**CHAPTER ONE- SOLAR SYSTEM**

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| Solar system is the gravitationally bound system of the sun and the objects that orbit it either directly or indirectly. Solar system is made up of the sun and everything that orbits around it including planets, moons, asteroids, comets and meteoroids.  **PLANET**  A planet is defined by International Astronomical Union in 2006 as follows   * Is an orbit around the sun * has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium or nearly round shape and has * Has cleared the neighborhood around its orbit. |

**COMPONENTS OF SOLAR SYSTEM**

1. **Inner planets**

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| **Inner planets**   * Inner planets are those planets which are closest to the sun and include the first four planets (Mercury, Venus, Earth and Mars) in order of increasing distance from the Sun. Mercury is the closest, followed by Venus, Earth and then Mars. * The inner planets are made up of rock and metal and are therefore solid. These planets move slowly as they are considered to be heavy. According to the Beacon Learning Center, because the four inner planets are solid, composed of rock and metals, they are also called “rocky” or “terrestrial” planets. * They have an average diameter of about 13000 km as they are small planets * They are made up mostly of heavy metals such as iron and nickel and have either no moons or few moons. * The inner planets are warmer than outer planets simply due to the fact that they are closer to the Sun. |

# MAJOR CHARACTERISTICS OF THE INNER PLANETS

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| The four inner planets -- Mercury, Venus, Earth and Mars -- share several features in common. Astronomers call them the “terrestrial planets” because they have solid, rocky surfaces roughly similar to desert and mountainous areas on the earth. The inner planets are much smaller than Jupiter, Saturn, Uranus and Neptune, and they all possess iron cores.  Inner planets are much smaller than the outer planets, and are rocky with  outer band of gaseous substances produced the outer planets.  Mars claiming two and Earth just one. Mercury and Venus have none. Each of the outer planets, on the other hand, has multiple satellites. |

1. **Outer planets**

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| **Outer planets**   * Outer planets are those which are further away from the Sun and include the next four planets in order of increasing distance from the Sun (Jupiter, Saturn, Uranus and Neptune), with Neptune being the furthest * Hence, the four large outer planets are called Jupiter, Saturn, Uranus and Neptune. * The outer planets are said to be made of gases and they are not really solid. The gases which make them up are Hydrogen and Helium; huge balloons floating in the space are considered as giant [gas](http://www.differencebetween.net/miscellaneous/difference-between-regular-and-premium-gas/) planets by people and they have an average diameter of about 48000 km. * They are mostly made of gases like hydrogen like hydrogen, helium and ammonia rather than rocky surfaces. These four outer planets are called Jovian or Jupiter-like planets because of their enormous size relative to the terrestrial planets * Outer planets are composed of lighter elements such as gases and inner planets are composed of heavy elements such as iron |

**DIFFERENCES BETWEEN YTHE INNER AND OUTER PLANETS**

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| **THE INNER PLANETS** | **THE OUTER PLANETS** |
| Mercury, Venus, Earth and Mars | Jupiter, Saturn, Uranus and Neptune |
| **The diagram below shows the inner and outer planets**  **inner and outer planets**  Figure 1 | |
| In summary,   * Inner planets are those which are closer to the Sun (Mercury, Venus, Earth and Mars) and outer planets are those which are further from the Sun (Jupiter, Saturn, Uranus and Neptune). * Inner planets have an average diameter of about 13000 km, they move slowly as they are heavier-being made up of metals and rock; outer planets have an average diameter of about 48000 km and are made of [hydrogen](http://www.differencebetween.net/science/chemistry-science/difference-between-hydrogen-peroxide-and-rubbing-alcohol/) and helium gases, therefore they move faster due to lesser weight * Inner planets are warmer due to[lesser distance from the Sun](http://www.differencebetween.net/science/physics-science/difference-between-distance-and-displacement/) * Inner planets have fewer moons, small, silicate surface, nickel-iron core, higher density and rotate slowly compared to Outer planets which have greater number of moons, faster rotation, no solid part, lower density and rings (in the case of Jupiter and Saturn) * Outer planets are significantly bigger than the inner planets; Jupiter is measured to be 88846 miles in diameter and Mercury is measured to be 3031 miles in diameter * Outer planets spin faster than inner planets which spin slowly * For the inner planets it takes lesser time to complete an orbit around the Sun whereas outer planets take greater time due to their greater distance from the Sun | |

1. **Dwarf planets**

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| * Dwarf planet is the celestial body that orbits around the sun. * It has enough mass to assume spherical shape but it is not a moon. * A dwarf planet meets two of the three requirements for planet hood. To be considered a planet, an object must orbit the Sun and have enough gravity to assume a nearly round shape and attract the smaller objects and dust sharing its orbit. * Dwarf planets lie outside the orbit of Neptune are called “plutoids”. * Dwarf planets **orbit the Sun**, and unlike smaller objects such as asteroids, they also **have enough mass to form a sphere**; however they **don’t have** **the gravity needed to clear their orbits of other objects and debris**   There are only five official recognized dwarf planets by many scientists in our solar system and these include **Ceres, Pluto, Eris, Haumea, and Makemake**. They are shown by the diagram below  C:\Users\new\Desktop\New folder (2)\Dwarf-Planets.jpg  Figure 2  Dwarf planets that lie outside the orbit of Neptune are also called “plutoids”. |

**DESCRIPTION OF EIGHT PLANETS**

**THE EIGHT PLANETS**

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| **The** [solar](http://www.differencebetween.net/science/difference-between-galaxy-and-solar-system/) [system](http://www.differencebetween.net/category/business/structure-systems/) consists of many planets, one of which is Earth. The total number of planets is eight although there have been disagreements to this statement with some saying there are more than eight (the opponents of the theory that Pluto is not a planet).The planets are divided into two groups; inner planets and outer planets. This classification is relative to the planets’ position with respect to the Sun. The eight planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. These eight planets are shown figure 3 below  C:\Users\new\Desktop\geography download\36958518-a-diagram-of-the-planets-in-our-solar-system-with-the-planets-names.jpg  Figure 3 ****Mercury****  * The smallest planet in our solar system is Mercury, which is also closest to the Sun. It is about 58,900,000 km from the sun. The geological features of Mercury consist of lobed ridges and impact craters. * Being closest to the Sun the Mercury’s temperature sores extremely high during the day time. Mercury can go as high as 450 degree Celsius but surprisingly the nights here are freezing cold. Mercury has a diameter of 4,878 km and Mercury does not have any natural satellite like Earth. It takes 88 days to rotate around the sun. * It does not have moons but it has a tenuous atmosphere or exosphere containing oxygen, sodium, hydrogen, helium and potassium * It was named after the Roman god Mercury.  ****Venus****  * Venus is also said to be the hottest planet of our solar system. It has a toxic atmosphere that always traps heat. Venus is also the brightest planet and it is visible to the naked eye. * Venus has a thick silicate layer around an iron core which is also similar to that of Earth. Astronomers have seen traces of internal geological activity on Venus planet. * Venus has a diameter of 12,104 km and it is just like Mars. Venus also does not have any natural satellite like Earth. * It takes 225 days to rotate around the sun. * It is the next closest planet to the sun and is about 107,200,000km from the sun. * It takes 243 days for it to complete a rotation on its axis, making one day longer than its year.  ****Earth**** Earth is the largest inner planet. It is covered two-third with water. Earth is the only planet in our solar system where life is possible. Earth’s atmosphere which is rich in nitrogen and oxygen makes it fit for the survival of various species of flora and fauna. However human activities are negatively impacting its atmosphere. Earth has a diameter of 12,760 km and Earth has one natural satellite that is the moon. ****Mars**** Mars is the fourth planet from the Sun and it is often referred to as the Red Planet. This planet has a reddish appeal because of the iron oxide present on this planet. Mars planet is a cold planet and it has geological features similar to that of Earth. This is the only reason why it has captured the interest of astronomers like no other planet. This planet has traces of frozen ice caps and it has been found on the planet. Mars has a diameter of 6,787 km and it has two natural satellites. ****Jupiter**** It is the largest planet in our solar system. Jupiter has a strong [magnetic field](https://www.toppr.com/guides/physics/moving-charges-and-magnetism/magnetic-force-and-magnetic-field/). Jupiter largely consists of helium and hydrogen. It has a Great Red Spot and cloud bands. The giant storm is believed to have raged here for hundreds of years. Jupiter has a diameter of 139,822 km and it has as many as 79 natural satellites which are much more than of Earth and Mars. **Saturn** Saturn is the sixth planet from the Sun. It is also known for its ring system and these rings are made of tiny particles of ice and rock. Saturn’s atmosphere is quite like that of Jupiter because it is also largely composed of hydrogen and helium. Saturn has a diameter of 120,500 km and It has 62 natural satellites that are mainly composed of ice. As compare with Jupiter it has less satellite. ****Uranus**** Uranus is the seventh planet from the Sun. It is 2,854,400 km away from the sun. It is the lightest of all the giant and outer planets. Presence of Methane in the atmosphere this Uranus planet has a blue tint. Uranus core is colder than the other giant planets and the planet orbits on its side. Uranus has a diameter of 51,120 km and it has 27 natural satellites. It revolves around the sun on its orbit in 84 years. It takes about 23 hours to complete one rotation on its axis. It rotates from east to west just like venus. ****Neptune**** Neptune is the last planet in our solar system. It is about 4,468,800,000km away from the sun. It is also the coldest of all the planets. Neptune is around the same size as the Uranus. And it is much more massive and dense. Neptune’s atmosphere is composed of helium, hydrogen, methane, and ammonia and it experiences extremely strong winds. It is the only planet in our solar system which is found by mathematical prediction. Neptune has a diameter of 49,530 km and it has 14 natural satellites which are more than of Earth and Mars. It takes 164.5 years to revolve around the sun on its orbit and 22 hours to rotate on its axis. Figure 4 shows Neptune and other planets.  C:\Users\new\Desktop\geography download\36422321-illustration-of-solar-system-showing-planets-around-sun.jpg  Figure 4 |

**NEW DEVELOPMENTS RELATED TO THE SOLAR SYSTEM**

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| 1. **Differences in the number of planets**  * Previously it was known that there were 9 planets revolving around the sun (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto). But in 2006, the International Astronomical Union (IAU) agreed Pluto should no longer be classified as a planet because it did fit the criteria of the description of a planet. * Once the ninth planet from the sun, Pluto is unlike other planets in many respects. * It is smaller than Earth's moon; its orbit is highly elliptical, falling inside Neptune's orbit at some points and far beyond it at others; and Pluto's orbit doesn't fall on the same plane as all the other planets — instead, it orbits 17.1 degrees above or below. T * hen, on Feb. 11, 1999, it crossed Neptune's path and once again became the solar system's most distant planet — until it was redefined as a dwarf planet by International Astronomical Union (IAU) in 2006. * A planet falls under the following criteria   1. It should have an orbit around the sun.   2. The gravity should be strong enough to retain spherical shape   3. It should have a clear neighborhood of its orbit around the sun. This means the gravitational force of the planet needs to be dominant in its orbit at it revolves around the sun  1. **Inclination of the planets**   Planets revolve around the sun on their specific orbits on the same orbital plane known as **the Ecliptic.** A planet has its own orbit on the ecliptic at an inclination of zero degrees. However not all planets orbit around the sun. Some of them have relatively small inclination from the common plane. Pluto and Eris are exempted since they have the inclination to the ecliptic of17 degrees and 44 degrees.   1. **Shifting of the poles**   The current North Pole and South Pole are rapidly shifting. The Pole is switching of the magnetic fields at a rate of 40 miles annually. This shifting can be proved by observing the angle at which the earth is currently tilted. **Angle of declination** is the difference between the true North Pole and magnetic north.  The shifting of the North Pole is caused by climate change which is also responsible for disasters such as Tsunami and Hurricanes. |

**PLUTO**

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| In 2006 the International Astronomical Union agreed that Pluto should no longer be classified as a planet because it did not fit the criteria of the description of the planet.  The following are the criteria for describing a planet   1. It should have an orbit around the sun. 2. The gravity should be strong enough to retain spherical shape 3. It should have a clear neighborhood of its orbit around the sun. This means the gravitational force of the planet needs to be dominant in its orbit at it revolves around the sun. |

**What makes the Earth habitable or supports life?**

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| It is the right distance from the Sun, it is protected from harmful solar radiation by its magnetic field, it is kept warm by an insulating atmosphere, and it has the right chemical ingredients for life, including water and carbon. The processes that shape the Earth and its environment constantly cycle elements through the planet. This cycling sustains life and leads to the formation of the mineral and energy resources that are the foundation of modern technological society |

