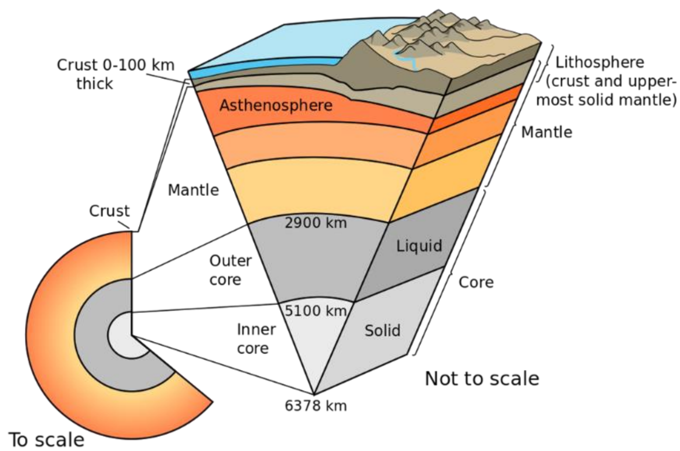
MODULE 1

Syllabus Systems of earth Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

LAYERS OF EARTH



The inner core

This solid metal ball has a radius of 1,220 kilometers (758 miles), or about three-quarters that of the moon. It’s located some 6,400 to 5,180 kilometers (4,000 to 3,220 miles) beneath Earth’s surface. Extremely dense, it’s made mostly of iron and nickel. The inner core spins a bit faster than the rest of the planet. It’s also intensely hot: Temperatures sizzle at 5,400° Celsius (9,800° Fahrenheit). That’s almost as hot as the surface of the sun. Pressures here are immense: well over 3 million times greater than on Earth’s surface. Some research suggests there may also be an inner, inner core. It would likely consist almost entirely of iron.

The outer core

This part of the core is also made from iron and nickel, just in liquid form. It sits some 5,180 to 2,880 kilometers (3,220 to 1,790 miles) below the surface. Heated largely by the radioactive decay of the elements uranium and thorium, this liquid churns in huge, turbulent currents. That motion generates electrical currents. They, in turn, generate Earth’s magnetic field. For reasons somehow related to the outer core, Earth's magnetic field reverses about every 200,000 to 300,000 years. Scientists are still working to understand how that happens.

At close to 3,000 kilometers (1,865 miles) thick, this is Earth's thickest layer. It starts a mere 30 kilometers (18.6 miles) beneath the surface. Made mostly of iron, magnesium and silicon, it is dense, hot and semi-solid (think caramel candy). Like the layer below it, this one also circulates. It just does so far more slowly.

Near its upper edges, somewhere between about 100 and 200 kilometers (62 to 124 miles) underground, the mantle's temperature reaches the melting point of rock. Indeed, it forms a layer of partially melted rock known as the asthenosphere. Geologists believe this weak, hot, slippery part of the mantle is what Earth's tectonic plates ride upon and slide across.

Diamonds are tiny pieces of the mantle we can actually touch. Most form at depths above 200 kilometers (124 miles). But rare "super-deep" diamonds may have formed as far down as 700 kilometers (435 miles) below the surface. These crystals are then brought to the surface in volcanic rock known as kimberlite.

The mantle's outermost zone is relatively cool and rigid. It behaves more like the crust above it. Together, this uppermost part of the mantle layer and the crust are known as the lithosphere.

The crust

Earth's crust is like the shell of a hard-boiled egg. It is extremely thin, cold and brittle compared to what lies below it. The crust is made of relatively light elements, especially silica, aluminum and oxygen. It's also highly variable in its thickness. Under the oceans (and Hawaiian Islands), it may be as little as 5 kilometers (3.1 miles) thick. Beneath the continents, the crust may be 30 to 70 kilometers (18.6 to 43.5 miles) thick.

Along with the upper zone of the mantle, the crust is broken into big pieces, like a gigantic jigsaw puzzle. These are known as tectonic plates. These move slowly — at just 3 to 5 centimeters (1.2 to 2 inches) per year. What drives the motion of tectonic plates is still not fully understood. It may be related to heat-driven convection currents in the mantle below. Some scientists think it's caused by the tug from slabs of crust of different densities, something called "slab pull." In time, these plates will converge, pull apart or slide past each other. Those actions cause most earthquakes and volcanoes. It's a slow ride, but it makes for exciting times here on Earth's surface.

Lithosphere contains rocks, soils and minerals

ROCKS

We all know a rock when we see one. But what makes something a rock? By definition, a rock is a mass of mineral matter.
A **mineral** is a naturally occurring crystalline substance. There are thousands of different types of minerals. Some minerals you may know include salt, coal, copper, quartz, and talc.

Think of rocks as a meal, and the minerals as the ingredients that make up the meal. There are thousands of different ingredients, and different combinations of those ingredients make different meals. In the same way, each rock has its own "ingredient list" of minerals.

All the thousands of different rocks fall into one of three categories: **igneous**, **sedimentary**, and **metamorphic**.

Igneous Rocks

We know that the temperatures inside the Earth are very hot. It is so hot that rocks actually turn into a liquid, called magma. This magma can cool beneath the Earth's crust to form igneous rock.

Magma sometimes erupts from the Earth's surface from a volcano. When magma reaches the surface of the Earth, we call it lava. When lava cools, it forms igneous rock.

Sedimentary Rocks

Over time, even something as hard as rock will begin to wear away. When rock wears down, it breaks into much smaller pieces, called **sediment**.

The small pieces of sediment collect together in layers called sediment beds. As the beds get larger, the pressure squeezes the sediment together to form new rock.

Sedimentary rock is new rock formed from the sediment of older rocks.

Metamorphic Rock

A caterpillar changing into a butterfly is an example of metamorphosis. Metamorphosis means to change from one thing into another. Metamorphic rock is rock that has changed from one type of rock to another by pressure or heat. For example, after thousands of years of pressure and heat, limestone is changed into marble.

Metamorphic rocks can be formed from igneous, sedimentary, or even other metamorphic rocks.

SOILS

When people think of soil, they often think of dirt. That's easy to understand, because soil can certainly make you dirty! Soil is very important to life on Earth. It is where plants and grasses grow. It is home to many small animals.

Just as the Earth has layers, the soil has its own layers. These layers are called horizons.

SOIL HORIZONS

Topsoil

Very high in organic matter. Plants grow here. Animals live in and above the topsoil. Can be as much as 12 inches (30 cm) deep.

Subsoil

Lower in organic matter than topsoil. Plant roots often reach down to this level for water. Many nutrients at this level help plants grow. Can range from 6 inches (15 cm) to 3 feet (1 m) below ground.

Weathered Parent Material

Made of rock particles that have been worn down and minerals. Very little life or organic material. Can go many feet deep into the ground.

Bedrock

Solid rock. This layer begins where the weathered parent material ends.

Soil Composition

Soil is made of four different types of material: **organic matter**, **inorganic matter**, air, and water.

Organic matter is the remains and waste of plants and animals. Inorganic matter is non-living matter, such as sand, silt, and clay.

The color of soil is affected by its composition, so geologists can tell a lot about soil from its color.

Think of how sand feels as it squeezes between your toes on the beach. Now think of how clay feels as you mold it. Soil texture is the amount of different sized inorganic particles in the soil. The texture affects how the soil feels when you touch it.

PARTICLE TYPES AND SOIL TEXTURES

Sand

The largest sized particle. You can see grains of sand with the naked eye. Sand feels gritty and rough to the touch.

Silt

Smaller sized particles that can only be seen with a microscope. Silt is silky and smooth when wet, and feels almost like flour.

Clay

Particles are much smaller than silt. Clay is sticky when wet and can be easily molded.

Why are some areas of the Earth covered in lush grasslands, while others are barren deserts? Some soils are much more fertile than others. Soil fertility is the soils ability to support plant life.

The type of soil in an area has a great effect on how fertile the soil is. Larger soil particles, like sand, cannot hold water or nutrients very well. That is why the sand in deserts can support very few plants.

In soil that is made up of silt or clay, water and nutrients stay in the smaller particles. Such soil is much more fertile. Many different types of plants can grow in fertile soil.

