

Topic: Earth in Space

Introduction

The interest of man in space has existed from ancient times when man employed the naked eyes to study and speculate on the moon, the stars, the sun, and other things which were imagined to be there in space. As time went by, man began to carry out more systematic studies of space. By the second century AD, a Greek mathematician called Ptolemy proposed that the earth moved in space. By the 16th century AD, some other scientists such as Tycho Brahe and Kepler had deduced the relationships between the motion of the earth round the sun and the motion of the moon round the earth. In the year 1686, Isaac Newton deduced and published the laws of mechanics. These included those governing the circular motion of the earth round the sun.

Tycho Brahe was one of those scientists who made very powerful telescopes for studying the details of very far objects such as those in space like the moon. The use of such powerful telescopes revealed that many more planets than just the earth existed. It also revealed that there were other smaller bodies which moved round some of the planets. These smaller bodies were then called moons.

Since scientists found that there were many planets which moved round the sun, man has been curious to find out whether:

There was life on the moon and other planets

Man could leave the earth and go to settle on any of the planets or the moon

By the end of World War II in 1945, powerful nations such as Russia (then USSR) and the United States of America began to think of establishing space stations on the moon. There were doubts however whether it was possible to establish such space stations. This was the origin of space exploration.

The Solar System

The solar system consists mainly of the sun and nine planets which move around it, with the sun at the centre. The planets are massive objects in the solar system and they are kept in their track around the sun as a result of a force of attraction from the sun. The distance of these planets to the sun determines how long it takes for the planets to complete one revolution round the sun. The time it takes for the planets to complete one revolution round the sun is known as the planet's year. For earth, the planet year is 365 days or 3.2×10^7 seconds.

Apart from the planets, there are also several moons. A moon is a satellite of a planet. For example, the earth has only one moon which moves round it; mars has two moons; Jupiter has twelve moons; Saturn

has nine and Uranus four.

What is Space?

Space refers to the region of our environment outside the earth's crust. There are three important regions outside the earth's surface. These are the troposphere, the stratosphere and ionosphere.

The troposphere starts from the surface of the earth and extends to a height of about 16,000 metres. Most of the air and water vapour in our environment are found in this region. As one goes up in the troposphere, the temperature falls and it therefore becomes cooler. The stratosphere is the region directly above the troposphere. The region contains very little air. The temperature of the stratosphere does not fall as one goes up in this region.

The ionosphere is the upper part of the atmosphere. It contains mainly charged particles. The ionosphere is very useful to man because it enables the reflection and transmission of radio waves and signals round the world. You listened to radio programmes from other parts of the world, for example, Voice of America and BBC. You can now know how these radio broadcasts reach you in Nigeria.

The Earth

The earth is a natural body which revolves in space around the sun. It is one of the nine planets called the inner planets because it is comparatively near the sun. The shape of the earth is best described as spheroid such that starting from any point on its surface and travelling in a straight line, one will eventually come back to the starting point. This means that the diameter along the equator is not exactly equal to the diameter along the north and south poles. However, if we assume the earth to be a perfect sphere, the average radius will be 6400 Kilometres. The earth consists of a solid part called the lithosphere, the waters covering 75% of the earth's surface is known as hydrosphere and the gaseous envelope surrounds the other two parts is called atmosphere.

Formation of Volcanoes

The centre of the earth is hot molten mass that is under very high pressure. When a crack occurs in the hard covering of the earth, the pressure on the molten interior pushes out some of the sludge to the surface. The phenomenon is what is called Volcano eruption.

Rotation of the Earth

The earth moves (rotates) round the sun. In doing this, it traces out a path on its journey round the sun. The path is called the earth's orbit. The earth also rotates round its North-South axis once in twenty-four hours. The journey round the sun is called the planet's year. So one year on the earth is 365 days. The earth has two types of movement; circling round and round its axis and revolving round the sun.

The Moon

The moon is the nearest heavenly body to the earth. The radius of the moon's orbit round the earth is about 384,000 km. While the diameter of the earth is 12,800 km, the diameter of the moon is 3,200 km.

The moon is much smaller than the earth and is also far away from it. The earth has a much greater mass than the moon and therefore has a controlling influence on the motion of the moon.

Phases of the Moon

Phases of the moon refer to the bright surface of the moon which is visible from earth at night. The good way to understand the phases of the moon is to examine an earth-moon-sun diagram:

It's probably easiest to understand the moon cycle in this order: new moon and full moon, first quarter and third quarter, and the phases in between.

As shown in the above diagram, the new moon occurs when the moon is positioned between the earth and sun. The three objects are in approximate alignment. The entire illuminated portion of the moon is on the back side of the moon, the half that we cannot see.

At a full moon, the earth, moon, and sun are in approximate alignment, just as the new moon, but the moon is on the opposite side of the earth, so the entire sunlit part of the moon is facing us. The shadowed portion is entirely hidden from view.

The first quarter and third quarter moons (both often called a "half moon"), happen when the moon is at a 90 degree angle with respect to the earth and sun. So we are seeing exactly half of the moon illuminated and half in shadow.

Once you understand those four key moon phases, the phases between should be fairly easy to visualize, as the illuminated portion gradually transitions between them.