**THE SHAPE OF THE EARTH**

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| The shape of the earth is geoid or oblate spheroid, that is, it is not perfectly round. It bulges at the equator due to its rotation. The rotation momentum tends to force the earth to bulge at the equator which causes the diameter at the equator to be 43km than the diameter from pole to pole.  In other words, the earth is not a perfect sphere because of the force caused when the earth rotates, the North Pole and South Poles are slightly flat. Earth’s rotation, wobbly motion and other forces are making the planet change shape very slowly but it is still round. Figure 5 shows earth’s rotation.  C:\Users\new\Desktop\New folder (3)\gd-0045.png  Figure 5   * In the direction of its rotation axis, that is, from North Pole to the South Pole, the Earth’s diameter is 12,714km. The diameter is 12,756 km at the Equator. * The Equator divides the Earth in two halves, called hemispheres from hemi, half. The upper one is called the Northern Hemisphere and the lower one is called the Southern Hemisphere. The Earth has a spherical shape and is divided at the Equator into the Northern and Southern Hemispheres. |

**EVIDENCE TO SHOW THAT THE EARTH IS A SPHERE**

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| 1. **Ship’s visibility**   When the ship leaves the harbor, it disappears little by little beginning its lower body followed by its funnel, mast and smoke. When the same ship approaches the harbor. It appears little by little. This happens because the earth is spherical in shape. Figure 6 shows ship’s visibility.  C:\Users\new\Desktop\geography download\downloadyyyyy.jpg  Figure 6   1. **Sunrise and sunset**   The sun rises and sets at different times in different places. As the earth rotates from west to east, the sun rises in the east and sets in the west. This means that places in the east experience the sun earlier than those in the west. If the earth were flat, every place on the earth would experience the sun rise and sunset all at the same time.   1. **The lunar eclipse**   This occurs when the earth is between the sum and the moon. When this happens, a shadow of the earth is cast onto the moon. This shadow is always circular in shape. This is good evidence that the earth is spherical.   1. **The circular horizon or earth’s curved horizon**   Standing outside the room and look far ahead you see that at a certain point, the earth seems to meet the sky. This happens because the earth’s surface appears a bit curved in front of you. This prevents someone from seeing beyond the horizon**.**   1. **Circumnavigation of earth**   The first navigation around the world by Ferdinand Magellan and others from the year 1519 to 1522 proved that the earth is spherical. They started off from Spain and sailed towards the west, eventually they ended up arriving at the same point where they started their journey. This means that the earth is spherical -round.   1. **Surveying with poles on level ground- Wallace’s experiment**   Poles of equal lengths when driven into level ground at equal intervals do not show the same height. The central pole projects above the level of the poles on the sides when observed through a telescope. This happens because the earth is spherical. If the earth were flat, the tops of all the poles would have the same height when observed through the telescope.   1. **Aerial photographs.**   Pictures that are taken from high altitudes by rockets and satellites show clearly the curved edge of the earth. |

**MAIN MOVEMENTS OF THE EARTH**

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| Galileo stated in the 17th century that the earth is a planet in constant motion and performs two types of movement.  The two main movements of the earth are rotation and revolution. These movements are shown in figure 7 below  motions of the earth  Figure 7 Rotation of the Earth Rotation is the movement of the earth on its axis. Days and Nights take place because of rotation. So, the days and nights that you see are actually because of this rotation of the earth around its own axis. The axis of the earth, which is an imaginary [line](https://www.toppr.com/guides/maths/basic-geometrical-ideas/lines/), has axis tilted at an [angle](https://www.toppr.com/guides/maths/lines-and-angles/angles-and-its-types/) of 66.5 ° with its [orbital](https://www.toppr.com/guides/chemistry/structure-of-atom/energies-of-orbitals/) plane. The circle that divides the day from night on the globe is called the circle of illumination. The moon is the satellite of the earth. Revolution of the Earth Revolution is the second type of [motion](https://www.toppr.com/guides/physics/motion/equations-of-motion/) of the earth. It is the [movement](https://www.toppr.com/guides/science/body-movements/movement/) of the earth around the Sun in a fixed path or orbit. Revolution causes the change of seasons.  It takes 365days and 6hours (one year) to revolve around the sun. It is important to note that we consider a year as consisting of 365days only. |

1. **ROTATION OF THE EARTH**

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| Rotation is when the planet spins around once. The Earth rotates once around its axis an imaginary line that joins the North and South poles every day. When a place on the Earth’s surface comes to directly face the sun, it is said to be noon at that location.  The Earth rotates counterclockwise. This is why the sun “rises” in the East and “sets” in the West. Because of Earth’s rotation, the Earth’s surface moves at the Equator at a speed of about 467m per second or slightly over 1675km per hour. If you could look down at the Earth’s North Pole from space you would notice that the direction of rotation is counter clockwise as shown in the figure below. The opposite is true if the Earth is viewed from the South Pole. One rotation takes exactly 24 hours and is called a **Mean Solar Day**. The Earth’s rotation is responsible for the daily cycles of day and night. At any one movement one half of the Earth is in sunlight while the other half is in darkness. The edge dividing the daylight from night is called the **circle of illumination**. The Earth’s rotation also creates the apparent movement of the sun across the horizon. Figure 8 and figure 9 show earth’s rotation.  C:\Users\new\Desktop\ROTATION\rotation_poles.jpg  Figure 8   1. .     Figure 9  The following are the results of the rotation of the earth:   1. It rotates on its imaginary axis. 2. It completes a rotation in 24 hours 3. The earth’s rotation on its axis causes day and night  * Planet Earth rotates in a counter clockwise direction and rotates around in its axis. |

**RESULTS OF ROTATION OF THE EARTH**

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| 1. **It causes day and night**   Rotation of the Earth causes one half of the Earth to face the sun and that side experiences day light.   1. **Deflection of winds and ocean currents to the right in the northern hemisphere and to the left in the southern hemisphere.**   Rotation produces a coriolis force which deflects freely moving substances such as ocean currents and winds to the right , that is , clockwise, in the northern hemisphere and to the left , anticlockwise, in the southern hemisphere. This is according to the Ferrel’s Law of Deflection.  The figure 10 below shows of ocean currents and winds in the Northern Hemisphere and the Southern Hemisphere.  C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\Coriolis-Effect.jpg  Figure 10  **The Trade winds** - high pressure windblown to the west from 30N while **Easterlies** deflected to the East   1. **Daily rising and falling of tides.**   On water bodies such as oceans, the coriolis force or centrifugal force pushes the surface water to create waves or tides which rise and fall around the water. |

1. **REVOLUTION OF THE EARTH**

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| * Revolution is the orbit of the Earth around the sun. In other words, is the [movement](https://www.toppr.com/guides/science/body-movements/movement/) of the earth around the Sun in a fixed path or orbit. * Revolution causes the change of seasons. * It takes 365days and 6hours (one year) to revolve around the sun. This means that this celestial motion takes 365.26 days to complete one cycle. * Further, the Earth’s orbit around the sun is not circular but oval or elliptical as shown in the figure 12 below. * An elliptical orbit causes the Earths distance from the sun to vary over a year. * The Figure 12 also illustrates the positions in the Earth’s revolution where it is closest and farthest from the Sun. On January 3, **Perihelion**, the Earth is closest to the sun (147.3 million km). The Earth is farthest from the Sun on July 4 or Aphelion (152.1 million km). The average distance of the Earth from the Sun over a one year period is about 149.6 million km.   C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\helions.jpg  Figure 11  The Earth’s revolution:   1. Orbits the sun, following the imaginary ecliptic plane. 2. Completes its orbit in a year. The Earth travels around the Sun once over the course of a year, while at the same time rotating on its axis. As its travels around the Sun, the Earth traces an elliptical path. This path is called the Earth’s revolution. As it revolves the Sun, the Earth stays tilted at an angle.     Figure 12  **REVOLUTION OF THE EARTH**  C:\Users\new\Desktop\ROTATION\01m.jpg  Figure 13   * The tilt of Earth’s rotation axis and the revolution around the sun causes the following **results** throughout the year  1. Changes in the length of day and night. 2. The seasons; spring, summer, autumn and winter. These seasons are divided according to the length of the day and are marked by particular days: Equinoxes and Solstices.   C:\Users\new\Desktop\EARTH\equinox (1).jpg   * The earth’s revolution in its orbit around the sun causes change in seasons. * When nights and days are equal is known as **Equinoxes**. During the Equinoxes’ time, the sun shines exactly over the equator. * **March 21** of every year is known as the **vernal or spring equinox** and **September 23** of every year is known as the **autumnal equinox.** On 21st March and 23rd September, direct rays of the sun fall directly on the equator. During this period, the whole earth experiences equal days and equal nights. This is called an equinox * When the difference between the lengths of day and night is maximum is known as Solstice. The solstices are the positions of the Earth's orbit that mark the longest and shortest days of the year. The winter solstice in the Northern Hemisphere is the shortest day, after which daylight hours grow longer. The summer solstice in the Northern Hemisphere falls on the longest day, after which daylight hours become shorter. The solstices can also be named for the month in which they occur. For example, the June solstice is the point in the Earth's orbit where the North Pole faces the sun. In the Northern Hemisphere, the June solstice is the longest day of the year. In the Southern Hemisphere, the June solstice is the shortest day of the year. * During the solstice time, the sun shines over the tropics either **on Tropic of Cancer or Tropic of Capricorn.** * 23.5 degrees north represents **North Tropic of Cancer** and it is known as the longest day of the year.  June 21 is known as the Summer Solstice. The earth goes around the sun in an elliptical [orbit](https://www.toppr.com/guides/chemistry/structure-of-atom/electrons-distributed-orbits-shells-electronic+configuration/). The nights are longer than the days of the winter season. This position of the earth is called the summer solstice. C:\Users\new\Desktop\EARTH\summer_solstice.jpg   * 23.5 degrees South represents Tropic of Capricorn. On December 21, the sun shines over the Tropic of Capricorn and it is known as the longest night of the year. * December 21 is known as **Winter Solstice**. On 21st December, the Tropic of Capricorn gets direct rays of the sun as the South Pole tilts towards it. It is summer in Southern hemisphere and winter in the Northern hemisphere. This is called winter solstice   C:\Users\new\Desktop\EARTH\winter_solstice (1).jpg   1. The continuous movement of the earth can cause eclipses. They occur when the sun, the Earth and the Moon are aligned like   C:\Users\new\Desktop\ROTATION\Earth_Orbit-browse.jpg  C:\Users\new\Desktop\ROTATION\rotaterevolvesunearthmoon.png  The Moon is the Earth’s satellite. As it orbits the Earth, the part of the moon facing us changes according to how it is illuminated, causing the lunar phases which are Full Moon, First Quarter, New Moon and the Last Quarter.   * When light of a celestial body is obscured by another celestial body, the situation is known as Eclipse. * When the earth comes between the Sun and the Moon, it is known as Lunar Eclipse.   C:\Users\new\Desktop\EARTH\lunar_eclipse (1).jpg   * When the Moon come between the Sun and the Earth, it is known as Solar Eclipse   C:\Users\new\Desktop\EARTH\solar_eclipse (1).jpg |

**THE RESULTS/EFFECTS OF THE REVOLUTION OF THE EARTH**

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| Results of the Earth revolution are   1. Changing of the seasons   C:\Users\new\Desktop\geography download\the-seasons-earths-revolution-axis.jpg   1. Not same temperature in different parts of the Earth 2. Change of the length of the day and night during the year 3. Change of the position of the midday sun and night during the year and in the different parts of the Earth. 4. Change of the lunar eclipse |

**CHAPTER TWO: THE HYDROSPHERE**

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| Hydrosphere the part of the earth that is made up of water bodies such as dams, lakes and rivers.  In other words, it refers to the total amount of water on a planet. It includes water that is on the surface of the planet, underground and in the air.  Hydrosphere is the concept of the **water cycle or hydrological cycle**. This cycle consists of a group of reservoirs containing water, the processes by which water is transferred from one **reservoir** to another or transformed from one state to another, and the rates of transfer associated with such processes. These transfer paths penetrate the entire hydrosphere, extending upward to about 15km in Earth’s **atmosphere** and downward to depths on the order of 5km in its **crust.**  Hydrological cycle can be defined as the continuous process of exchange of water from the earth surface to the atmosphere or vice versa by the influence of solar radiation or solar heat. t is a closed system where the water gets transformed either from one place to other or from one form to other under the action of sun heat  The figure below shows the water cycle**.**  C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\393px-Watercyclesummary.jpg   * Above 71% of the surface of the earth is made up of water. This is unique because it is the only part that has stable and consistent amounts of liquid water on its surface. * The water on the earth’s surface is composed of both fresh and saline water. Fresh water has salinity percentage of less than 1%. * Saline (Salty) water makes up about 97% of the total water available on the earth’s surface, while about 2.5% o this total is mainly fresh water. |