LAYERS OF ATMOSPHERE

The atmosphere is an integral part of the earth. It surrounds the earth from all sides. Generally it extends up to about 1600 kilometers from the earth’s surface. 97 percent of the total amount of weight of the atmosphere is limited up to the height of about 30 kilometers. The atmosphere can be divided into five layers according to the diversity of temperature and density.

(a) Troposphere

(b) Stratosphere

(c) Mesosphere

(d) Ionosphere

(e) Exosphere

(a) <u>TROPOSPHERE:-</u>

This is the lowest layer of the atmosphere. The height of this layer is about 18 kms on the equator and 8 kms on the poles. The main reason of higher height at the equator is due to presence of hot convection currents that push the gases upward. This is the most important layer of the atmosphere because all kinds of weather changes take place only in this layer. Due to these changes development of living world take place on the earth. The air never remains static in this layer. Therefore this layer is called changing sphere or troposphere. The environmental temperature decreases with increasing height of atmosphere. It decreases at the rate of 10 ^{o}C at the height of 165 meter. This is called Normal lapse rate. The upper limit of the troposphere is called tropopause. This is a transitional zone. In this zone characteristics of both the troposphere and ionosphere are found.

(b) <u>STRATOSPHERE</u>

This layer is above the troposphere. This layer is spread up to the height of 50 kms from the Earth's surface. Its average extent 40 kms. The temperature remains almost the same in the lower part of this layer up to the height of 20 kms. After this the temperature increases slowly with the increase in the height. The temperature increases due to the presence of ozone gas in the upper part of this layer. Weather related incidents do not take place in this layer. The air blows horizontally here. Therefore this layer is considered ideal for flying of aircrafts.

(c) <u>MESOSPHERE</u>

It is the third layer of the atmosphere spreading over stratosphere. It spreads up to the height of 80 kms from the surface of the earth. Its extent is 30 kms. Temperature goes on decreasing and drops up to – 1000 ^{o}C. 'Meteors' or falling stars occur in this layer.

(d) <u>IONOSPHERE</u>

This is the fourth layer of the atmosphere. It is located above the mesosphere. This layer spreads up to the height of 400 kms from the surface of the earth. The width of this layer is about 300 kms. The temperature starts increasing again with increasing height in this layer. Electrically charged currents flows in the air in this sphere. Radio waves are reflected back on the earth from this sphere and due to this radio broadcasting has become possible.

(e) <u>EXOSPHERE</u>

This is the last layer of the atmosphere located above ionosphere and extends to beyond 400 km above the earth. Gases are very sparse in this sphere due to the lack of gravitational force. Therefore, the density of air is very less here.

OZONE LAYER

"The ozone layer is a region in the earth's stratosphere that contains high concentrations of ozone and protects the earth from the harmful ultraviolet radiations of the sun."

What is Ozone Layer?

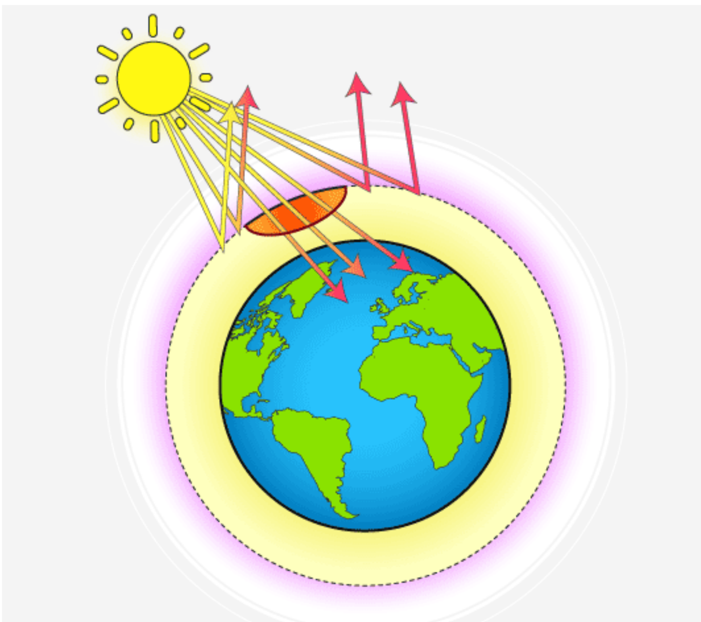
The ozone layer is found in the lower portion of the earth's atmosphere. It has the potential to absorb around 97-99% of the harmful ultraviolet radiations coming from the sun that can damage life on earth. If the ozone layer was absent, millions of people would develop skin diseases and may have weakened immune systems.

However, scientists have discovered a hole in the ozone layer over the Antarctica. This has focused their concern on various environmental issues and steps to control them. The main reasons for the ozone hole are chlorofluorocarbons, carbon tetrachloride, methyl bromide and hydrochlorofluorocarbons.

Let us have a detailed look at the various causes and effects of ozone layer depletion.

Ozone Layer Depletion

"Ozone layer depletion is the gradual thinning of the earth's ozone layer in the upper atmosphere caused due to the release of chemical compounds containing gaseous bromine or chlorine from industries or other human activities."



What is Ozone Layer Depletion?

Ozone layer depletion is the thinning of the ozone layer present in the upper atmosphere. This happens when the chlorine and bromine atoms in the atmosphere come in contact with ozone and destroy the ozone molecules. One chlorine can destroy 100,000 molecules of ozone. It is destroyed more quickly than it is created.

Some compounds release chlorine and bromine on exposure to high ultraviolet light, which then contributes to the ozone layer depletion. Such compounds are known as Ozone Depleting Substances (ODS).

The ozone-depleting substances that contain chlorine include chlorofluorocarbon, carbon tetrachloride, hydrochlorofluorocarbons, and methyl chloroform. Whereas, the ozone-depleting substances that contain bromine are halons, methyl bromide, and hydro bromofluorocarbons.

Chlorofluorocarbons are the most abundant ozone-depleting substance. It is only when the chlorine atom reacts with some other molecule, it does not react with ozone.

Montreal Protocol was proposed in 1987 to stop the use, production and import of ozone-depleting substances and minimize their concentration in the atmosphere to protect the ozone layer of the earth.

CAUSES OF OZONE LAYER DEPLETION

The ozone layer depletion is a major concern and is associated with a number of factors. The main causes responsible for the depletion of the ozone layer are listed below:

- **Chlorofluorocarbons**

Chlorofluorocarbons or CFCs are the main cause of ozone layer depletion. These are released by solvents, spray aerosols, refrigerators, air-conditioners, etc.

The molecules of chlorofluorocarbons in the stratosphere are broken down by the ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.

- **Unregulated Rocket Launches**

Researchers say that the unregulated launching of rockets result in much more depletion of ozone layer than the CFCs do. If not controlled, this might result in a huge loss of the ozone layer by the year 2050.

- **Nitrogenous Compounds**

The nitrogenous compounds such as NO_2, NO, N_2O are highly responsible for the depletion of the ozone layer.

- **Natural Causes**

The ozone layer has been found to be depleted by certain natural processes such as Sun-spots and stratospheric winds. But it does not cause more than 1-2% of the ozone layer depletion.

The volcanic eruptions are also responsible for the depletion of the ozone layer.

Ozone Depleting Substances (ODS)

"Ozone depleting substances are the substances such as chlorofluorocarbons, halons, carbon tetrachloride, hydrofluorocarbons, etc. that are responsible for the depletion of ozone layer."

Ozone depleting substances	Sources
Chlorofluorocarbons (CFCs)	Refrigerators, air-conditioners, solvents, dry-cleaning agents, etc.
Halons	Fire-extinguishers
Carbon tetrachloride	Fire extinguishers, solvents
Methyl chloroform	Adhesives, aerosols
Hydrofluorocarbons	fire extinguishers, air-conditioners, solvents

EFFECTS OF OZONE LAYER DEPLETION

The depletion of the ozone layer has harmful effects on the environment. Let us see the major effects of ozone layer depletion on man and environment.

- **Effects on Human Health**

The humans will be directly exposed to the harmful ultraviolet radiations of the sun due to the depletion of the ozone layer. This might result in serious health issues among humans, such as skin diseases, cancer, sunburns, cataract, quick ageing and weak immune system.

- **Effects on Animals**

Direct exposure to ultraviolet radiations leads to skin and eye cancer in animals.

- **Effects on the Environment**

Strong ultraviolet rays may lead to minimal growth, flowering and photosynthesis in plants. The forests also have to bear the harmful effects of the ultraviolet rays.

