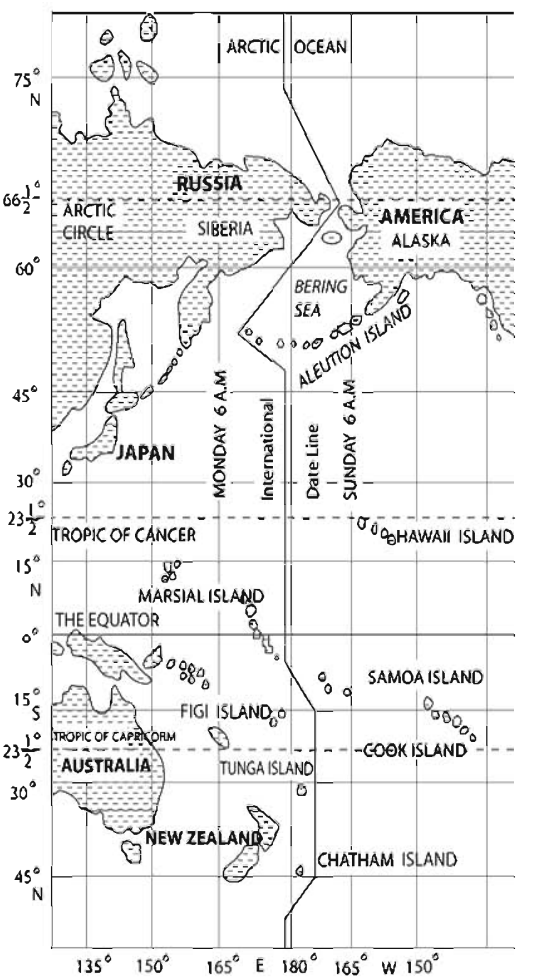


Fig.3.4: International Date Line

night and 10 o'clock on Monday night cannot happen at the same time. In order to solve this problem, a line that has been imagined having recourse to the 180° meridian in the atlas over the water-surface of The Pacific Ocean under the International recognition is the International Line. Since passing through this line results in changes of day and date, that's why it is called International Date Line (see figure). It passes through the northeast region of Siberia, Allucian, Fiji and Chatham islands. In order to solve problems of the local people in calculating 30° dates, this line has been designed over the water-surface in Bering system making it bent towards at 12° East Allusion islands 70° West, and 11 ° East at Fiji and Chatham islands.

By ship or aircraft towards eastern region, while people routinely pass through this line, they deduct one day from their extended time in order to maintain harmony with the local time over there. Similarly while passing through it towards western region, people calculate their date by adding one day to their curtailed time.

The Role of Imaginary Line to Determine Time

The Earth is almost like a globe. So the imaginary line plays a great role in the world's map in order to determine time within its territory. The round shape Earth orbits its own axis from the West to the East in due course. Consequently, different parts of the Earth's surface face the Sun at different durations. While the meridian of any part stands just in front of the sun at a particular time, the midday occurs at that part and it is 12 o'clock by watch over there. The other timings of the day are determined in accordance with the Noon or Midday. The Earth orbits from the West to East, so the sun rises earlier in the parts existing in the eastern side. If it is 1 o'clock, the time at its 1° East will be 4 past one, and at 1° West 4 minutes to one. In Greenwich (0°) when it is 8 am, it is 10 am somewhere else, and the meridian of such place will be Meridian 30° East. Again, when the time runs behind than that of Greenwich, the said place will be at the West of Greenwich.

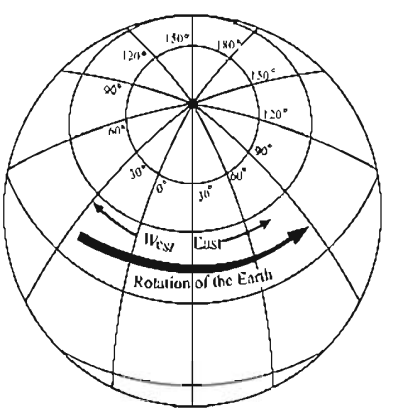


Figure 3.5: Earth's Rotation from West to East

Section 3.3: The Motion of Earth

We regularly notice that the sun rises in the East and sets in the West in due course. But have we ever thought on how it happens? It is because the Earth is on motion. The Earth being regulated by the gravity, rotated on its own axis following the sun in its front and moves round the sun through

particular orbits. This is the Earth's motion. The Earth's motion is classified into two ways - The Annual Motion and the Diurnal Motion.