**THE PROCESSES OF THE HYDROLOGICAL (WATER CYCLE)**

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| The main features of the hydrological cycle include the sun, vegetation, water masses and clouds.  The figure below shows the hydrological cycle     * The following are the processes that are involved in the hydrological cycle: * **Evaporation**   It is the transformation of water from liquid to gas phases as it moves from the ground or bodies of water into the overlying atmosphere.   * **Transpiration**   It is the release of water vapour from plants and soil into the air. Water vapour is a gas that cannot be seen.   * **Evapo- transpiration**   This is a combined loss of water vapour from vegetation, land and water bodies.   * **Percolation**   This refers to water flows horizontally through the soil and rocks under the influence of gravity.   * **Condensation**   This refers to the transformation of water vapour to liquid water droplets in the air creating clouds and fogs.   * **Deposition**   It is also known as desublimation, is a thermodynamic process, a phase transition in which gas (vapor) transforms into solid (ice).   * **Precipitation**   It is when condensed water vapour that falls to the Earth’s surface. Most precipitation occurs as rain, but also includes snow, hail, fog drip, graupel and sleet.   * **Sublimation**   This is the state change directly from solid water that is snow or ice to water vapour.   * **Infiltration**   This is the soaking of water into the soil.   * **Capillary attraction**.   This is the process in which water is attracted by plants until it is finally absorbed. ****Water balance Equation**** As per the water balance equation, the sum of inflow waters = sum of outflow waters. Out of the three processes precipitation, runoff, and evaporation, inflow is precipitation. Runoff and evaporation comes under outflow, then the water balance equation can be written as,  **Precipitation – runoff = Evaporation**  That gives  **Precipitation (P) = Evaporation (E) + Runoff (R)** |

**DESCRIPTION OF THE HYDROLOGICAL CYCLE**

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| Hydrological cycle can be defined as the continuous process of exchange of water from the earth surface to the atmosphere or vice versa by the influence of solar radiation or solar heat. t is a closed system where the water gets transformed either from one place to other or from one form to other under the action of sun heat  The diagram below shows the hydrological cycle and various processes that occur.   * During hydrological cycle, heat energy from the sun heats up vegetation, surface of the earth and water bodies and transforms liquid water into water vapour through **transpiration** and **evaporation** respectively. * On rising, the air gets cooled and condensed, in which water vapour forms water droplets in the process known as **condensation**. This leads to the formation of clouds in what we call advection. * When the clouds can no longer hold excess water droplets, liquid or solid water falls from the clouds to the earth’s surface in the process known as **precipitation**. * On the earth’s surface, the water runs to water bodies such as rivers, lakes, oceans in the process called run- off. The other amount of water infiltrates into the ground in the process called infiltration. When the amount of water infiltrates into the ground where it percolates and joins water in bodies in the process known as percolation. * A certain amount of water is taken up by the plants. The process then starts all over again, completing the cycle.   C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\hydrocycle.gif |

**IMPORTANCE OF THE HYDROLOGICAL CYCLE**

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| **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\unnamed (1).jpg**  The above hydrological cycle is important in the following ways:   1. For plant growth 2. For sporting activities such as swimming 3. For transportation through the movement of ships. 4. For industrial and domestic use. 5. For the production of hydro-electric power 6. For regulating temperatures by ensuring that moisture at available in the atmosphere. 7. For promoting the tourism industry by providing an attractive scenery. 8. For sustaining life on earth since acts as a habitat for aquatic species such as fish. |
| **FACTORS THAT CAN DISTURB THE HYDROLOGICAL CYCLE** |
| 1. **Urbanization**   This happens when the natural water cycle cannot function properly in urban areas due to buildings, concrete and other surfaces that are preventing the water from reaching the ground, allowing it to soak into the soil.  When humans remove natural vegetation and replace those areas with infrastructure, it speeds up overflow which leads to evaporation and higher river levels.   1. **Artificial reservoirs**  * Artificial reservoirs are man-made reservoirs, which can be formed by building a dam across a valley, diverting river flow into the reservoir. This causes more environmental stress on land and has a big impact on time concentration of watersheds because of the evaporation caused.  1. **Climate change**  * Hydrological cycle is driven by sunlight radiation and the global temperature distribution, which in turn affects the distribution of rainfall. The more humans influence the quality of the available water, the bigger the effect is on global patterns of stream flow, meaning that changes in sea level, ocean salinity and in biophysical properties will result in rapid climate change. * Global warming can increase the rates of transpiration and evaporation in some areas leading to heavy rains.  1. **Deforestation**  * This is the process of clearing all or removing specific trees from forest land. This reduces evapo transpiration from land and ocean surface to the atmosphere, leading to a possible reduction in precipitation.  MiningRemoval of vegetation increases surface runoffCloud seeding  * Cloud seeding is a weather modification, where you change the amount or type of precipitation that falls from clouds through the usage of harmful substances. During this process, the substances that fall from the clouds are dispersed into the air, causing cloud condensation which further affects climate conditions.  1. **Poor agricultural practices**  * The cultivation of crops on steep slopes reduces vegetation thereby reducing the rate of transpiration, leading to little or no rainfall.  1. **Building up of dam reservoirs**  * Increases water storage and reduces river levels. * Increases evaporation which may affect local rainfall patterns  1. **Acid rain**   This rainfall is formed when greenhouse gases from homes and industries react with water molecules in the atmosphere. Acidic rains destroy the leaves of vegetation. This reduces the rate of transpiration, leading to little or even no rainfall. |

**WAYS OF MAINTAINING THE HYDROLOGICAL CYCLE**

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| 1. **Practicing good farming practices**   Avoid cultivation of steep slopes and avoid shifting cultivation to reduce siltation of water bodies. This will help to keep enough water for evaporation and maintain vegetation for transpiration.   1. **Conserving water catchment areas**   It helps to reduce the rate of transpiration, leading to adequate rainfall.   1. **Civic education on environmental protection**   This can help change the mindset of people environmental degradation. This in return helps to promote environmental protection, leading to good transpiration and evaporation rates that yield good rains.   1. **Avoiding the release of greenhouse gases into the atmosphere**   This can reduce the occurrence of global warming that disturbs the hydrological cycle by leading to too much or too little rainfall.   1. **Afforestation and reforestation**   Afforestation helps to reduce concentration of carbon dioxide in the atmosphere which they use for photosynthesis. In return, it reduces the occurrence of global warming that disturbs hydrological cycle by leading to too much or little rainfall. |

**CHAPTER THREE: THE ATMOSPHERE**

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| * Atmosphere can be defined as  1. The part of the part of the earth that is made up of different gases. In 2. A layer of gases surrounding a planet that is held in place by the gravity of that body. 3. The layer of gases that surround the planet and makes conditions on Earth suitable for living things.  * Earth’s atmosphere is made up the following composition of gases:  |  |  | | --- | --- | | Name of the gas | Percentage | | Nitrogen | 78% | | Oxygen | 21% | | Argon | 0.93% | | Carbon dioxide | 0.03 | | Water vapour | 0.04 |  * The Earth’s atmosphere is made up of five layers which include  1. The Troposphere 2. The Stratosphere 3. The Mesosphere 4. The Thermosphere and 5. The Exosphere  * The four layers of the atmosphere are shown in the figure below   C:\Users\new\Desktop\MESO\5-Layers-Of-The-Atmosphere.jpg Troposphere  * The [**troposphere**](https://www.aeronomie.be/en/encyclopedia/troposphere-why-it-important-atmospheric-layer) (between 0 and about 15 kilometers) is the first layer above the Earth’s surface and contains approximately 85 to 90 % of the mass of the Earth’s atmosphere. * It is characterized by decreasing temperature with increasing altitude. The temperature and pressure drops as you go higher up the Troposphere. * The temperatures at the troposphere remain constant. * The troposphere’s thermal profile is largely the result of the heating of the Earth’s surface by incoming solar radiation. Heat is then transferred up through the troposphere by a combination of convective and turbulent transfer. * Weather occurs in the Earth’s troposphere. and also contains air current. * The Troposphere is wider at the equator than at the poles * The top part is bounded by a layer of air called the Tropopause which separates the Troposphere from the Stratosphere.  StratosphereIn the [stratosphere](https://www.aeronomie.be/en/encyclopedia/stratosphere-atmospheric-layer-where-temperature-rises-altitude) (between approximately 15 and 50 km) .The figure shows Stratosphere C:\Users\new\Desktop\MESO\Stratosphere.jpg The temperature rises as a function of increasing height. The temperature increase with the increasing altitude. This warming is the result of the direct absorption of solar radiation by the [ozone layer](https://www.aeronomie.be/en/encyclopedia/ozone-molecules-mainly-found-two-layers-our-atmosphere), thereby preventing a large part of harmful [ultraviolet radiation from the sun](https://www.aeronomie.be/en/encyclopedia/ultraviolet-radiation-uv-sun-definition) to reach the Earth’s surface  * There is temperature inversion or negative lapse rate which prohibits vertical winds so that horizontal winds are almost parallel to the ground which ensures fast and smooth flying of aircrafts. Temperature inversion occurs when the temperature rises as the height above the earth’s surface increases. The diagram below shows temperature inversion   C:\Users\new\Desktop\MESO\Temperature-Inversion.jpg   * It has ozone layer which is crucial for life forms on the Earth. * Absence of clouds which allows for great visibility. * It causes meteorites to burn up before they can hit the surface of the earth. Hence, it is the protective layer. * Stratosphere is separated from mesosphere by the atmospheric boundary referred to as the Stratopause.   **Function of the stratosphere**   1. It contains ozone layer which protects the earth from the harmful ultraviolet rays of the sun. 2. It acts as a barrier or containment layer. It confines the important elements in the air including water vapour to the atmosphere. 3. Jet airlines make good use of some of the attributes of the Stratosphere.   C:\Users\new\Desktop\MESO\airplane-in-stratosphere (1).jpg  They fly at cruising altitudes in the lower stratosphere for 2 reasons   1. All weather is restricted to the stratosphere, allows aircraft to fly above the weather in the stratosphere, avoiding turbulence and potential damage in the process. 2. In the lower stratosphere, the air is also much thinner than in the Troposphere, allowing airliners to fly through air with much less resistance. In the same process it saves significant amount of fuel which also extend the range of the airplane. 3. **The Mesosphere**  * The [**mesosphere**](https://www.aeronomie.be/en/encyclopedia/mesosphere-coldest-layer-earths-atmosphere) is the next layer of the atmosphere (from 50 to 90 km), characterized by temperatures that decrease the further up one goes to an average of -90°C.. * It contains fairly high concentration of iron and metal atoms. * It experiences the strongest winds than other layers. There is the presence of zonal winds, atmospheric tides, gravity waves and planetary waves. * Ozone element can be found in abundance in the mesosphere. Despite the fact that the ozone layer can be found in the stratosphere, overall the mesosphere contains more ozone than the layers below it. * Ionization occurs in this layer as sunlight reduces the molecules to electronically charged particles. * It is separated from the thermosphere by the mesopause which is also coldest part of the Earth with a temperature of around °C. * A lot of [**meteors**](https://www.aeronomie.be/en/encyclopedia/meteor-space-debris-particle-flying-through-atmosphere) burn up in this layer while entering the Earth’s atmosphere. The shooting starts observed in the night sky are meteorites that vaporize as it burns up in the mesosphere.   **Importance of Mesosphere**  It is the protective layer of the earth’s atmosphere. It protect us from two dangers   1. Protects us from meteorites (20 metres in size) of various sizes that burn up in the mesosphere. They are vaporized in the atmosphere before they can reach earth’s surface. 2. Protects us from the sun’s ultraviolet rays. A combination of ozone and molecular oxygen in the mesosphere protects us from solar radiation with varying wavelengths.  Thermosphere  * It extends from 80km to over 400km above the earth’s surface. The figure below shows Thermosphere.   C:\Users\new\Desktop\MESO\thermosphere.jpg   * The air is extremely thin and gravity almost non-existent in the thermosphere. The little air consists of helium, atomic nitrogen and atomic oxygen. * Thereafter the[**thermosphere**](https://www.aeronomie.be/en/encyclopedia/thermosphere-and-exosphere-outermost-shells-earths-atmosphere) takes over where temperatures increase steadily with altitude. It is the layer of the atmosphere which is first exposed to the Sun’s radiation. It absorbs high amounts of solar radiation * The increasing in temperatures takes place mainly because the atomic oxygen present here absorbs the ultraviolet. * The thermosphere also includes the [**ionosphere**](https://www.aeronomie.be/en/encyclopedia/ionosphere-upper-atmospheric-layer-what-it), a region of the atmosphere that is filled with charged gas particles that help in the transmission of radio signals. * Ionisation continues to take place in the lower of the thermosphere **(ionosphere)** producing belts that reflect rapid waves. This is the reason this layer is good for communication. * The highest point of thermosphere, the **thermopause** and the lowest point of the Exosphere, **Exobase** combine to form an atmospheric boundary between the two layers. * It is referred to as the biggest among all layers of the planet, atmosphere.   **Importance of the Thermosphere**   1. Protection against the Sun’s radiation. It supports and protects all life on earth by absorbing the majority of the Sun’s X- rays and extreme ultraviolet radiation. 2. Creation of the Ionosphere which has the ability to make long-distance radio communication possible. The electrically charged ions acts as a giant mirror for radio waves can now travel vast distances by simply bouncing them off the ionosphere. 3. The ideal environment for space utilization and exploration  THE EXOSPHERE  * The upper limit of Earth’s atmosphere is the [**exosphere**](https://www.aeronomie.be/en/encyclopedia/thermosphere-and-exosphere-outermost-shells-earths-atmosphere) where the atmosphere merges into space. * Temperatures are generally very cold and constant. In direct sunlight, it can get very hot and in the shade freezing cold though. * It forms the ideal environment for spacecraft to be placed into orbit around the earth. * It allows satellites and other objects to be placed in a much higher orbit than communication satellites * The figure below shows Exosphere   C:\Users\new\Desktop\MESO\exosphere (1).jpg  The Exosphere is mainly made up of hydrogen and helium. It also contains satellites.  **NB**: Living things played an important role in forming the Earth’s atmosphere because with the use of photosynthesis, plants converted carbon dioxide and water into food- giving off oxygen. |