- **Effects on Marine Life**

Planktons are greatly affected by the exposure to harmful ultraviolet rays. These are higher in the aquatic food chain. If the planktons are destroyed, the organisms present in the food chain are also affected.

SOLUTIONS TO OZONE LAYER DEPLETION

The depletion of the ozone layer is a serious issue and various programs have been launched by the government of various countries to prevent it. However, steps should be taken at the individual level as well to prevent the depletion of the ozone layer.

Following are some points that would help in preventing this problem at a global level:

- **Avoid Using ODS**

Reduce the use of ozone depleting substances. E.g. avoid the use of CFCs in refrigerators and air conditioners, replacing the halon based fire extinguishers, etc.

- **Minimize the Use of Vehicles**

The vehicles emit a large amount of greenhouse gases that lead to global warming as well as ozone depletion. Therefore, the use of vehicles should be minimized as much as possible.

Use Eco-friendly Cleaning Products

Most of the cleaning products have chlorine and bromine releasing chemicals that find a way into the atmosphere and affect the ozone layer. These should be substituted with natural products to protect the environment.

- **Use of Nitrous Oxide should be prohibited**

The government should take actions and prohibit the use of harmful nitrous oxide that is adversely affecting the ozone layer. People should be made aware of the harmful effects of nitrous oxide and the products emitting the gas so that its use is minimized at the individual level as well.

GREEN HOUSE EFFECT

"Greenhouse effect is the process by which radiations from the sun are absorbed by the greenhouse gases and not reflected back into space. This insulates the surface of the earth and prevents it from freezing."

What is the Greenhouse Effect?

A greenhouse is a house made of glass that can be used to grow plants. The sun's radiations warm the plants and the air inside the greenhouse. The heat trapped inside can't escape out and warms the greenhouse which is essential for the growth of the plants.

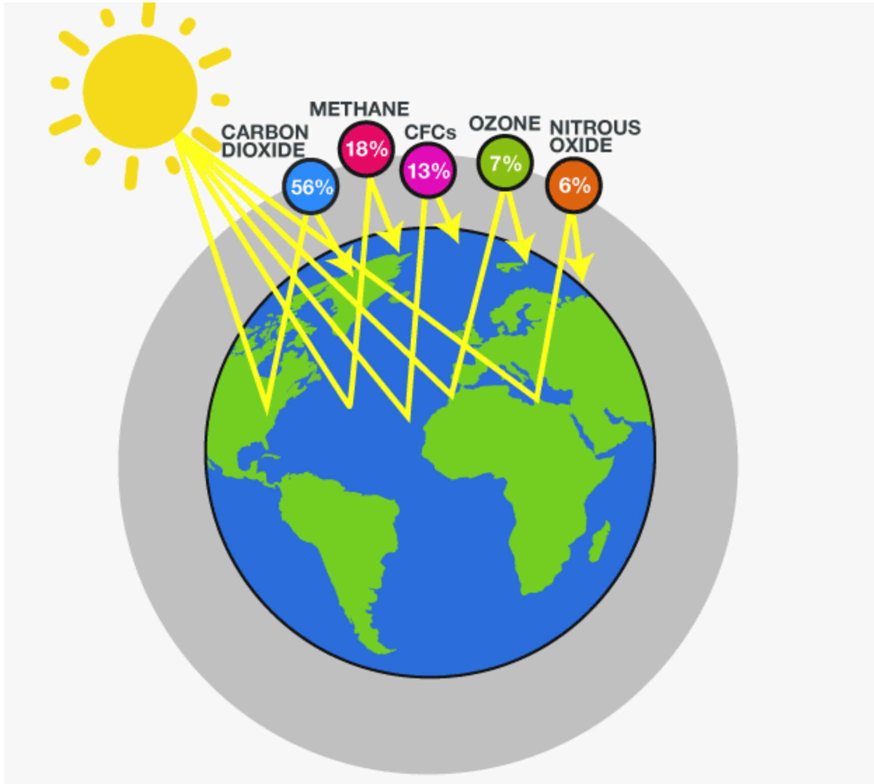
Same is the case in the earth's atmosphere. During the day the sun heats up the earth's atmosphere. At night, when the earth cools down the heat is radiated back into the atmosphere. During this process, the heat is absorbed by the greenhouse gases in the earth's atmosphere. This is what makes the surface of the earth warmer that makes the survival of living beings on earth possible.

However, due to the increased levels of greenhouse gases, the temperature of the earth has increased considerably. This has led to several drastic effects.

Let us have a look at the greenhouse gases and the causes and consequences of greenhouse effects.

Greenhouse Gases

"Greenhouse gases are the gases that absorb the infrared radiations and create a greenhouse effect. For e.g., carbondioxide and chlorofluorocarbons."



The major contributors to the greenhouses gases are factories, automobiles, deforestation, etc. The increased number of factories and automobiles increases the amount of these gases in the atmosphere. The greenhouse gases never let the radiations escape from the earth and increase the surface temperature of the earth. This then leads to global warming.

CAUSES OF GREENHOUSE EFFECT

The major causes of the greenhouse effect are:

- **Burning of Fossil Fuels**

Fossil fuels are an important part of our lives. They are widely used in transportation and to produce electricity. Burning of fossil fuels releases carbon dioxide. With the increase in population, the utilization of fossil fuels has increased. This has led to an increase in the release of greenhouse gases in the atmosphere.

- **Deforestation**

Plants and trees take in carbon dioxide and release oxygen. Due to the cutting of trees, there is a considerable increase in the greenhouse gases which increases the earth's temperature.

- **Farming**

Nitrous oxide used in fertilizers is one of the contributors to the greenhouse effect in the atmosphere.

- **Industrial Waste and Landfills**

The industries and factories produce harmful gases which are released in the atmosphere.

Landfills also release carbon dioxide and methane that adds to the greenhouse gases.

EFFECTS OF GREENHOUSE EFFECT

The main effects of increased greenhouse gases are:

- **Global warming**

It is the phenomenon of a gradual increase in the average temperature of the Earth’s atmosphere. The main cause for this environmental issue is the increased volumes of greenhouse gases such as carbon dioxide and methane released by the burning of fossil fuels, emissions from the vehicles, industries and other human activities.

- **Depletion of ozone layer**

Ozone Layer protects the earth from harmful ultraviolet rays from the sun. It is found in the upper regions of the stratosphere. The depletion of the ozone layer results in the entry of the harmful UV rays to the earth’s surface that might lead to skin cancer and can also change the climate drastically.

The major cause of this phenomenon is the accumulation of natural greenhouse gases including chlorofluorocarbons, carbon dioxide, methane, etc.

- **Smog and air pollution**

Smog is formed by the combination of smoke and fog. It can be caused both by natural means and man-made activities.

In general, smog is generally formed by the accumulation of more greenhouse gases including nitrogen and sulfur oxides. The major contributors to the formation of smog are the automobile and industrial emissions, agricultural fires, natural forest fires and the reaction of these chemicals among themselves.

- **Acidification of water bodies**

Increase in the total amount of greenhouse gases in the air has turned most of the world’s water bodies acidic. The greenhouse gases mix with the rainwater and fall as acid rain. This leads to the acidification of water bodies.

Also, the rainwater carries the contaminants along with it and falls into the river, streams and lakes thereby causing their acidification.

- **Runaway greenhouse effect**

This phenomenon occurs when the planet absorbs more radiations than it can radiate back. Thus, the heat lost from the earth’s surface is less and the temperature of the planet keeps rising. Scientists believe that this phenomenon took place on the surface of Venus billions of years ago.

This phenomenon is believed to have occurred in the following manner:

- A runaway greenhouse effect arises when the temperature of a planet rises to a level of the boiling point of water. As a result, all the water from the oceans converts into water vapour, which traps more heat coming from the sun and further increases the planet's temperature. This eventually accelerates the greenhouse effect. This is also called the "positive feedback loop".
- There is another scenario giving way to the runaway greenhouse effect. Suppose the temperature rise due to the above causes reaches such a high level that the chemical reactions begin to occur. These chemical reactions drive carbon dioxide from the rocks into the atmosphere. This would heat the surface of the planet which would further accelerate the transfer of carbon dioxide from the rocks to the atmosphere, giving rise to the runaway greenhouse effect.