The Diurnal Motion: Let us have a look to the figure 3.9. What do we see there? There are a burning candle and a globe. We can see and notice that one side of the globe is illuminated and the other side is dark. The day and night come alternatively in the same manner due to the diurnal motion in the Earth. The Earth rotates on its axis from the West to the East regularly. It rotates in this way almost 24 hours or a day. The time for one complete rotation is 23 hours, 56 minutes and 4.09 seconds. This motion of Earth is called the 'Diurnal Motion'. The time for one compete rotation of Earth is called a Solar Day. The days and nights come due to the Diurnal Motion. The Earth possesses no light itself. It gets illuminated with the sunshine. Since the Earth is round, the sunlight cannot reach the whole of its surface at a time. During the rotation, the part where the rays fall in, day occurs, and the other part remains dark, and vice versa. The time can be calculated on recourse to the diurnal motion. Considering the complete rotation 24 hours, the time is calculated by dividing it in hours, minutes and seconds as well. The ebb and flow takes place in the Earth by attraction of the Moon and the Sun due to the diurnal motion. The diurnal motion affects to a great extent the sea-streams and air-ventilation.

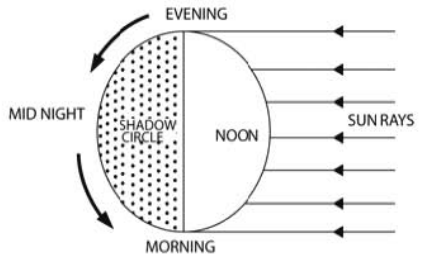


Figure 3.6: Occurrence of Day-night

The Experiment: Supposing a burning candle on the table in a dark room as the Sun and the globe as the Earth, we can find that the front part of the candle is lighted and its opposite part remains dark by moving the globe before the burning candle. Day occurs in the lighted part and night in darkness. The circular region in between the lighted and the dark regions of Earth is known as the shade-circle. The part of the Earth that just reaches the lighted part due to the rotation by passing through the shade-circle from the darkness dawn occurs over there. The time when meager light exists sometimes earlier from the daybreak is called the dawn, and the time when meager light exists before sunset is called twilight.

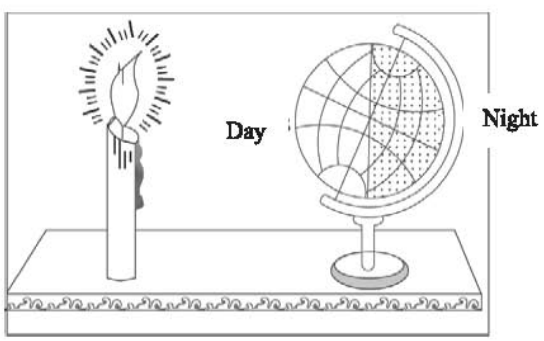


Figure 3.7 : With the candle and the globe

The Annual Motion: The Earth moves round the sun continuously on its own axis through a certain semi-circular orbit, to a certain direction and in a certain duration. Such rotation of Earth to the East from the West is called the Annual Motion. The Earth moves round the sun in a speed of 30 km per second. The time required for the earth to make one complete rotation around the sun is 1 year. It is called the solar year. The exact time is 365 days, 5 hours, 48 minutes, 45.51 seconds. As the solar year is calculated on 365 days, every fourth English year is calculated with an additional day, i.e. 366 days. In that year, February possesses 29 days instead of 28, and such year is called the 'Leap Year'. The waning and waxing of the day-night and changes of seasons happen in the Earth in consequence of the annual motion.

The Role of the Annual Motion to the Waning and Waxing of Day-Night and to the Changing of the Seasons

We have noticed that the time of different days and nights in the year have discrimination, i.e. sometimes days are longer and sometimes nights are longer. Have we ever thought on how it differentiates? It can be replied that such disparity occurs due to the annual motion. An annual motion causes to wan and wax days and nights and to change the seasons.

The Reasons that Make Days and Nights Longer or Shorter

Let us have a look to the following figure. While moving round the sun, the four stays of the earth have been specified in the orbit such as June 21, September 23, December 22 and March 21.

June 21: While moving round the sun, the earth upon its course reaches at such a place on the orbit on June 21, where the North Pole mostly inclines (23.5°) towards the sun, and the South Pole remains farthest away from the sun. On this day at noon, the sunlight falls over 23.5° North Latitude lengthways (at angle 90°). The day on this date becomes the longest in the north hemisphere and the night becomes the shortest. The opposite situation exists in the south hemisphere

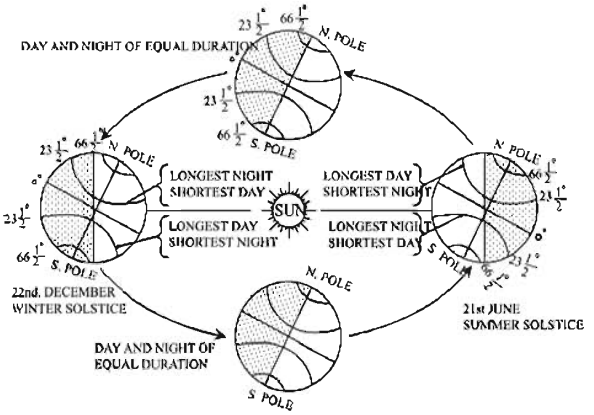


Figure 3.8 : Increase and Decrease of day-night