**IMPORTANCE THE TROPOSPHERE**

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| * It is the most important layer of all of us humans. This is the layer we all live in and also the layer that supports other forms of life as well. * It is also the layer in which almost all forms weather occurs. * It also contains the vast majority water vapour on the planet. * The following are the specific elements that makes up air in the Troposphere  |  |  | | --- | --- | | Name of the gas | Percentage | | Nitrogen | 78% | | Oxygen | 21% | | Argon | 0.93% | | Carbon dioxide | 0.03 | | Water vapour | 0.04 |  * The most important aspects of the atmosphere that make life on earth possible is  1. **Necessity of gasses.** Oxygen allows us to breath and carbon dioxide is essential for plant life. 2. **Weather-** This creates seasons which help to regulate and balance the planet’s temperature, rainfall and air movement. |

**IMPORTANCE OF THE ATMOSPHERE**

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| 1. Provides the air needed for respiration and photosynthesis. 2. Protects living things from the sun’s harmful sun’s ultraviolet rays and other stellar objects, 3. It helps to control the weather patterns and conditions on the earth’s surface. 4. Allows the light to reach the Earth’s surface 5. Radiates heat back to the Earth- keeping the planet warm. 6. It helps to control temperatures on earth. 7. It protects s from the meteorites (rocks from the space) since it helps to burn them up before they hit the earth’s surface. 8. It helps in communication (phones, radios and television) since the sound waves are transmitted and reflected back to the earth**.** |

**IMPACTS OF RAPID POPULATION GROWTH ON ATMOSPHERE**

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| 1. **Air pollution**   The wastes discharged from homes, industries and gases from cars can pollute the air, water and land.   1. **Global warming**   This may be caused by deforestation when people clear forests for settlement or farming. Trees absorb carbon dioxide for photosynthesis so clearing forests promotes the accumulation of greenhouse gases in the atmosphere damage the ozone layer leading to global warming. The impact of greenhouse gases on global warming is called **Greenhouse effect.**  Global warming can also be caused by the harmful greenhouse gases produced by refrigerators, air conditioners or cars. These destroy the ozone layer that protects us from harmful sun rays, leading to increasing temperatures on the earth’s surface. |

**CHAPTER FOUR: WEATHER & CLIMATE**

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| Weather refers to short-term changes in the atmosphere. In other words, weather is the condition of the atmosphere for a short period of time.  Climate is the average weather condition of a particular place observed over a long periods of time. This period can take 25 years or more.  The following are the elements of weather: Temperature, rainfall, air pressure, wind, humidity, cloud cover and sunshine. |

**TEMPERATURE**

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| Temperature refers to how hot or cold something is or it is the degree of hotness or coldness. |

**MEASUREMENT OF TEMPERATURE**

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| Temperature is measured in Degree Celsius of Fahrenheit using an instrument known as Thermometer.  The two types of thermometer are   1. Single Tube Thermometer 2. Maximum and Minimum Thermometer (Six’s Thermometer) |

**THE MAXIMUM & MINIMUM THERMOMETER (SIX’S THERMOMETER)**

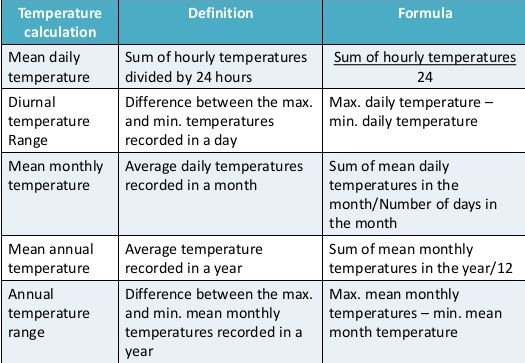
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| * The temperature readings for both the daily maximum and minimum temperatures are observed at the bottom end of the metal indicators. * In the figure above, the glass tube contains mercury in the middle and alcohol or oil of creosote on either end of the tube. * When temperature decreases, the alcohol contracts and pulls the mercury along the tube on the left side. The mercury pushes up the metal indicator/Steel index. The minimum temperature is obtained by reading the scale at the end of the index which is nearer the meniscus. * When temperature rises, the alcohol expands and this pushes the mercury on the right tube upwards which pushes up the index. The maximum temperature s obtained at the end of the index which is in contact with the mercury on the right hand limb. * The readings are taken once a day in the morning.   **NB**- Meniscus is the curved surface in the liquid that is created by tension of the liquid surface of the mercury. |

**HOW TO RESET FOR THE NEXT DAY’S MEASUREMENT**

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| This is done by drawing the indicator back to the meniscus using a magnet. |

**CALCULATION OF TEMPERATURE READINGS**

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| **MEAN OR AVERAGE (DIURNAL) TEMPERATURE**  It is found by adding the maximum and minimum temperature for the day and divided by 2.  Mean or average (diurnal) temperature **=**  **MEAN OR AVERAGE (DIURNAL) TEMPERATURE RANGE**  It is found by subtracting the daily minimum temperature from the daily maximum temperature  Average (diurnal) temperature range = Daily Max. Temp Daily Min. Temp  **ANNUAL TEMPERATURE RANGE**  It is found by subtracting the minimum mean monthly/annual temperature from the maximum temperature.  Annual temperature range = Max Temperature Minimum Temperature  **MEAN/AVERAGE MONTHLY TEMPERATURE**  Mean/average monthly temperature =  **MEAN/AVERAGE ANNUAL TEMPERATURE**  Mean/average annual temperature = |

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**FACTORS THAT AFFECT TEMPERATURE**

**Altitude**

Altitude is the height above the sea level

###### High altitude (at the mountain), low temperature

###### Low altitude (on land surface), high temperature

###### **Reasons**

* At the higher altitudes, the amount of atmosphere decreases and as the result there is less water vapour in the air. The atmosphere absorbs less heat and therefore the temperature at higher altitude drops.

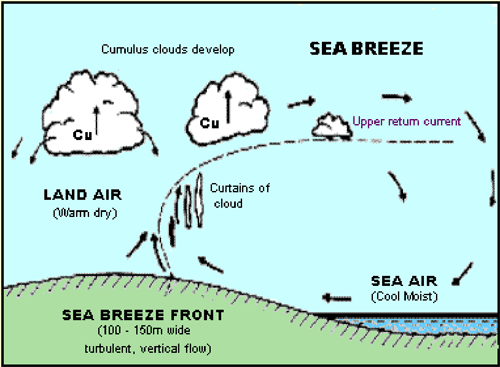
**Latitude**

* Latitude affects the temperature of a region, because the Sun's rays hit the Earth more directly at the equator, at less directly at the North and South poles, making it warmer in places such as Brazil, and colder in places like Scotland.
* **Polar Zone** : Latitude Range 66.5°N to 90°N to 66.5°S to 90°S, Low Sun Angles, Cool To Cold Temperatures.
* **Tropical Zone** : Latitude Range 23.5°N to 23.5°S, Direct or Nearly Direct Sun Angles, Warm Temperatures.
* **Temperate Zone :** Latitude Range 23.5°N to 66.5°N to 23.5°S to 66.5°S, Lower Sun Angles, Warm to Hot Temperatures.
* **From 0° to 23.5°,** there are very little seasonal changes

#### Distance from the sea

###### The difference in heating of land and water affects the temperature of places located near the coast differently from those located inland. It is illustrated by the land breeze and sea breeze.

* The sea breeze occurs when the land is warmer than the sea. When air expands and rises on sea creating low pressure area. It is likely to occur during day time. The air parcel which is now higher up in the atmosphere, travels and cools over sea than creating high pressure area over the sea. The wind blows from the sea high pressure) towards the land where there is low pressure. The sea breeze is shown below.



The land breeze occurs when the sea is warmer than the land. Warm air expands and rises on sea creating low pressure area. It is likely to occur during night time. The air parcel, which is now higher up in the atmosphere, travels and cools over the land, then sinks creating high pressure over the land. The wind blows from the land towards the sea



**LAND BREEZE AND SEA BREEZE**

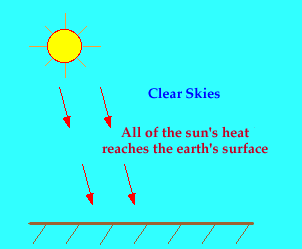
|  |  |
| --- | --- |
| **Land breeze** | **Sea Breeze** |
| **NIGHT** | **DAY** |
| Cool air sink on the land and has high pressure | Warm air expands and rises on the land where there low pressure. |
| Warm air expand and rise on sea where there is low pressure | Cool air sinks along sea where there is high pressure. |
| Wind blows and an area of low pressure to high pressure | Wind blows an area of high pressure to low pressure. |
| Wind blows from the land towards the sea | Wind blows from the sea towards the land. |
| C:\Users\new\Desktop\geography download\see and land breeze.jpg  C:\Users\new\Desktop\geography download\breeze.jpg  **SEA BREEZE**  **C:\Users\new\Desktop\geography download\see and land breeze.jpg**  It occurs when the land is warmer than the sea. When air expands and rises on sea creating low pressure area. It is likely to occur during day time. The air parcel which is now higher up in the atmosphere, travels and cools over sea than creating high pressure area over the sea. The wind blows from the sea high pressure) towards the land where there is low pressure.  **OR**  In the day, when the sun is up, the land heats up very quickly and the air above it warms up a lot more than the air over the water. The warm air over the land is less dense and begins to rise. Low pressure is created.  The air pressure over the water is higher with cold dense air, which moves to occupy the space created over the land. The cool air that comes along is called a sea breeze.  **LAND BREEZE**  **C:\Users\new\Desktop\geography download\breeze.jpg**  It occurs when the sea is warmer than the land. Warm air expands and rises on sea creating low pressure area. It is likely to occur during night time. The air parcel, which is now higher up in the atmosphere, travels and cools over the land, then sinks creating high pressure over the land. The wind blows from the land towards the sea.  **OR**  In the night, the land quickly loses its’ heat while the water retains its’ warmth. This means the air over the water is warmer, less dense and begins to rise. Low pressure is created over the water. Cold and dense air over the land begins to move to the water surface to replace the warmer rising air. The cool breeze from the land is called a land breeze | |

**CLOUD COVER**

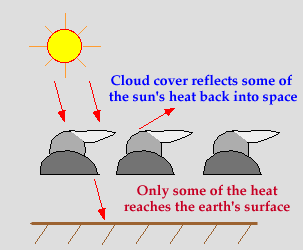
* Place near the equator where humidity is high has greater amount of cloud cover.
* As a result the areas near the equator experiences low temperatures due to the greater amount of cloud cover which reduces the amount of radiation leaving the earth’s surface thereby lowering temperatures.
* Areas in the desert where humidity is low will have lower amount of cloud cover. As a result the areas in the deserts experiences high temperatures due to the lower amount of cloud cover which increases the amount of radiation leaving the earth’s surface thereby increasing temperatures.

## Effects of Cloud Cover

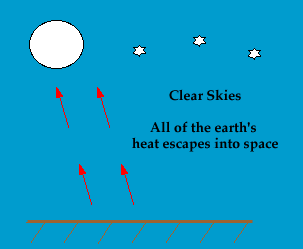
During the day, the earth is heated by the sun. If skies are clear, more heat reaches the earth's surface (as in the diagram below). This leads to warmer temperatures.

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However, if skies are cloudy, some of the sun's rays are reflected off the cloud droplets back into space. Therefore, less of the sun's energy is able to reach the earth's surface, which causes the earth to heat up more slowly. This leads to cooler temperatures



At night cloud cover has the opposite effect. If skies are clear, heat emitted from the earth's surface freely escapes into space, resulting in colder temperatures.

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However, if clouds are present, some of the heat emitted from the earth's surface is trapped by the clouds and reemitted back towards the earth. As a result, temperatures decrease more slowly than if the skies were clear.