In simple words, increasing the greenhouse effect gives rise to a runaway greenhouse effect which would increase the temperature of the earth to such an extent that no life will exist in the near future.

WEATHER

Rain and dull clouds, windy blue skies, cold snow, and sticky heat are very different conditions, yet they are all weather.

Weather is the mix of events that happen each day in our atmosphere. Weather is different in different parts of the world and changes over minutes, hours, days and weeks. Most weather happens in the troposphere, the part of Earth's atmosphere that is closest to the ground.

Air Pressure and Weather

The weather events happening in an area are controlled by changes in air pressure. Air pressure is caused by the weight of the huge numbers of air molecules that make up the atmosphere. Typically, when air pressure is high there skies are clear and blue. The high pressure causes air to flow down and fan out when it gets near the ground, preventing clouds from forming. When air pressure is low, air flows together and then upward where it converges, rising, cooling, and forming clouds. Remember to bring an umbrella with you on low pressure days because those clouds might cause rain or other types of precipitation.

Predicting Weather

Meteorologists develop local or regional weather forecasts including predictions for several days into the future. The best forecasts take into account the weather events that are happening over a broad region. Knowing where storms are now can help forecasters predict where storms will be tomorrow and the next day. Technology, such as weather satellites and Doppler radar, helps the process of looking over a large area, as does the network of weather observations.

The chaotic nature of the atmosphere means that it will probably always be impossible to predict the weather more than two weeks ahead; however, new technologies combined with more traditional methods are allowing forecasters to develop better and more complete forecasts.

Weather and Climate

The average weather pattern in a place over several decades is called climate. Different regions have different regional climates. For example, the climate of Antarctica is quite different than the climate of a tropical island. Global climate refers to the average of all regional climates.

As global climate changes, weather patterns are expected to change as well. While it is impossible to say whether a particular day's weather was affected by climate change, it is possible to predict how patterns might change. For example, scientists predict more severe weather events as climate warms. Also, they predict more hot summer days and fewer extreme cold winter days. That doesn't mean that there will be no more winter weather, in fact, large snowstorms might even be more likely in some areas as less cold air is able to carry more water with which to make snowflakes.

Weather is also affected by climate events like El Nino and La Nina (together known as ENSO). Climate events like these affect the weather in many areas of the world causing extreme events like storms and droughts.

CYCLONE

Tropical cyclones are formed only over warm ocean waters near the equator. When warm, moist air over the ocean rises upward from near the surface, a cyclone is formed. When the air rises up and away from the ocean surface, it creates an area of lower air pressure below. It causes the air from surrounding areas with higher pressure to move towards the low-pressure area which further leads to warming up of the air and causes it to rise above.

As the warm, moist air rises and cools the water in the air forms clouds. The complete system of clouds and wind spins and grows, along with the ocean's heat and water evaporating from the ocean surface.

As the wind system rotates with increasing speed, an eye gets formed in the middle. The centre of a cyclone is very calm and clear with very low air pressure. The difference of temperature between the warm, rising and the cooler environment causes the air to rise and become buoyant.

- When the winds speed is 39 mph (63 kmph), the storm is called a "tropical storm".
- Whereas when the wind speed reaches 74 mph (119 kmph), the storm is officially a "tropical cyclone" or hurricane.

Annually, around 70 to 90 cyclonic systems develop all over the globe. The Coriolis force causes the wind to spiral around a low-pressure area. As the presence of Coriolis force is negligible in the equatorial belt between 5 degrees north and 5 degrees south latitudes, hence cyclonic systems do not develop in this region.

Categories of Cyclone

Cyclones are categorized on the basis of the strength of the winds. Below mentioned are the different categories starting from level 1. The wind speed and damage potential of each category cyclones have also been mentioned.

- **Category 1:** Wind Speed 74-95 mph
  Damage: Minimal
  Surge surface: 4-5 feet
- **Category 2**: Wind Speed 96-110 mph
  Damage: Moderate
  Surge Surface: 6-8 feet

- **Category 3:** Wind Speed 111-130 mph
  Damage: Extensive
  Surge surface: 9-12 feet
- **Category 4:** Wind Speed 131-155 mph
  Damage: Extreme
  Surge surface: 13-18 feet
- **Category 5**: Wind Speed >155 mph
  Damage: Catastrophic
  Surge surface: 19+ feet

Major Cyclones which hit Indian coasts recently

Cyclone Nivar which got built over the Bay of Bengal and heading towards the southern states and Union territory (UT) of Andhra Pradesh, Tamil Nadu and Puducherry. It is expected to make landfall on Wednesday causing heavy rainfalls.

Cyclone Amphan: It had hit Indian coasts in 2020, leading to major damage in West Bengal, along with the bordering areas.

Cyclone Nisarga: It was a severe cyclone which had hit the Indian subcontinent in less than 14 days of Amphan. It led to huge destruction in Maharashtra, causing a large number of fatalities. Cyclone Nisarga formed on June 1 and dissipated on June 4, becoming the strongest tropical cyclone to strike Maharashtra since 1891.

Cyclone Fani: It was a huge cyclone which caused major damage in Odisha, being the strongest tropical cyclone to hit the state since 1999. Odisha faced maximum vandalization among the states hit by the cyclone. Fani affected other states like West Bengal and Andhra Pradesh, as well as neighboring countries like Bangladesh, Bhutan and Sri Lanka.

Cyclone Bulbul: It was another severe cyclone which impacted both West Bengal and Bangladesh. Bulbul was a tropical cyclone which began forming on November 5, 2019, and dissipated on November 11 and claimed 41 lives. Neighboring countries like Myanmar and Thailand were also affected.

Cyclone Vayu: It was the strongest cyclone to hit the Saurashtra region of Gujarat since 1998. It was formed on June 10, 2019, dissipated on June 17 and claimed 8 lives in June 2019. Vayu is taken from the Sanskrit and Hindi word 'Vayu' meaning wind. It had affected more than 6.6 million lives in the northwestern parts of the country.

Cyclone Maha: It had impacted the states of Maharashtra, Gujarat and Kerala. It was formed on October 30, 2019, dissipated on November 7 as a severe cyclonic storm.

ATMOSPHERIC CIRCULATIONS

Air expands when heated and gets compressed when cooled. This results in variations in the atmospheric pressure. The result is that it causes the movement of air from high pressure to low pressure, setting the air in motion. Atmospheric pressure also determines when the air will rise or sink. The wind redistributes the heat and moisture across the planet, thereby, maintaining a constant temperature for the planet as a whole. The vertical rising of moist air cools it down to form the clouds and bring precipitation.

You already know that the air is set in motion due to the differences in atmospheric pressure. The air in motion is called wind. The wind blows from high pressure to low pressure. The wind at the surface experiences friction. In addition, rotation of the earth also affects the wind movement. The force exerted by the rotation of the earth is known as the Coriolis force. Thus, the horizontal winds near the earth surface respond to the combined effect of three forces – the pressure gradient force, the frictional force and the Coriolis force. In addition, the gravitational force acts downward.

Pressure Gradient Force

The differences in atmospheric pressure produces a force. The rate of change of pressure with respect to distance is the pressure gradient. The pressure gradient is strong where the isobars are close to each other and is weak where the isobars are apart.

Frictional Force

It affects the speed of the wind. It is greatest at the surface and its influence generally extends up to an elevation of 1 - 3 km. Over the sea surface the friction is minimal.

Coriolis force

The rotation of the earth about its axis affects the direction of the wind. This force is called the Coriolis force after the French physicist who described it in 1844. It deflects the wind to the right direction in the northern hemisphere and to the left in the southern hemisphere. The deflection is more when the wind velocity is high. The Coriolis force is directly proportional to the angle of latitude. It is maximum at the poles and is absent at the equator. The Coriolis force acts perpendicular to the pressure gradient force. The pressure gradient force is perpendicular to an isobar. The higher the pressure gradient force, the more is the velocity of the wind and the larger is the deflection in the direction of wind. As a result of these two forces operating perpendicular to each other, in the low-pressure areas the wind blows around it. At the equator, the Coriolis force is zero and the wind blows perpendicular to the isobars. The low pressure gets filled instead of getting intensified. That is the reason why tropical cyclones are not formed near the equator.