An easy way to remember and understand those "between" lunar phase names is by breaking out and defining 4 words: crescent, gibbous, waxing, and waning. The word crescent refers to the phases where the moon is less than half illuminated. The word gibbous refers to phases where the moon is more than half illuminated. Waxing essentially means "growing" or expanding in illumination, and waning means "shrinking" or decreasing in illumination.

Thus you can simply combine the two words to create the phase name, as follows:

After the new moon, the sunlit portion is increasing, but less than half, so it is waxing crescent. After the first quarter, the sunlit portion is still increasing, but now it is more than half, so it is waxing gibbous. After the full moon (maximum illumination), the light continually decreases. So the waning gibbous phase occurs next. Following the third quarter is the waning crescent, which wanes until the light is completely gone — a new moon.

Climate and Seasons

Weather changes in cycles. Cycles of weather changes are called seasons. Weather forecasters tell us what the weather will be like. They find out from meteorologists. Meteorologists are scientists who study weather. There are four seasons: winter, spring, summer and autumn. Some seasons are hot. Some seasons are cold. Some seasons are wet. Some seasons are dry. Winter is the cold season.

Summer is the hot season, These seasons are often dry. Spring is the season between winter and summer. The air begins to warm in the spring. Autumn, or fall, is the season between summer and winter. The air begins to cool in the fall. Spring and fall are often wet.

Cycles of weather changes differ from place to place. The long-term pattern of weather in any part of the world is called climate. There are three major climate zones: tropical, temperate, and polar. Climate zones differ in temperature and precipitation. Tropical climates are usually warm and wet most of the year. Much of Central and South America are in the tropical climate zone. Temperate climates cycle through all four seasons—winter, spring, summer, and autumn. Much of the United States is in a temperate climate zone. Polar climates are usually cold and dry most of the year. Antarctica is in a polar climate zone.

Shadows and Eclipses

Light produces shadows when solid objects obstruct its passage a shadow is a shade and a shade is obtained when an object blocks the path of light rays. The sun is the object which supplies the earth and moon with daylight. The sun moves round the sun, while the moon moves round the earth. Sometimes, the moon gets in between the sun and the earth.

An eclipse of the Sun (or solar eclipse) can only occur at New Moon when the Moon passes between Earth and Sun. If the Moon's shadow happens to fall upon Earth's surface at that time, we see some portion of the Sun's disk covered or 'eclipsed' by the Moon. Since New Moon occurs every 29 1/2 days, you might think that we should have a solar eclipse about once a month. Unfortunately, this doesn't happen because the Moon's orbit around Earth is tilted 5 degrees to Earth's orbit around the Sun. As a result, the Moon's shadow usually misses Earth as it passes above or below our planet at New Moon. At least twice a year, the geometry lines up just right so that some part of the Moon's shadow falls on Earth's surface and an eclipse of the Sun is seen from that region.

The Moon's shadow actually has two parts:

Penumbra

- The Moon's faint outer shadow.
- Partial solar eclipses are visible from within the penumbral shadow.

Umbra

- The Moon's dark inner shadow.
- Total solar eclipses are visible from within the umbral shadow.

When the Moon's penumbral shadow strikes Earth, we see a partial eclipse of the Sun from that region. Partial eclipses are dangerous to look at because the un-eclipsed part of the Sun is still very bright. You must use special filters or a home-made pinhole projector to safely watch a partial eclipse of the Sun

An eclipse of the moon occurs when the earth moves into the space between the moon and the sun. The earth blocks the moon from direct sunlight. The moon then will be in the region of the earth's shadow.

What is a Star?

A star is a ball of gas held together by its own gravity. The force of gravity tries to force the star to collapse but this force is countered by the pressure of the hot gas inside the star or by the radiation from within the star. This is called hydrostatic support. Stars are very far away from the earth. That is why they appear as tiny points of light.

How a Star is Formed

A star is formed when great clouds called nebulae collapse because of gravitation. If these clouds are large enough, the temperature and pressure in them starts off a type of nuclear reaction called thermonuclear reaction. In this type of reaction, hydrogen inside the cloud will be changed to helium. The reaction, which takes place in chains, produces a high amount of heat energy. This is the origin of the light of the stars. The very bright stars are called active stars. Some stars have ceased to be active and are not as bright as active stars, because their centres are no longer undergoing nuclear transformations. When the hydrostatic support inside a star can no longer balance the gravitational force, such star disintegrates, producing meteorites.

The study of stars dates back to ancient times or the study of star in groups is usually referred to as constellation.

Four major groups of stars can be seen at various periods of the year in our part of Africa. These are:

Orion: This is a group of about nine stars that almost form a rectangle. Orion may be visible from the months of December, through January to April.

Plough: This is a group of seven bright stars. They may be seen from early evening between the months of April and July.

Scorpius: This is another group of stars seen in groups of two. One with three star each and the other with one other star that is farther away from the others. These stars may be seen between June and October.

Pegasus: This is another group of seven stars, five of which are prominent with the remaining two not being outstanding. Pegasus may be seen between September and December.

It is important to note that the sun is also a star. The energy and heat from the sun is similar to the ones that give the other stars their light at night.