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1. **Winds**

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| Hot, dry winds blowing in a particular area brings about hot and dry conditions in areas they blow to. |

1. **Ocean currents and winds**

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| Both ocean currents and winds affect temperature by transporting their heat or coldness into adjacent regions. Ocean currents like Gulf Stream or the North Atlantic Drift warm the coastal districts of Western Europe keeping their sports ice-free. Ports located in the same latitude but washed by cold currents such as the cold Labrador Current off north- east Canada, are frozen for several months.  Cold currents also lower the summer temperature, particular when they are carried landwards by on-shore winds. On the other on-shore Easterlies, convey much tropical warm air to temperate coasts, especially in winter. |

1. **Vegetation**

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| There is a cooling effect on the earth’s surface when there is vegetative cover. But when there is no vegetation cover on the land, more energy from the sun reaches the earth’s surface and more of it will be released back into the atmosphere. |

**TYPES OF RAINFALL**

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| The three types of rainfall include |

**FORMATION OF CONVECTIONAL RAINFALL**

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| **When the earth’s surface is greatly heated,** air naturally rises and expands when it heats up, and it cools when it reaches higher elevations. Cooling makes the water vapour to become saturated and the moisture condenses into clouds known as cumulus clouds. Eventually, the clouds become so laden with moisture that rain starts to fall.  In other words, the sun heats the ground which causes the air to warm and become very hot. Then the air rises upwards and becomes cool. Then it condenses to form cumulus cloud. When this cloud is saturated, it begins to precipitate giving heavy and thundery showers  C:\Users\new\Desktop\New folder (5)\main-qimg-ed1fe0395d5a67dbf34fc3f060c41efa.gif  C:\Users\new\Desktop\New folder (5)\4585d3e77946de793dc76a2d3563cf18.jpg  **Characteristics of conventional rainfall**   1. It is associated with thunder and lighting 2. It falls heavily for a short period of time. 3. It has anvil-shaped clouds known as cumulus clouds 4. It covers a small area. 5. It often comes in the afternoon after great heating of land surfaces. |

**FRONTAL RAINFALL/DEPRESSION RAINFALL**

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| This rainfall occurs when a warm, tropical air mass comes in contact with a cold, polar air mass at the front. After meeting, the warm air mass rises over the cold air mass. Upon rising, the air is cooled and so condenses to form a stratus cloud. Thus when the stratus cloud becomes saturated, it begins to precipitate or which eventually brings about rainfall.  C:\Users\new\Desktop\New folder (7)\Frontal-Rainfall.png  **FRONTAL RAINFALL**  C:\Users\new\Desktop\New folder (7)\199_bitesize_ks3_geography_weather_frontalrainfall_516.pngC:\Users\new\Desktop\New folder (7)\GEEN11002971-1.png  **Characteristics of cyclonic frontal rainfall/cyclonic rainfall**   1. Heavy rainfall that lasts for a short time. 2. It produces cumulonimbus clouds 3. It is lighter rainfall that lasts for a long time 4. It is associated with cyclones (storms) |

**RELIEF RAINFALL**

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| **C:\Users\new\Desktop\New folder (5)\berglee-fig01_013.jpg**  **C:\Users\new\Desktop\New folder (5)\370px-Rain_shadow_effect.jpg**  This type of [rainfall](https://www.toppr.com/guides/geography/climate/climate-of-india/)  frequently occurs near mountains beside the sea. The moisture-laden wind blows in from the sea. Since the [wind](https://www.toppr.com/guides/science/winds-storms-and-cyclones/) meets a high mountain, it is **forced to rise upwards**. At the height, **it is cooled** and then the **cloud is formed**. This saturated cloud with water vapor begins to precipitate, that is rain falls on the side of the mountain facing the sea. This front side of the mountain is called **the windward side**. The cloud mostly precipitates on the windward side of the mountain.  Meanwhile, the cloud meets the other side of the mountain, which is called **the leeward side**. Since the cloud has already lost most of its moisture so it rains very little there. This makes leeward sides of mountain very little rains. There is a much more moist climate on the windward sides of slopes.  **Characteristics of Relief Rainfall**   1. It is widespread 2. It falls for a long time. 3. It occurs in the mountain on the side that faces the direction of wind, the windward side. |

**SIMILARITIES AMONG THE THREE TYPES OF RAINFALL**

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| These include:   1. They all involve warm moist air rising 2. They all involve warm air cooling. 3. They all involve water vapour condenses to form clouds. 4. They all involve further cooling that leads to precipitation. |

**DIFFERENCES AMONG THE THREE YTYPES OF RAINFALL**

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| The three types of rainfall are different in the way how air rises to form clouds and later to precipitate in the following ways   1. In relief rainfall, air is forced to rise over a barrier such as mountains. 2. In frontal rainfall, warm air is rising over cold air. 3. In conventional rainfall, air rises because it is being heated. |

**MEASURING OF RAINFALL**

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| The amount of rainfall is measured using a rain gauge. |

**RAING GAUGE**

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| **Components of rain gauge**   1. **Funnel**   This directs water into the collecting glass bottle or bucket.   1. **Collecting bucket**   It is used to pour water into measuring cylinder where readings are taken.   1. **Measuring cylinder**   It is used for taking reading readings. The depth of the rain in millimetres can be read from the side of the container or measuring cylinder.  Photograph of a rain gauge  The rain gauge is usually anchored in the ground with the top of the gauge around 30cm above the ground surface for the following reasons:   1. Avoid rain splashing into the funnel does not affect the results. 2. Prevent evaporation of water from the funnel due to the reflected heat from the ground.   **NB**: The instrument should be sited well away from tall buildings, high trees and other objects to avoid sheltering it. |

**WIND AND PREVALING WINDS**

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| Wind is defined as any air in motion while prevailing winds are the winds that blow more frequently than type of wind in a particular area.  Wind normally blows from an area of high temperature to an area of low pressure. |

**INSTRUMENTS USED FOR MEASURING WIND DIRECTION**

**WIND VANE**

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| Wind vane, also called a wind sock, measures the direction of the wind at any given point in time. A weighted arrow spins around a fixed shaft and points north, south, east or west, typically marked on separate fixed shafts parallel to the arrow.  Wind direction is reported by the direction it is blowing **from**, according to the compass. Wind blowing from the west is travelling eastwards so is called a westerly wind, not an easterly wind. Wind direction is often observed using a wind vane.  Photograph of a wind vane  C:\Users\new\Desktop\geography download\wind vane.jpgA Man uses anemometer to measure the strength of the wind at sea |

**WIND ROSE AND ITS FUNCTION**

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| * A wind rose is an instrument which graphically displays wind speed and wind direction at a particular location over a period of time. * Wind rose is used for recording wind direction for a particular place**.** * It is an eight-sided chart and each side of the wind rose represents a cardinal point. * Cardinal points show how many times the wind has blown from one direction. * The cardinal point that is longest has the most frequency of the wind. * The number of calm days, that is, when wind did not blow from any direction, is indicated at the centre of the rose. |

**WAYS OF RECORDING WIND DIRECTION USING THE WIND ROSE**

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| 1. When there is wind blowing from a particular direction, the following happen: 2. A line is drawn across the rectangle representing the direction from which the wind blows. 3. A date is indicated in the correct rectangle representing where the wind is blowing from. 4. When there is no wind, the number of calm days is indicated in the centre of the wind rose. |

**WINDSOCK AND ITS FUNCTION**

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| * Windsock is an instrument that is used to show both direction and wind strength. * It is kept in an open space in places such as airports to how strong the wind is blowing, and its direction. * If the wind is very strong, the windsock is stretched out parallel to the ground in the direction the wind is blowing. * When the wind is blowing gently/lightly, the windsock will be close to the shaft/vertical pole, indicating that it is gentle breezes. C:\Users\new\Documents\LECTURE\IMG-20200607-WA0021.jpgC:\Users\new\Desktop\WW1\images (13).jpeg |

**WIND SPEED**

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| * Wind speed can be measured using cup anemometer. The anemometer should be held at arm’s length, above the head so that the cups can rotate without any interference. The strength of the wind is measured in knots. * Anemometers measure the direction and speed of wind in miles per hour. A common type of anemometer has three cups fixed to a mobile shaft. * When the wind blows, the cups are filled with air and this forces them to rotate. There is a metre in the anemometer which automatically reads and records the wind speed in kilometers per hour. * As the wind blows faster, the cups spin around faster. The stronger the wind blows, the faster the cups will rotate and vice versa. The actual speed of the wind shows up on a dial. Another type of anemometer uses a propeller instead of cups to accomplish the same function.   Photograph of an anemometer |

**BEAUFORT SCALE**

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| * A Beaufort scale can also be used to give the wind speed. * Wind speed can be estimated and its strength determined approximately by observing how certain objects are moved by the wind using the Beaufort scale. * A Beaufort scale shows wind description, speed and its effects on the environment. |

**EXPLAIN THE FACTORS THAT AFFECT WIND**

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| 1. **Obstacles**  * Obstructions in the path of the wind reduce wind strength and it cannot be windy. * Wind strength is well felt and its direction can easily be known in an open space.  1. **Air pressure**  * Air moves from an area of high pressure to an area of low pressure. In other words, the wind blows more strongly between areas of very high and low pressure. This means that air pressure affect wind strength and direction.  1. **Rotation of the earth**  * Rotation of the earth creates a coriolis force which deflects winds to the right in the northern hemisphere and to the left in the southern hemisphere. This means that rotation of the earth affects wind direction. |

**AIR PRESSURE/ATMOSPHERIC PRESSURE**

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| * Air pressure is the force of air that is exerted at a place due to its weight. It is measured in millibars (mbs). * Atmospheric pressure is the weight of air pressing down on us. Air is light but because there is so much of it above us, it exerts a pressure on us. Atmospheric pressure is measured by a barometer. The units used are millibars. * The greater the reading, the higher the pressure. Normal pressure is 1000mb with a reading above this being regarded as high pressure and a reading below is regarded as low pressure. * Air exerts the pressure of 986 grams per square centimeter and a mercury column of 760mm or 76cm at the sea level (0metre). * A high-pressure system is called **an anticyclone.** Air falls in an anticyclone so no clouds are formed. * In summer, high pressure usually results in clear skies, gentle breezes and fine weather. In winter high pressure leads to clear skies and colder conditions. * An area of low pressure is called a **depression**. Air rises in a depression so clouds and rainfall are formed. * Depressions therefore bring unsettled weather and rain. Winds are normally stronger. They usually form over the Atlantic Ocean and are carried across Britain by westerly winds * Under most conditions, high and rising pressure indicates sunny weather, while low and falling pressure indicates approaching rain |

**ISOBARS**

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| These are lines drawn on weather maps joining places of equal air pressure.  The diagram below depicts a pair of sample isobars.  At every point along the top isobar, the pressure is 990 mb while at every point along the bottom isobar, the pressure is 1000 mb.  Points above the 1000 mb isobar have a lower pressure and points below that isobar have a higher pressure.  **C:\Users\new\Documents\LECTURE\IMG-20200607-WA0006.jpg** |

**INSTRUMENTS FOR MEASURING AIR PRESSURE**

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| These include   1. Barometer 2. Aneroid barometer/Barograph   **NB**: Barometer was invented by Galileo and Torricelli in the year 1643. |

**MERCURY BAROMETER AND HOW IT WORKS**

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| Air pressure is measured by a **barometer**. The units used are millibars.  The greater the reading, the higher the pressure.  C:\Users\new\Desktop\New folder (4)\nczvh0sURUibhJTjQ5bJ_4881fkl (1).jpg C:\Users\new\Desktop\New folder (4)\ZlPF0JjfQgytPklY7my4_MercuryBarometer.jpg  When air pressure increases, the air pressing on the surface of the mercury forces it to rise up the mercury column. This makes the barometer to register high pressure.  When the air pressure decreases, the mercury column drops since there is low weight on the mercury in the container. This makes the barometer to register low air pressure. The pressure readings are taken on the scale on the glass tube.  C:\Users\new\Desktop\New folder (4)\unnamed (1).gif  **Advantage**   * It is an accurate instrument for measuring air pressure   **Disadvantage**   * The mercury barometer is not good for outdoor measurement |

**AN ANEROID BAROMETER AND HOW IT WORKS**

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| **C:\Users\new\Desktop\New folder (4)\unnamed (1).jpg**   * It consists of a metal box with very little air inside. Any increase in air pressure on the outside of the box makes the lid to move inwards. This makes the chain to be to the right making the pointer to move to the right as well to register high air pressure. * When air pressure decreases; the lid of the box moves outwards. This makes the pointer/indicator to move to the left to register low air pressure. * **Disadvantage** * It is less accurate than a mercury barometer. |

**BAROGRAPHY**

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| * Barograph is another type of an aneroid thermometer. * It has a pen which is attached to the pointer. The pen sticks ink onto a paper that is fixed to a rotating drum. As the drum rotates, readings depending on the air pressure are taken on a continuous basis. |

**FACTORS THAT AFFECT AIR PRESSURE**

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| 1. **Altitude**  * The more concentration of air molecules at the earth’s surface than at higher at altitudes increases its weight per unit area. This increases air pressure. At higher altitudes, the air is thin and as a result it expands to occupy a larger space. This makes it weight per unit volume to be less than on the earth’s surface. This leads to low air pressure.  1. **Temperature**  * When air is heated, it becomes less dense/lighter and rises. This reduces air pressure. But when air is cooled, it becomes heavier and sinks back to the earth’s surface. This increases air pressure.  1. **Rotation of the earth**  * When air is thrown away from the poles as the earth rotates, it is spread and occupies larger latitudes/space. This reduces air pressure. * The air that goes back to the poles from the equator occupies shorter latitudes and gets concentrated on a small space. This increases air pressure.  1. **Humidity**   Water vapour is lighter than air. This means a large amount of water vapour/high humidity in the air reduces air pressure. At the same time, low humidity increases air pressure.  **NB**: Humidity is the actual amount of water vapour in a given volume of air at a particular temperature.   1. **Wind speed**   Strong wings reduces air pressure and vice versa. |