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INDIAN MONSOON

- The term monsoon has been derived from the Arabic word **mausin** or from the Malayan word **monsin** meaning **'season'.**
- Monsoons are seasonal winds (Rhythmic wind movements)(Periodic Winds) which reverse their direction with the change of season.
- The monsoon is a double system of seasonal winds – They flow from sea to land during the summer and from land to sea during winter.
- Some scholars tend to treat the monsoon winds as land and sea breeze on a large scale.
- Monsoons are peculiar to Indian Subcontinent, South East Asia, parts of Central Western Africa etc..

- They are more pronounced in the Indian Subcontinent compared to any other region.
- Indian Monsoons are Convection cells on a very large scale.
- They are periodic or secondary winds which seasonal reversal in wind direction.
- India receives south-west monsoon winds in summer and north-east monsoon winds in winter.
- South-west monsoons are formed due to intense low pressure system formed over the Tibetan plateau.
- North-east monsoons are associated with high pressure cells over Tibetan and Siberian plateaus.
- South-west monsoons bring intense rainfall to most of the regions in India and north-east monsoons bring rainfall to mainly south-eastern coast of India (Southern coast of Seemandhra and the coast of Tamil Nadu.).
- Countries like India, Indonesia, Bangladesh, Myanmar etc. receive most of the annual rainfall during south-west monsoon season whereas South East China, Japan etc., during north-east rainfall season.

  Factors responsible for south-west monsoon formation
- *Intense heating of Tibetan plateau during summer months.*
- *Permanent high pressure cell in the South Indian Ocean (east to north-east of Madagascar in summer).*
- Subtropical Jet Stream (STJ).
- Tropical Easterly Jet (African Easterly Jet).
- Inter Tropical Convergence Zone.

<u>Factors that influence the intensity of south-west monsoons</u>

- *Strengths of Low pressure over Tibet and high pressure over southern Indian Ocean.*
- *Somali Jet (Findlater Jet).*
- *Somali Current (Findlater Current).*
- *Indian Ocean branch of Walker Cell.*
- *Indian Ocean Dipole.*
- Formation and strengthening of high pressure cells over Tibetan plateau and Siberian Plateau in winter.
- Westward migration and subsequent weakening of high pressure cell in the Southern Indian Ocean.
- Migration of ITCZ to the south of India.
- All these will be discussed in detail.

  <u>Mechanism of Indian Monsoons</u>

  <u>Classical Theory</u>
- Monsoons are mentioned in scriptures like the **Rig Veda**. But these scriptures didn’t make any mention of the monsoon mechanism.
- The first scientific study of the monsoon winds was done by **Arab traders**.

- Arab traders used the sea route to carry out trade with India and monsoon patterns were of prime importance for them.
- In the tenth century, **Al Masudi**, an Arab explorer, gave an account of the **reversal of ocean currents and the monsoon winds** over the north Indian Ocean.
- In seventeenth century, Sir Edmund Halley explained the monsoon as resulting from **thermal contrasts** between continents and oceans due to their differential heating.

Modern Theories

- Besides differential heating, the development of monsoon is influenced by the shape of the continents, orography (mountains), and the conditions of air circulation in the upper troposphere {jet streams}.
- Therefore, Halley's theory has lost much of its significance and modern theories based on air masses and jet stream are becoming more relevant.

<u>Indian Monsoons – Classical Theory: Sir Edmund Halley's Theory</u>

<u>Summer Monsoon</u>

- In summer the sun's apparent path is vertically over the Tropic of Cancer resulting in high temperature and low pressure in Central Asia.
- The pressure is sufficiently high over Arabian Sea and Bay of Bengal. Hence winds flowed from Oceans flow towards landmass in summer.
- This air flow from sea to land bring heavy rainfall to the Indian subcontinent.

<u>Winter Monsoon</u>

- In winter the sun's apparent path is vertically over the Tropic of Capricorn.
- The north western part of India grows colder than Arabian Sea and Bay of Bengal and the flow of the monsoon is reversed.
- The basic idea behind Classical theory is similar to land and sea breeze formation except that in the case of monsoons the day and night are replaced by summer and winter.

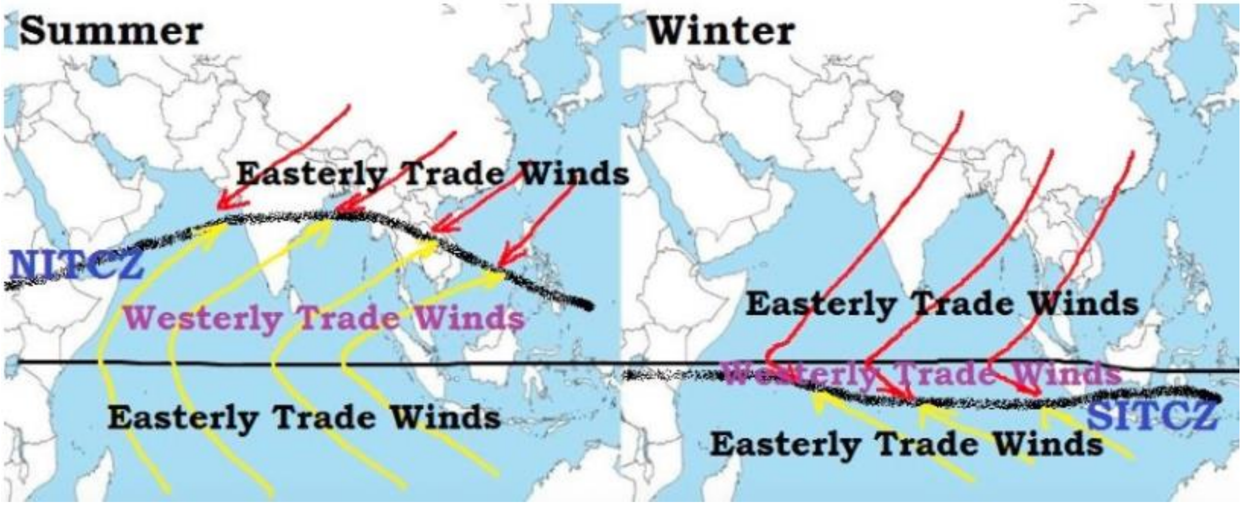
Drawbacks: The monsoons do not develop equally everywhere on earth and the thermal concept of Halley fails to explain the intricacies of the monsoons such as the **sudden burst** of monsoons, **delay** in on set of monsoons sometimes, etc..

<u>Indian Monsoons – Modern theory: Air Mass Theory</u>

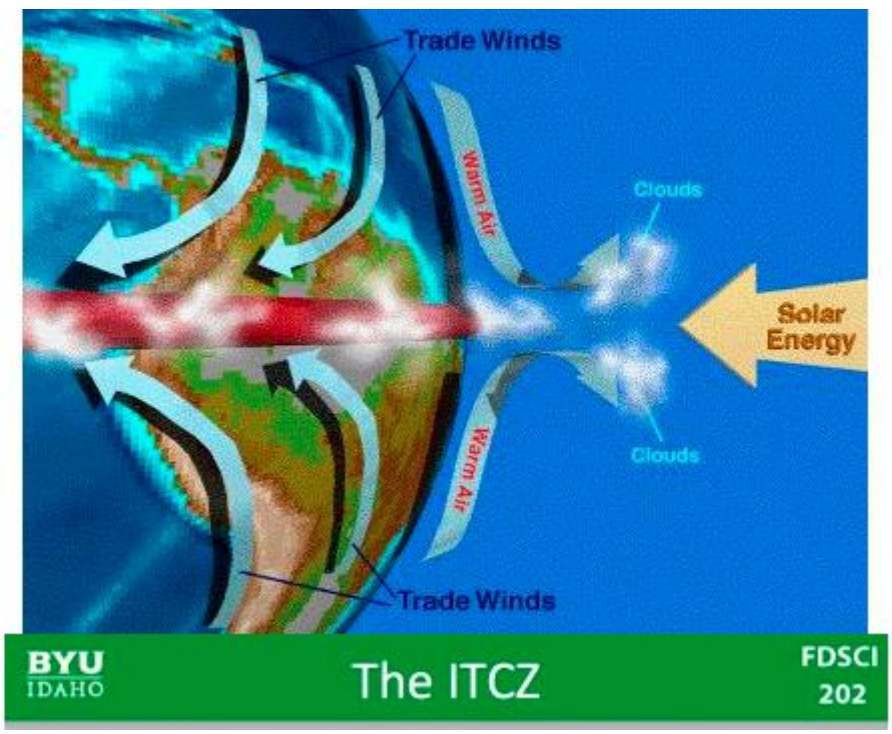
- According to this theory, the monsoon is simply a **modification of the planetary winds of the tropics.**
- The theory is based on the migration of ITCZ based on seasons.