**SUNSHINE**

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| Sunshine refers to the rays that are received on earth directly from the sun. |

## SUNSHINE RECORDER/CAMPBELL STOKES RECORDER

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| It is an instrument that is used to measure the amount of sunshine a place receives/. It records the number of hours and minutes of sunshine and the intensity per day.  Sunshine recorder consists of spherical glass that is partially surrounded by a metal frame. There is sensitive card inside the metal frame which is graduated in hours and minutes.  **HOW DOES SUNSHINE WORK**    The Campbell Stokes Recorder measures sunshine. Sunlight shines into one side of a glass ball and leaves through the opposite side in a concentrated ray. This ray of light burns a mark onto a thick piece of card. The extensiveness of the burn mark indicates how many hours the sun shone during that day. |

**FACTORS THAT AFFECT THE AMOUNT OF SUNSHINE**

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| 1. **Humidity**  * Water vapour absorbs sun’s heat, and in turn this can reduce the amount of sunshine an area can receive.  1. **Latitude**   Areas close to the equator receives a lot of sunshine because the equatorial regions experience sunshine for a greater length of time than the Polar regions.   1. **Amount of dust in the atmosphere**   More presence of dusts in the atmosphere promotes the formation of cloud as water droplets form around them. This reduces sunshine. But fewer dust particles reduces cloud formation and this increases sunshine.   1. **Revolution of the earth**   Revolution of the earth causes seasons such as summer, autumn, winter and spring. Some seasons such as summer receive greater sunshine intensity while some seasons such as winter receives shortest amounts of sunshine.   1. **Aspect**   This refers to the direction a slope faces in relation to the overhead sun. Areas facing the sun receive a lot of sunshine |

**HUMIDITY & OTHER TERMS**

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| * **Humidity** is the amount of water vapour the air can hold at a particular time. * **Absolute Humidity** is the actual amount of water vapour in the atmosphere expressed in grams per cubic metre. * **Relative Humidity** is the measure of the amount of water vapour in a given volume of air compared to the total amount of moisture that the volume of air can hold at a given temperature. For example at 40C , 2 of air can hold at a total of 15 grams of water vapour. |

**INSTRUMENTS USED FOR MEASURING HUMIDITY**

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| * Humidity is measured using **Hygrometer.** * **Hygrometer is made up of two thermometers**  1. **Dry Bulb Thermometer**  * It measures dry air temperatures within the Stevenson Screen  1. **Wet Bulb Thermometer**  * It is called Wet Bulb Thermometer because it is covered by a wet muslin cloth which is wrapped around its base.   C:\Users\new\Documents\LECTURE 2\IMG-20200607-WA0065.jpg |

**HOW HYGROMETER WORKS**

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| * When the air is saturated or 100% full of moisture, there is no evaporation taking place from the muslin cloth. The two thermometers, the Dry Bulb Thermometer and Wet Bulb Thermometer will then show the same readings. * When the air is not saturated, moisture evaporates from the muslin cloth. Mercury contracts when evaporation is taking place. Temperature is therefore lowered in the Wet Bulb by this evaporation. But the temperature in the Dry Bulb Thermometer remains the same. * The difference between the two readings shows the humidity of the air. * The following are the meanings of thermometer reading  1. No difference means that air is saturated. 2. Small difference means that humidity is high 3. Large difference means that humidity is low  * The following are two uses of humidity data/information  1. It shows the amount of rain that can be received in a particular area. 2. It tells the amount of heat that is held in the atmosphere in a particular area. |

**FACTORS THAT AFFECT HUMIDITY**

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| 1. **Temperature**  * High temperatures promote the rate of transpiration and evaporation. This leads to high humidity.  1. **Wind speed**  * High wind speed carries away a lot of water vapour and this leads to low humidity. * Low wind speed makes the air to hold a lot of water vapour thereby increasing the humidity.  1. **Latitude**  * Areas that are close to the equator experience high temperature, thus they high humidity which results from high transpiration and evaporation rates. * Areas in the Polar Regions have low humidity due to their low temperatures that reduce evaporation and transpiration rates.  1. **Cloud cover**  * There will be low rates of transpiration and evaporation when there is a lot of cloud cover. The smaller the cloud cover the higher the humidity. * There will be high rates of transpiration and evaporation in places of small cloud cover. So the larger the cloud cover, the lower the humidity.  1. **Amount of dust in the atmosphere**  * The presence of dust particles in the atmosphere promotes cloud formation as water droplets form around them. Thus, the more the amount of dust in the atmosphere, the large the cloud cover, the lower the humidity.  1. **Distance from the sea**  * Areas closer to water bodies are likely to experience high humidity due to high rates of evaporation than areas far away from water bodies. |

**STEVENSON SCREEN**

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| **Temperature** is measured in Celsius (°C) using a thermometer. The thermometer must be shaded from direct sunlight and should have air circulating around it. The thermometers can be placed in a **Stevenson Screen**.   * The Stevenson Screen (a wooden box) is slatted/louvered sides to allow air to flow into and out of the box easily, a sloping roof and legs to keep the screen off the ground. * It is painted white to reflect the sun. * It is placed at 1.2 metres above the ground in order to prevent the heat from the ground from affecting the reading in the Stevenson’s Screen. This helps the Meteorologists to get more reliable data or readings. Meteorologists are people who study weather.   C:\Users\new\Desktop\geography download\steven.jpg  A boy checks the weather readings of a Stephenson screen  The thermometers can be placed in a **Stevenson Screen** to make sure that the temperature is taken in a shady environment.  **INSTRUMENTS CONTAINED THE STEVENSON’S SCREEN BOX**:  The following are the instruments which are contained in the Stevenson’s Screen Box:   1. Hygrometer 2. Barometer 3. Thermometer   **USES OF STEVENSON’S SCREEN**   1. To regulate the air flow so that accurate weather readings can be collected. 2. To provide shade for the instruments in order to have accurate readings. 3. To protect weather instruments from damage. |

**TEMPERATURE**

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| Temperature is measured in Celsius (°C) using a digital thermometer. The thermometers can be placed in a **Stevenson Screen** to make sure that the temperature is taken in a shady environment.  This is a wooden box with slatted sides, a sloping roof and legs to keep the screen off the ground. It is painted white to reflect the sun.  Photograph of a thermometer |

**ANNUAL DISTRIBUTION OF TEMPERATURE IN MALAWI**

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| * Along lakeshore areas and Shire Valley experience high temperatures of over 24C. * Along the Rift Valley floor it varies between 20C and 30C and in Nsanje it goes beyond 32C. * In higher attitudes, that is mountaind and highlands which include Dedza-Kirk Range,Viphya and Nyika Plateaus, Zomba Plateau and Mulanje Mountains, there are low temperatures ranging between 14C and 18C. |

**ANNUAL RAINFALL DISTRIBUTION OF MALAWI**

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| 1. **Lakeshore**   These areas receive an average annual rainfall of between 1250mm and 1500mm. These areas include Rumphi, Nkhota Kota, Thyolo, Mulanje, Nkhata Bay and parts of Karonga district.   1. **The Shire Valley**   This area receives an average of 650mm of rain per year. It is within the shadow area.   1. **Plains**   These areas receive moderate rainfall between 750mm and 1000mm. These include Chirwa-Phalombe plains.   1. **Plateaus**   These areas receive relief rainfall because they face the rain-bearing winds from the lake. |

**CLIMATE EXPERIENCED IN MALAWI**

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| * Malawi experiences Tropical Continental Climate. It is also called Sudan or Savanna Climate**.** * It receives heavy Convectional Rainfall in summer, and winters are generally dry. * Summers are hot with temperatures around 32C and winters are cooler about 21C with an annual temperature range of 11C. * Hightemperatures occur just before the rainy season. |

**CLIMATIC REGIONS OF MALAWI**

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| 1. **Highland Modified Climate-Cool Areas**  * It is mainly experienced in mountains and plateaues and has a maximum temperature of more than 22C. * It receives Orographic and Convectional Types of rainfall.  1. **Tropical Savanna Climate/Moderate Areas**  * It is mainly experienced in middle-latitude areas which include Lilongwe plains and has a maximum temperature of 28C. * Annual rains are received during the hot and wet seasons.  1. **Humid Savanna Climate/Hot Areas**  * This is experienced in very hot areas such as the rift valley. It has maximum temperature of about 32C. It receicves unreliable rainfall which may get to 800mm per annum. * They have high risks of drought and famine. |

**FACTORS THAT AFFECT CLIMATE OF MALAWI**

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| 1. **Latitude**  * Areas in equalatorial regions have higher temperatures than areas in Polar Regions. * High temperatures in the equalateral regions also help increase the rates of transpiration and evaporation leading to heavy Convectional rainfall in summer, and winters are generally high.  1. **Distance from the lake**  * During the day, the air blowing from the sea to the land-sea breeze lowers summer temperatures in the surrounding land masses. * During the night, the air is blowing from the land to the sea-land breezes lowers the temperatures in the water bodies**.**   C:\Users\new\Desktop\HMC MATIMBA\sea-breeze-circulations-cloud-formations.jpg   1. **Aspect**  * Aspect means the angle of slope on the earth’s surface. Areas on slopes facing the sun experience higher temperatures than those facing away from the sun. These areas that face the sun receive a lot of rainfall due to the high rates of transpiration and transpiration experienced in these areas that result from high temperatures.  1. **Prevailing winds**  * Climate ihn Malawi is influenced by the South East Trade Winds which originate from the Indian Ocean. These lower the temperatures during the day time in summer. These winds bring about persistent low clouds which ring drizzles /little rainfall in the southern region of Malawi because they carry warm,moist air from the Indian warm.  1. **Altitude**  * Areas of high altitudes such as Nyika plateau receive heavy Relief Rainfall as warm moist air from Lake Malawi is forced to rise over these areas. |

**THE INTER-TROPICAL CONVERGENCE ZONE (ITCZ)**

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| * The **Inter Tropical Convergence Zone, or ITCZ**, is a belt of low pressure which circles the Earth generally near the equator where the trade winds of the Northern and Southern Hemispheres come together. * This is an area where air masses meet and is indicated by the apparent movement of the sun. It is also called the **Metrological or Equatorial Trough.** * It is characterized by convective activity which generates often vigorous thunderstorms over large areas. It is most active over continental land masses by day and relatively less active over the oceans |

**FORMATION OF ITCZ IN AFRICA IN JANUARY**

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| * The warm dry stable air masses from the land, north of the low pressure zone and the moist unstable maritime air from the Atlantic and Indian Ocean and Zaire Air masses meet in the Southern Hemishere. Such meeting makes the moist air to rise over the warm stable one, resuling in rainfall. |

**FORMATION OF ITCZ IN AFRICA IN JULY**

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| * The Inter Tropical Convergence Zone or ITCZ shifts to the north. The warm moist air from the Atlantic/western coast, meet the warm dry stable air from the land North of Africa including Sahara and it leads to rainfall.   THE ITCZ    THE TRPICAL MARITIME AIR MASS  C:\Users\new\Desktop\HMC MATIMBA\cT+mT+This+means+that+Africa+is+dominated+by+the+Tropical+Maritime.jpg   * The types of rain that is experienced in the Inter Tropical Convergence Zone or ITCZ include cyclonic rainfall and convectional rainfall. * Rainfall can be predicted by studying the position of the Inter Tropical Convergence Zone or ITCZ in Central Africa. * In Africa, rains are expected to be good if the ITCZ is positioned between Mid-Tanzania and Southern Zimbabwe. * Any disturbing conditions that would increase pressure would lead to poor distribution of rainfall. |

**COMPONENTS OF THE ENVIRONMENT**

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| 1. **Physical/natural environment**   This part contains natural features or resources such as   1. land 2. water 3. air 4. mountains 5. animals 6. vegetations 7. human beings.   The diagram below shows the classification of the natural environment  **C:\Users\new\Desktop\HMC MATIMBA\biosphere-vector-illustration-labeled-all-natural-ecosystems-wildlife-biosphere-vector-illustration-labeled-all-natural-160042996 (1).jpg**   * **Lithosphere-** It is the part of the earth that is made up of rocks or stones. * **Bioshere-** This is the part of the earth in which living things are found * **Hydrosphere-** This is the part of the earth that is made up of water bodies such as lakes, rivers and oceans. * **Atmosphere-** This is the part of the earth that is made up of different gases such as oxygen, carbon dioxide etc.  1. **Human/social/built environment**   It is part of the environment that is made up of things made by human beings such as roads, dams and bridges. |

**RELATIONSHIP BETWEEN THE LIVING AND NON-LIVING THINGS IN THE ENVIRONMENT**

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| * Soil provides nutrrients to plants and provide support to the plants**.** * Animals provide manure for the soil which is used by plants. * Animals provide food for people as they provide proteins * Water is used for domestic purposes in homes * Water provides a habitat for aquaic species such as fish. * Water dissolves soil nutrients used for plant growth. * The land acts as a habitat for people and animals. * Plants release oxygen that supports life on earth while people and animals release carbon dioxide that is used by plants duuring photosynthesis. * Vegetation provide timber for construction of buildings and used as electric poles. * Plants reduces the rate of evaporation by providing shade to the soil. * Vegetation helps in rain formation through transpiration. * Vegetation helps prevent soil erosion by holding soil particles together. |