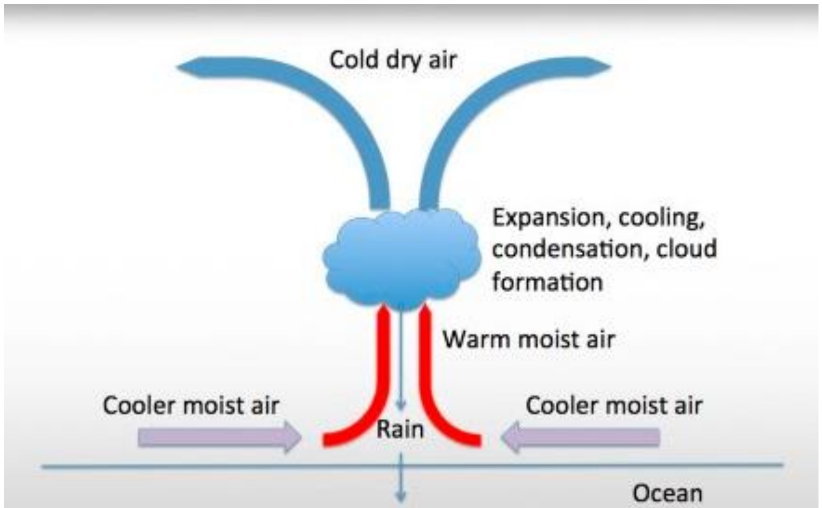
Indian Monsoons – Role of ITCZ [Inter-Tropical Convergence Zone]

- The southeast trade winds in the southern hemisphere and the northeast trade winds in the northern hemisphere meet each other near the equator.
- The meeting place of these winds is known as the **Inter-Tropical Convergence Zone (ITCZ).**



- This is the region of ascending air, maximum clouds and heavy rainfall.
- The location of ITCZ shifts north and south of equator with the change of season.
- In the summer season, the sun shines vertically over the Tropic of Cancer and the ITCZ shifts northwards.
- The southeast trade winds of the southern hemisphere cross the equator and start blowing in southwest to northeast direction under the influence of Coriolis force.





- These displaced trade winds are called south-west monsoons when they blow over the Indian sub-continent.
- The front where the south-west monsoons meet the north-east trade winds is known as the **Monsoon Front (ITCZ). Rainfall occurs along this front.**
- In the month of July the ITCZ shifts to 20°- 25° N latitude and is located in the Indo-Gangetic Plain and the south-west monsoons blow from the Arabian Sea and the Bay of Bengal. The ITCZ in this position is often called the **Monsoon Trough [maximum rainfall]**.
- The seasonal shift of the ITCZ has given the concept of Northern Inter-Tropical Convergence Zone (NITCZ) in summer (July – rainy season) and Southern Inter-Tropical Convergence Zone (SITCZ) in winter (Jan – dry season).
- NITCZ is the zone of clouds and heavy rainfall that effect India.

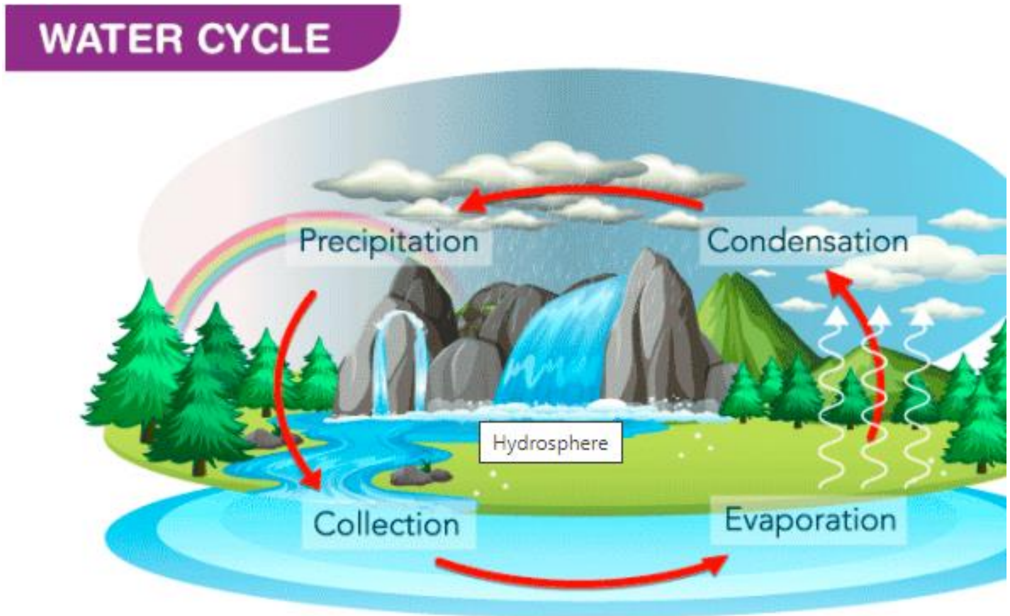
HYDROSPHERE

What is Hydrosphere?

The hydrosphere is the combined mass of water found on, under, and above the surface of the earth. It has been estimated that there are 1386 million cubic kilometers of water on earth. This includes water in liquid and frozen forms in groundwater, oceans, lakes and streams approximately 75% of Earth's surface, an area of some 361 million square kilometers is covered by ocean.

Hydrological cycle

The hydrological cycle transfers water from one state or reservoir to another. Reservoirs include atmospheric moisture including snow, rain and clouds, streams, oceans, rivers lakes, groundwater, subterranean aquifers, polar icecaps and saturated soil.



The Solar energy is the source of heat and light and gravity causes the transfer from one state to another over periods from hours to thousands of years. Most evaporation comes from the oceans and is returned to the earth as snow or rain.

<u>Importance of Hydrosphere</u>

It consists of all bodies of water, icebergs and water vapour in the earth's atmosphere. Oceans contain 97 per cent of water in the hydrosphere, while rivers, lakes and other water bodies on land and underground water contains a small percentage of total water in the hydrosphere.

Here is the importance of the Hydrosphere-

- Helps to maintain the hydrological cycle.
- Good means of transport of water
- Plays a vital role in the earth's climate.

<u>Hydrosphere Facts</u>
• The amount of water on the Earth's surface remains constant over time. This signifies that the amount of water available on the Earth today is the same as it was when dinosaurs were roaming the Earth. • 68.7% of the freshwater exists in the form of permanent snow. • The total amount of water on Earth is about 333 million cubic miles or 1,386 million cubic kilometers.

OCEANS

The ocean is a continuous body of salt water that covers more than 70 percent of the Earth's surface. Ocean currents govern the world's weather and churn a kaleidoscope of life. Humans depend on these teeming waters for comfort and survival, but global warming and overfishing threaten Earth's largest habitat.

Geographers divide the ocean into five major basins: the Pacific, Atlantic, Indian, Arctic, and Southern. Smaller ocean regions such as the Mediterranean Sea, Gulf of Mexico, and the Bay of Bengal are called seas, gulfs, and bays. Inland bodies of saltwater such as the Caspian Sea and the Great Salt Lake are distinct from the world's oceans.

The oceans hold about 321 million cubic miles (1.34 billion cubic kilometers) of water, which is roughly 97 percent of Earth's water supply. Seawater's weight is about 3.5 percent dissolved salt; oceans are also rich in chlorine, magnesium, and calcium. The oceans absorb the sun's heat, transferring it to the atmosphere and distributing it around the world. This conveyor belt of heat drives global weather patterns and helps regulate temperatures on land, acting as a heater in the winter and an air conditioner in the summer.

Sea life

The oceans are home to millions of Earth's plants and animals—from tiny single-celled organisms to the gargantuan blue whale, the planet's largest living animal. Fish, octopuses, squid, eels, dolphins, and whales swim the open waters while crabs, octopuses, starfish, oysters, and snails crawl and scoot along the ocean bottom.

Life in the ocean depends on phytoplankton, mostly microscopic organisms that float at the surface and, through photosynthesis, produce about half of the world's oxygen. Other fodder for sea dwellers includes seaweed and kelp, which are types of algae, and seagrasses, which grow in shallower areas where they can catch sunlight.

The deepest reaches of the ocean were once thought to be devoid of life, since no light penetrates beyond 1,000 meters (3,300 feet). But then hydrothermal vents were discovered. These chimney-like structures allow tube worms, clams, mussels, and other organisms to survive not via photosynthesis but chemosynthesis, in which microbes convert chemicals released by the vents into energy. Bizarre fish with sensitive eyes, translucent flesh, and bioluminescent lures jutting from their heads lurk about in nearby waters, often surviving by eating bits of organic waste and flesh that rain down from above, or on the animals that feed on those bits.

Despite regular discoveries about the ocean and its denizens, much remains unknown. More than 80 percent of the ocean is unmapped and unexplored, which leaves open the question of how many species there are yet to be discovered. At the same time, the ocean hosts some of the world's oldest creatures: Jellyfish have been around more than half a billion years, horseshoe crabs almost as long.

Other long-lived species are in crisis. The tiny, soft-bodied organisms known as coral, which form reefs mostly found in shallow tropical waters, are threatened by pollution, sedimentation, and global warming. Researchers are seeking ways to preserve fragile, ailing ecosystems such as Australia's Great Barrier Reef.

Human impacts

Human activities affect nearly all parts of the ocean. Lost and discarded fishing nets continue to lethally snare fish, seabirds, and marine mammals as they drift. Ships spill oil and garbage; they also transport critters to alien habitats unprepared for their arrival, turning them into invasive species. Mangrove forests are cleared for homes and industry. Our garbage—particularly plastic—chokes the seas, creating vast "garbage patches" such as the Great Pacific Garbage Patch. Fertilizer runoff from farms turns vast swaths of the ocean into dead zones, including a New Jersey-size area in the Gulf of Mexico.

Climate change, the term scientists now use to describe global warming and other trends currently affecting the planet because of high greenhouse gas emissions from humans, is strikingly reflected in the oceans. The year 2018 marked the oceans' hottest year on record, and warmer waters lead to a range of consequences, from changing colors to rising sea levels to more frequent powerful storms. The greenhouse gas carbon dioxide is also turning ocean waters acidic, and an influx of freshwater from melting glaciers threatens to alter the weather-driving currents: the Atlantic Ocean's currents have slowed by about 15 percent over the past few decades.

A community of scientists, explorers, and citizen scientists continues to study the ocean, hoping that more information will yield more paths for conservation. Underwater drones, for example, are being deployed to explore undersea frontiers, while new tools are helping scientists measure and understand what they find.

INLAND WATER BODIES

Freshwater systems – lakes, wetlands, rivers and streams, have been critical to the establishment of civilizations throughout human history. From ancient times, civilizations have been established based on their proximity to water. Water bodies are essential to humans not only for drinking but also for transportation, agriculture, energy production, industry and waste disposal. Contaminated runoff from expanding urban and agricultural areas, airborne pollutants and hydrologic modifications such as drainage of wetlands are just few of the many factors that continue to degrade surface waters. Determining which of these factors has the most significant influence on the quality of a water body requires knowledge about the interaction of the water body with its watershed and how the various inputs affect its physical, chemical and biological characteristics. One of the critical sciences required to understand these aquatic ecosystem interactions is called limnology.

Limnology is the study of fresh or saline water covering all aquatic ecosystems**,** including lakes, ponds, reservoirs, streams, rivers, and oceans. It is a multidisciplinary science that integrates biology, chemistry, physics and geology in order to study inland waters as complex ecological systems.

FORMATION OF LAKES

Lakes are formed as a result of different natural and artificial processes, which are often interlinked resulting in lakes of similar origin, physical and biological characteristics.

- ***Lakes formed by glaciers:***

The gouging and scraping actions of glaciers have led to the formation of lakes in the north temperate zones. Glaciers followed existing valleys, deepening and widening them. When the mass of ice melted, it left piles of moraine, which blocked valleys, damming streams and rivers.

- ***Ice-scour lakes:***

Where ice sheets move over relatively flat surfaces of hard jointed or fractured rock, hollow basins are formed and subsequently filled with water.

- ***Lakes formed by movements of the earth's crust:***

When a portion of the earth's surface subsides in relation to its surroundings or conversely the sides are uplifted, a lake basin may be formed. The area and depth of water will depend on the drainage from the surrounding land, which depends on the amount of rainfall and the size of the area from where water drains into the lake.

- ***Lakes formed by volcanoes:***

Many lakes are formed due to volcanic eruptions called as crater lakes. These lakes are fed only by rainfall and run-off. They are found where a series of minor eruptions have taken place fairly close to each other, rather than one massive eruption. In some cases, where the volcano was big and erupted long ago, the floor of the enormous crater is relatively flat and water accumulates in the lowest places. Volcanic activity also forms lakes when the ash or lava from an eruption blocks natural drainage.

- ***Lakes formed by rivers:***

When the flow of water is suddenly slowed by a decrease in gradient, it takes a longer route and flows at a slower rate. Sediments are eroded from the outside and deposited on the inside so that the channel becomes more twisted. Sometimes the river breaks through a narrow isthmus between two succeeding curves. This may leave a loop of the river to one-side of the new watercourse. The isolated portion may retain enough water to form an "oxbow lake".

Other lakes may be formed from hollows in the valley floor, filled by the river when it overflows its banks during floods. The flat floor of a wide valley, which is periodically flooded by the river, is known as floodplain. In many parts of the world, coastal impoundment results in freshwater lagoons adjacent to the sea. The freshwater lagoons are formed because a single strip of sand barricades the flow of water from river to sea.

Lakes are constantly changing and follow the natural stages of transition and death. Starting out pristine and deep, they slowly fill in due to natural causes, becoming shallower until the wetland turns into a bog and finally ceases to exist. This is a very slow process and takes thousands of years to complete. This phenomenon called natural eutrophication is inevitable. Human activity accelerates this process and changes the water quality within few years. This is referred to as cultural or anthropogenic eutrophication, due to which clear nutrient-poor water changes to green, nutrient rich water. The overall quality and quantity of the water is dependent on the physical dimensions of the lake and its basin.

- **Lentic and Lotic ecosystems**

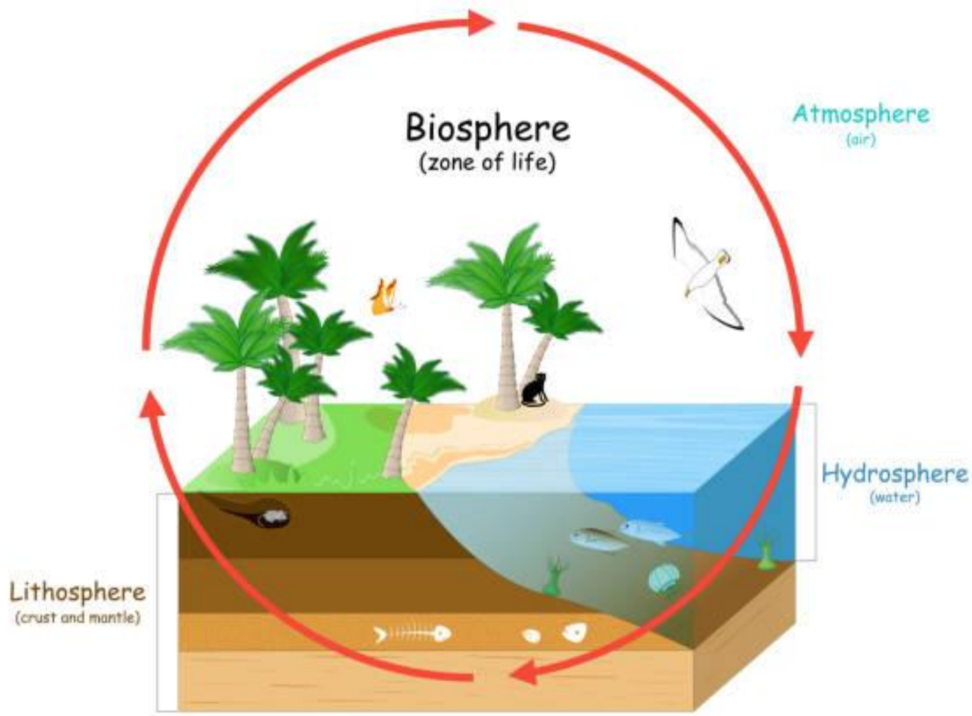
Inland water bodies can be classified as either lotic (running-water) or lentic (standing-water). Lotic habitats include rivers, streams, and brooks, and lentic habitats include lakes, ponds, and marshes. The major difference between them is the persistent flow of water in a lotic ecosystem. Large deep basins usually characterize lentic ecosystems with little or no flow existing within the basin. Characteristic of lentic ecosystems is the development of vertical differences (vertical stratification) of several important features, which often display marked seasonal variation as well. However, the decisive criterion is the length of time a given mass of water resides within a certain part of an aquatic ecosystem, a concept clearly related to flow rates. Some large rivers with only a slight gradient have low rates of discharge and flow and extensive floodplains with many interconnected bodies of lentic waters.