**IMPORTANCE OF COMPONENTS OF ENVIRONMENT- WATER**

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| * Water is used as a preservative when in a frozen state which is used to keep food fresh for a long time. * Water acts a a solvent for nutrients used in plants. * Water is used for transportatrion by boats. * Water is used for the generation of hydro-electric power. * Water provides a habitat for aquatic species such as frogs. * Water is used for domestic purposes in homes. * Water is used for photosynthesis. |

**IMPORTANCE OF AIR-COMPONENT OF THE ENVIRONMENT**

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| * It is used for respiration thereby supporting life on earth. * It is used for the generation of wind energy. * Wind is used for cooling living organism * Air is used for combustion with the help of oxygen. * It is used as a medium that conducts sound. * It is used for flying aero planes and parachute. * It makes navigation easy when wind blows in the same direction of ships. * It is used for pollination in plants. * It helps to reduce air pollution in an area by removing bad smell. |

**IMPORTANCE OF VEGETATION IN THE ENVIRONMENT**

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| * It is the source of medicine * It is a source of raw materials for making paper. * It provides firewood. * It is used to attract tourists * It protects the soil erosion by providing soil cover. * It provides food to people and animals. * Plants help in rain formation through transpiration. * Plants help to purify the air by taking in carbon dioxide for photosdynthesis. and release oxygen. |

**IMPORTANCE OF LANDFORMS/RELIEF/LAND AS A COMPENENT OF THE ENVIRONMENT**

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| * Mountains contain minerals which is mined and used for many purposes. * Mountains receive relief rainfall that it gives rise to important rivers. * Mountain provide timber for construction. * Mountains, vegetation and streams are used for tourist attraction. |

**HUMAN ACTIVITIES THAT ENDANGER THE ENVIRONMENT**

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| 1. **Deforestation**   This is the careless cutting down of trees without replacing them.  **Effects of deforestation**   1. Climate change. Deforestation reduces the rate of transpiration. This leas to little or no rainfall. It promotes the accumulation of greenhouse gases into the atmosphere which may damage the ozone layer, leading to global warning. 2. It damages the habitats for wild habitats such as birds and lions. 3. It encourages soil erosion, leading to loss of soil fertility. This results in lowyield. 4. It promotes siltation of water of water bodies which may cause floods. 5. Ecological imbalance since the interdependence of living things in the environmental is destroyed. 6. **Setting bushfires**  * Climate change. Deforestation reduces the rate of transpiration. This leads to little or no rainfall. |

**TOPIC 5: THE BIOSPHERE**

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| Biosphere is an entire environment where all living things are found**. It** includes people, vegetation ana animals. |

**COMPONENTS OF THE BIOSPHERE**

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| The figure below shows the components of the biosphere  **C:\Users\new\Desktop\HMC MATIMBA\Biosphere+Biosphere+Model.jpg**  **The components of Biosphere include**   * **Lithosphere-** It is the part of the earth that is made up of rocks or stones. * **Hydrosphere-** This is the part of the earth that is made up of water bodies such as lakes, rivers and oceans. * **Atmosphere-** This is the part of the earth that is made up of different gases such as oxygen, carbon dioxide etc. |

**RELATIONSHIP AMONG THE COMPONENTS OF THE BIOSPHERE**

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| * Human beings plant trees where they have been cut down , thus helping in the continuity of the forests. * Animals provide food to people while people look after the domestic animals and ensure they have insufficient food, water and medication. * Both people and animals use oxygen which is released by plants while plants use the carbon dioxide for photosynthesis which is released by both animals and people. * Vegetation provides food for animals and people. It also provide timber and medicine to people while animals provide manure and helps plant to grow. |

**IMPORTANCE OF THE BIOSPHERE**

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| * Plants provide timber and firewood for various domestic purposes. * Animals provide food in the form of meat, milk and eggs to people. * Plants provide food for animals and people. * The hydrosphere helps to provide water to sustain life on earth. * Vegetation helps to purify the air by giving out oxygen and taking in carbon dioxide during photosynthesis. * Animals provide manure that is used by plants to grow well. * Plants help to bring about rainfall through transpiration. |

**PROBLEMS AFFECTING THE BIOSPHERE**

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| 1. **Deforestation** - Forests are cleared for settlement and farming. 2. **Poor waste disposal**- This comes from industries and homes being discharged into water bodies or on land 3. **Industrialization-** It is the major contributor of air pollution. 4. **Pollution**- It may take the form of air, water and land pollution. 5. **Overstocking and overgrazing**.   Overtocking means keeping too many animals in a small area than the land can support which leads to overgrazing leaving the land bare and prone to soil erosion and siltation of water bodies. |

**WAYS OF MAINTAINING THE BIOSPHERE**

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| * Practicing agroforestry where trees are grown in the same field with crops. This helps bind the soil together and control soil erosion. * Construction of dams to keep water that can help in the hydrological cycle. * Practising proper farming methods such as bush fallowing to provide vegetative cover and control soil erosion. * Controlling rapid population growth to reduce demand on the environmental resources. * Avoid fishing using poisonous herbs, nets with small fish mesh and avoid fishing during closed fishing seasons to allow the fish breed. * Doing fish farming to conserve fish species and increase their numbers. * Civic education to the people on the importance of wild life conservation- protection * Creation of game reserves and national parks to maintain wildlife. * Afforstation to maintain the vegetation |

**TOPIC 6: THE ENVIRONMENT**

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| These are living and non living surroundings. These may include people, vegetation, wildlife. |

**PROBLEMS AFFECTING ENVIRONMENT**

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| 1. **Overfishing**  * This poblem has ben worsened by rapid population growth which has increased the deamand for fish resources. * People catch fish during the breeding seasons and they also catch fish using nets that have small mesh.   **Effects of overfishing**   * It leads to the reduction in the number of fish species. * It leads to extinction of fish resources. * It negatively affects the toursim industry.  1. **Poaching**  * Poaching is the illegal killing of wild animals in protected areas. Animals are killed for their meat, skins, ivory etc.   **Effects of poaching**   * It leads to reduction in the number of animal species. * It leads to extinction of some animals. * Tourism is negatively affected since the game that attract tourists are killed.  1. **Poor wastage disposal**   Wastes from homes and industries are disposed off in water bodies, on the land and some fumes also escape into the atmosphere causing air pollution  **Effects of poor wastage disposal**   * It leads to air pollution which is responsible for global warming and acidic rainfall. * It leads to land pollution when wates are discharged on the land. * It leads to water pollution when wastes are discharged in water bodies.  1. **Poor farming practices**  * Some of the practices may include ultivation in river banks, cultivation on steep slopes, sifting cultivation etc.   **Effects of poor farming practices**   * Destruction of vegetation * Water cycle will be disturbed * They promote soil erosion and loss of soil fertility. * Poor crop yield and famine * Flooding which causes loss of life and property. |

**ENVIRONMENTAL MANAGEMENT**

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| This means the process of enhancing the reelationship between the environment and human beings in order to improve the quality of the two. |

**ENVIRONMENTAL MANAGEMENT PRACTICES IN MALAWI**

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| 1. **Measures taken to manage and conserve vegetation**  * Afforestation and re-afforestation * Following good farming practices * Agro-forestry. This is the growing of arable crops together with trees * Controlling population growth to reduce the demand on forest resources. * Civic education on the importance of conservation * Establishment of forest reserves.  1. **Measures taken to manage and conserve wildlife.**  * Creation of game reserves and national parks. * Civic education on conservation. * Stiff punishment of offenders such as poachers. * Having closed seasons to allow the fish breed. * Practising fish farming. * Controlling population growth to reduce the demand on fish resources.  1. **Measures taken to manage and conserve soil**  * Controlling population growth * Practising agro-forestry * Practising strip cropping * Practising crop rotation * Practising contour ploughing * Afforestation * Re-afforestation |

**TOPIC 7: THE ECOSYSTEM**

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| 1. **Ecosystem**  * It is a community of interdependent organisms and the environment in which they live.  1. **Ecology**  * It is the study of organisms and species in relation to the natural environment.  1. **Biosphere**   It means a variety of living organisms and species found in an environment |

**COMPONENTS OF AN ECOSYSTEM**

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| 1. **Physical (natural) factors**   Under the physical factors include the following   1. **Water availability**  * Water availability enables plants to grow and animals to survive in the ecosystem. * If producers , the vegetation do not survive because of drought , it can lead to the death of primary consumers such as herbivores. * If vegetation does not survive, it can make oxygen concentration to decrease which can negatively affect the respiration of people and animals. * Water also helps plants to manufacture their own food.  1. **Oxygen concentration**  * Low oxygen levels can affect the respiration process in people and animals.  1. **Carbon dioxide concentration**  * Low levels of carbon dioxide in the environment can negatively affect the process of photosynthesis in plants. leading to low crop yields. This can in turn negatively affect the survival of plants and animals.  1. **Sunlight intensity**  * Sunlight is used in the process of photosynthesis in plants. If plants do not survive , other levels in the chain would not survive aswell.  1. **Wind speed**  * This affects the amount of heat and humidity in an area. Low wind speed will lead to high humidity and heat. This can in turn help in the rain formation and plants can survive well. As a result primary consumers will find food and the food chains and food webs will be aintained.  1. **Humidity**   This is the amount of water vapour in the atmosphere. This affects the growth of plants and animals in the food chain. It also helps to bring about good rainfall when humidity is high. Therefore, low humidity results in low rainfall and there would be less vegetation and herbivores.   1. **Soil**   The type and fertility of the soil affects the growth of plants. Infertile soils discourage the growth of plants and the survival of the primary consumers in the food chain and the survival of other organisms as well.   1. **Animal or faunal communities**  * This is a category made up of animals of different kinds that are living together in a part of an ecosytem.  1. **Plant or floral communities**  * These are plants of different species that live together in a part of the ecosytem. * Examples of these plants may include baobab, acacia and palm trees. |

**INTERRELATIONSHIP AMONG COMPONENTS OF THE ENVIRONMENT**

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| 1. Plants use carbon dioxide during photosynthesis released by animals, and animals use oxygen produced by plants. 2. Plants and some bacteria manufacture compounds from carbon dioxide during photosynthesis. Animals obtain them in ready-made-form by feeding on vegetation and decomposers obtain them when they break down the dead bodies or waste of other living things. These processes recycle the carbon over and over again. 3. Plants and animals form complex food chains and food webs. Big fish eat small fish. Vegetation provides food to people and animals. Animals provide food to people and manure to plants, and plants are habitats for various organisms. Vegetation also provides medicine. 4. Plants need nitrogen for the production of proteins ad other compounds. Some plants fix nitrogen in the soil. The nitrogen cycle recycle nitrogen between living organisms and the environment. However, some cause loss of nitrates from the environment. |

**FACTORS THAT CAN DISTURB THE ECOSYSTEM**

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| 1. **Disruption of the food chain**  * This can happen when some species in the ecosystem are killed or become extinct. This leads to loss of food in the form of proteins. * It also reduces the production of carbon dioxide which is used by plants for photosynthesis.  1. **Poor farming**  * Poor farming practices such as shifting cultivation depletes vegetation and promotes soil erosion and siltation of water bodies. * It reduces the amoun t of oxygen in the environment * Depletion of vegetation destroys the habitats for various organisms.  1. **Water pollution**  * Water pollution through the use of herbs in fishing and dumping of industrial and domestic waste into water bodies can lead to the death of aquatic species such as fish. This disturbs the food chains in water bodies. Extinction of fish leads to poor diets and the tourism industry can also be negatively affected.  1. **Poaching**  * Poaching is the illegal killing of animals in national parks and game reserves. This reduces the process of photosynthesis as the removal of animals reduces the concentration of carbon dioxide in the atmosphere. * It also reduces the production of mamure and affects the growth of vegetation. * It can also eliminates some animal species negatively affecting the tourism sector in the process. * People’s diet would also be negatively affected.  1. **Setting bushfires**  * This destroys vegetation and can affect the food web. * It reduces the amount of oxygen in the atmosphere. * It destroys the habitat for different organisms.  1. **Deforestation**  * Careless cutting of trees promotes soil erosion leading to infertile soils and low crop yield. This affects the animals that feed on plants and also disturbs air purification. |

**WAYS OF MAINTAINING ECOSYSTEM**

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| * Afforestation * Establishing conservation areas such as forest reserves, botanical gardens, game reserves and national parks. * Provision of alternative energyy sources such as solar energy to reduce pressure on forest reserves. * Controlling rapid population growth to reduce demand on environmental resources. * Proper farming such as agroforestry and avoid cultivation of steep slopes. * Competitions on environmental protection * Civic education on environmental conservation |

**IMPORTANCE OF ECOSYSTEM**

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| * Water is used for transportation. * Vegetation provide manure to the soil which promotes farming. * Vegetation is used to purify air releasing oxygen and taking in carbn dioxide. * Water is is used to produce hydro-electric power. * Vegetation provides medicine, paper, firewood etc. * Vegetation helps to bring about rainfall through transpiration. * Plant communities provide a habitat for animals. * They are a source of food since we eat meat. * They promote tourism as tourists come to view game. * Source of foreign exchange in form of poles, ivory etc. |

**TOPIC 8: NATURAL RESOURCES**

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| **Definition** | **Examples** |
| These are things provided by nature | * Sun * Vegetation * Soil * Wind * Water |

**TYPES OF NATURAL RESOURCES AND EXAMPLES**

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| **Types** | **Examples** |
| **Renewable resources**  These are resources that can be replaced or replenished themselves after being used up | The renewable resources include   * Water * Air * Fish * Animals |
| **Non- Renewable resources**   * These are resources that cannot be replaced or replenished themselves after being used up * They are finite resources | These include   * Fossil fuels such as petroleium, coal, natural gas * Minerals such as copper, gold, diamond etc |

**DIFFERENCES BETWEEN RENEWABLE AND NON RENEWABLE**

**RESOURCES**

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| **Renewable Resources** | **Non Renewable Resources** |
| This can be replaced after being used | They cannot be replaced after being used |
| They are not affected by human beig activities | They are affected by human being activities |
| They cannot be exhausted | They can be exhausted |
| They have a higher rate of decomposition | They have a lower rate of deecomposition than their rate of consumption |

**WAYS OF RENEWING SOME NATURAL RESOURCES**

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| **WATER** | * **Recycling.** This means treatment of substances already used so that further use is possible. * **Afforestation**. This means planting trees where there were no trees. * **Reforestation.** This means replanting trees where there were no trees. |
| **FISH** | * **Fish farming-** This helps to reduce demand on fish from natural water bodies. |
| **FORESTS** | * Afforestation * Reforestation |
| **ANIMALS** | * Reproduction |
| **AIR** | * Recycling * Afforestation |

**WAYS OF CONTROLLING THE DEPLETION AND EXTINCTION OF RENEWABLE RESOURCES**

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| 1. **Closed fishing season**  * This is the breeding period when no one is allowed to do fishing. The government of Malawi implements this with the help of Village Beach Committees. * Closed season is important because it allows the fish breed properly.  1. **Conservation farming**  * These are good farming practices that help to protect natural vegetation. Examples of conservation farming practices include making ridges across the slopes, making box ridges.  1. **Fish farming**  * This helps to reduce demand on fish from natural water bodies.  1. **Creation of national parks, game reserves etc**  * This will help reduce the killing of wild animals aimlessly. |

**IMPORTANCE OF NATURAL RESOURCES**

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| * Air sustains life of people, animals and plants. * They are a source of income after selling minerals, pole, etc. * They are a source of raw materials. For example, fish are used for making fertilizer. * Forests and water are habitats for wild animals and fish. * They are used for tourist attraction. For example, water in lakes and wild animals attract tourists. * Water is used for sporting activities. |

**WAYS IN WHICH NATURAL RESOURCES ARE MISMINAGED IN MALAWI**

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| 1. **Bushfires**  * People set bushfires to clear the land for settlement and farming. * Bushfires are also set to easily catch the hiding animals.  1. **Deforestation**  * This is the careless cutting down of trees as people clear forests for farming and settlement.  1. **Poor farming activities**  * These may include overgrazing, cultivation in river banks, and making ridges along the slopes. These destroy vegetation, leaving the land bare and prone to soil erosion.  1. **Overfishing**  * This is the catching of fish from water bodies at a faster rate than the rate at which they can reproduce. This is done by using fishing nets that have small mesh which catch even immature fish. Sometimes poisonous herbs such as **katupe** are used to catch fish.  1. **Poor waste disposal**  * These wastes come from industries and homes. They include glass, plastics, metals etc. They are discharged in water bodies and bare land, contributing to water, land and air pollution.  1. **Poaching**   This is the illegal killing of wild animals. |

**EFFECTS OF MISMANAGING NATURAL RESOURCES**

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| 1. **Bushfires**  * It leads to loss of soil fertility, leading to poor crop yield. * It destroys habitats for wildlife * It leads to ecological imbalance in the environment  1. **Deforestation**  * It results into soil erosion and siltation of water bodies and flooding since deforestation discourages infiltration. * Clearing of forests can disturb normal rainfall patterns since deforestation can reduce the rate of transpiration.  1. **Poor farming practices**  * These can result into soil erosion and siltation of water bodies and flooding. * Clearing of forests as it happens in shifting cultivation can disturb normal rainfall patterns since deforestation can reduce the rate of transpiration.  1. **Overfishing**  * This reduces the population of fish in water bodies, leading to poor health of human beings since fish are a reliable source of proteins * Overfishing can also lead to extinction of fish which can negatively affect the tourism industry.  1. **Poor waste disposal**  * Discharging untreated wastes in water bodies can lead to the death of aquatic species such as fish. * Burning of waste produces a lot of poisonous gases that can be poisonous and lead to global warming. * Wastes disposed of on bare land can make the land barren and destroy plants.  1. **Poaching**   This reduces the population of wildlife leading to their extinction. This in the end negatively affects the tourism industry. |

**WAYS OF MANAGING NATURAL RESOURCES**

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| 1. **Competition**  * The government and non-governmental organizations can organize competitions aimed at protecting natural resources in the environment from grass root levels. * Prizes can be given to people in these competitions to encourage people that take part in them.  1. **Demonstration projects**  * These are run by individual groups of people with the help of cooperatives and self-help schemes. These teach people various ways of caring for the natural resources such as wildlife and forest reserves.  1. **Awareness campaign**  * People need to be civic educated on the negative effects of mismanaging natural resources. * Civic education to people on the importance of caring for natural resources can also help to change people’s mindset. |

**TOPIC 9: NATURAL DISASTERS IN MALAWI**

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| * **Natural disasters** are effects felt by animals, people and property when a disaster takes place. * **Disasters** can be defined as serious disruptions of the functioning of a community involving widespread human, material, economic losses and effects which exceed the ability of the affected community to cope using its own resources. * **Natural hazards** are natural threats that exist in nature. Hard means the potentially dangerous event, substance, human activity that may cause loss of life, injury other health effects |

**THE TYPES OF NATURAL DISASTERS**

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| 1. **Droughts**   A drought is an extended time period when there is lack of rainfall in an area. They lead to poor crop yield.   1. **Fire disasters**   These can be bushfires, wildfires or forest fires. They can be caused by smokers that may drop a cigarette which can start fire**.**   1. **Earthquakes**   An earthquake is a sudden movement of the earth.   1. **Floods**   A flood is an overflow of a very large amount of water on the earth’s surface. Floods occur when there is excess rainfall which may lead to water bodies be filled with water and overflow to dry land.   1. **Hurricanes**   These are violent and destructive blowing winds.   1. **Volcanic eruptions**   These are formed when magma from beneath the earth’s surface is ejected out. |

**NATURAL DISASTERS COMMON IN MALAWI**

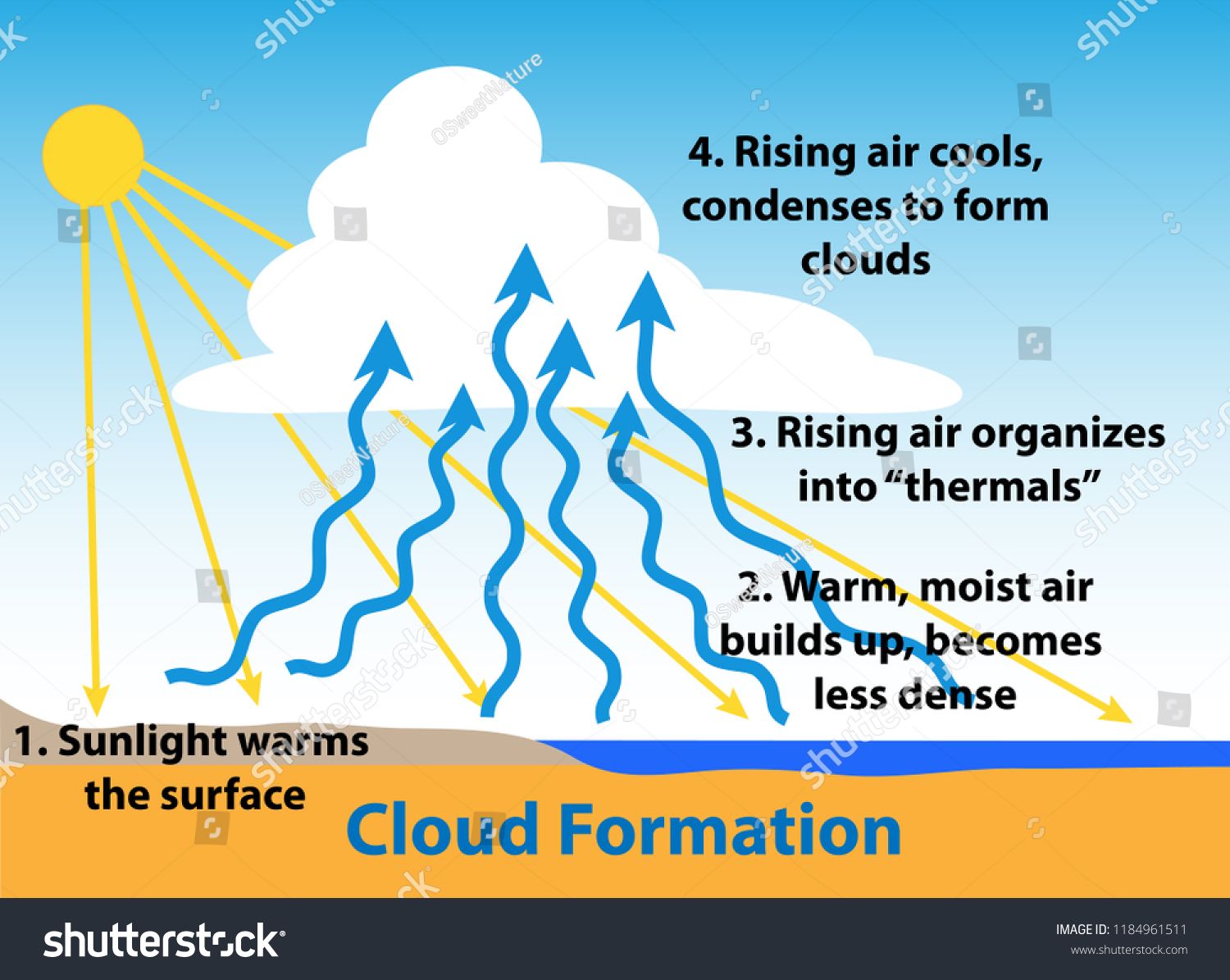
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| 1. **Flash floods-** Flash floods are common in the following areas in Malawi: Mouth of Domasi River, Shorelines of Lake Chiuta in Zomba District and Mouth of Phalombe River, around Ndindi and Elephant in Nsanje, on the lowlands around the lower arm of Lake Malawi in Mangochi, near the mouths of Linthipe and Bwanje rivers, Songwe Delta in Karonga, Dwangwa and Bua deltas in Nkhota Kota. 2. **Tremors-** These are slight vibrations of the crust caused by movements inside the crust. 3. **Droughts**- This is a prolonged period without rainfall. 4. **Cyclones**- These are strong storms which mainly originate from Mozambique and mainly affect the Southern region of Malawi. 5. **Landslides**- This is where the surface layers of rocks and soil crumble and slide down slope when soaked by rain water. They are common in hilly areas that receive heavy rains. They are caused by earthquakes. |

**EFFECTS OF NATURAL DISASTERS**

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| * High demand of relief items. * Loss of life and property * Destruction of environment * Interruption of social life and activities. * Spread of water borne diseases such as cholera and malaria. * Loss of livelihoods due to floods sweeping away people’s crops in fields and droughts lead to poor crop yields. * Pollution caused by volcanoes. * Destruction of buildings and infrastructure caused by earthquakes, volcanoes, hurricanes and floods may damage the roads, buildings and other infrastructure. * Emotional turmoil. This is the loss of life and property to natural disasters which affect -people psychologically as many survivors of natural disasters. People have high risks of suffering from trauma. |

**DISASTER RISK MANAGEMENT CYCLE**

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| The four stages in the disaster risk management in the diagram include   1. **Recovery**   It starts with recovery after a disaster has taken place.   1. **Assessment**   It is done to investigate the extent of damage the disaster has caused.   1. **Prevention and mitigation**   These include all activities that provide complete avoidance of adverse impacts of hazards and related disasters. It includes all the precautionary measures that can be taken against natural disasters.  This is done to ensure that every possible precaution is put in place in the event of other future occurrences.   1. **Preparedness of natural disasters**   These are all activities and measures taken in advance to ensure effective response to minimize the effects of hazards**.** This done to ensure that in case of future disaster, the response will be effective and timely to minimize the effects anticipated.  Examples of preparedness of natural disasters measures include |

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