BIOSPHERE

The biosphere, which includes the ground and the air, is characterized as the region of the planet where organisms live. The biosphere is defined as the region on, above, and below the Earth's surface where life exists.

The biosphere is a narrow zone on the surface of the earth where soil, water, and air combine to sustain life. Life can only occur in this zone. From fungi and bacteria to large animals, there are several different types of life.

The biosphere is characterized as an area that contains all living organisms and the products of their activities. As a result, it plays a critical role in the maintenance of ecosystems, i.e., the existence of species and their reciprocal interactions. And the biosphere is critical for climate regulation.



Biosphere Resources

The biosphere provides important resources. Many people rely on the biosphere for basic necessities including food, medicine, construction materials, and fuel. Indigenous peoples, in particular. Except for salt, all food comes from the biosphere, but established societies prefer to farm rather than forage.

The biosphere is a relatively thin layer of the Earth's surface that supports life, reaching from a few kilometers into the atmosphere to deep-sea vents. The biosphere is a global ecosystem made up of living organisms (biota) and the nonliving (abiotic) factors that provide them with energy and nutrients.

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Importance of Biosphere

The biosphere provides the ecosystem that is needed for survival. Adaptation to the biosphere's climate is expected for living organisms. Biodiversity thrives within ecosystems, and the biosphere is a reliable source of food on Earth. Biodiversity is just what it sounds like biological variety.

Safe areas for the protection of plants and animals are known as biosphere reserves. It also helps to restore the tribal's traditional way of life in the region. They protect the region's biodiversity. The biosphere is the ecological organization's highest level. It covers all types of life as well as any biome on the earth.

The biosphere functions as the planet's life support system, assisting in the control of atmospheric composition, soil health, and the hydrological (water) cycle. A indicator of a biome's contribution to the earth. The biosphere is a narrow zone on the surface of the earth where soil, water, and air combine to sustain life. Life can only occur in this zone.

Biosphere Facts

- The biosphere is related to the lithosphere, hydrosphere, and atmosphere, which are all spheres of the physical world. The lithosphere is the Earth's solid outer layer, which contains rocks, sand, and soil.
- The biosphere is characterized as an environment that contains all living organisms and the products of their activities. As a result, it plays a vital role in the conservation of ecosystems, i.e., the life of species and their reciprocal interactions. And the biosphere is critical for climate regulation.
- Any of the main greenhouse gases, such as methane, carbon dioxide, and nitrous oxide, are affected by the biosphere.
- Various environmental conditions, such as favorable temperature and moisture, are needed for organisms to live on Earth. Energy and nutrients are also needed by the species. The biosphere of the Earth contains all of the mineral and animal nutrients needed for life.

Biosphere Examples

The biosphere, which includes the ground and the air, is characterized as the region of the planet where organisms live. The biosphere is defined as the region on, above, and below the Earth's surface where life exists. The part of the world where life naturally exists, spreading from the deep crust to the lower atmosphere.

The biosphere, also known as the ecosphere, is the Earth's dynamic biological epidermis of unknown dimensions. It is the natural habitat of living organisms. It is made up of the lithosphere's surface, a lower portion of the atmosphere, and the hydrosphere.

The biosphere is the world's ecological system as a whole. It encompasses all forms of life on Earth as well as all habitats capable of sustaining life. There are many biomes that make up the biosphere. These areas have unique climates, vegetation, wildlife, and adaptations that must be met in order to live.

Photosynthesis is the main source of energy for ecosystem processes. Processes in the biosphere are intertwined with those in the atmosphere, hydrosphere, and geosphere. Via the balance of photosynthesis and respiration, biological processes play a significant role in controlling atmospheric CO_2 concentrations.

KEY TERMS IN DISASTER RISK REDUCTION & MANAGEMENT

DISASTER

The term "DISASTER" owes its origin to French word "Disastre", a combination of two words "Des" meaning "Bad" and "Aster" meaning "Star" thus the term Disaster refers to "Bad or Evil Star". The term can be used for personal tragedies also, as they may cause emotional and financial sufferings. Disasters, however, are the catastrophic events resulting in heavy losses in terms of human, animal and plant lives, injuries and disabilities and damage to property and environment.

The World Health Organization (WHO) defines a disaster as “a sudden ecological phenomenon of sufficient magnitude to require external assistance”. It is also defined as any event, typically occurring suddenly, that causes damage, ecological disruption, loss of human life, deterioration of health and health services, and which exceeds the capacity of the affected community on a scale sufficient to require outside assistance. Disasters are events that occur when significant numbers of people are exposed to extreme events to which they are vulnerable, with resulting injury and loss of life, often combined with damage to property and livelihoods. Disasters, commonly leading to emergency situations, occur in diverse situations in all parts of the world, in both sparsely populated rural and densely populated urban regions, as well as in situations involving natural and man-made hazards. Disasters are often classified according to their speed of onset (sudden or slow), their cause (natural or man-made), or their scale (major or minor).

HAZARDS

According to the United Nations International Strategy for Disaster Reduction (UNISDR), a hazard is a natural process or phenomenon that may pose negative impacts on the economy, society, and ecology, including both natural factors and human factors that are associated with the natural ones. Hazards are the origins of disasters. Hazards are detrimental to the development of human beings and hinder the sustainability of the world.

A hazard is a situation where there is a threat to life, health, environment or property. ... These hazards are termed as disasters when **they cause widespread destruction of property** and human lives. Once a hazard becomes active and is no longer just a threat, it becomes a disaster.

EXPOSURE

Exposure is defined as “the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas”. As stated in the UNIDRR glossary, “measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest”.

VULNERABILITY

Vulnerability is the inability to resist a hazard or to respond when a disaster has occurred. For instance, people who live on plains are more vulnerable to floods than people who live higher up. In actual fact, vulnerability depends on several factors, such as people's age and state of health, local environmental and sanitary conditions, as well as on the quality and state of local buildings and their location with respect to any hazards

RISK

Risk (or more specifically, disaster risk) is the potential disaster losses (in terms of lives, health status, livelihoods, assets and services) which could occur to a particular community or a society over some specified future time period.

It considers the probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environmentally damaged) resulting from interactions between natural or human induced hazards and vulnerable conditions.

Risk can be calculated using the following equation: *Risk = Probability of Hazard x Degree of Vulnerability.*

RISK ASSESSMENT

A qualitative or quantitative approach to determine the nature and extent of disaster risk by analyzing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods and the environment on which they depend.

Disaster risk assessments include: the identification of hazards; a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability, including the physical, social, health, environmental and economic dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios.

RISK MAPPING

Risk mapping is a process of analyzing the hazard, vulnerability and capacity through a scientific methodology. The process of risk map preparation includes analysis of several variables and parameters which are sub-sets of base categories; hazard, vulnerability and capacity. Hence, preparation of multi hazard risk map is a combination of all risk elements on several hazards. This process is important in risk map preparation and obviously in disaster management field for appropriate implementation of disaster risk reduction activities. One of the key actions that can be associated with Disaster Risk Reduction (DRR) map will be re organizing of urban spaces to strengthen urban morphology with appropriate spaces and several disaster management elements. This mapping technology will allow the decision makers to carry out their work more rationally, by adopting a more scientific process than what is currently used; a mapping technology that is used for DRR in urban settlements.

CAPACITY

Capacity refers to all the strengths, attributes and resources available within a community, organization or society to manage and reduce disaster risks and strengthen resilience.

It is important to emphasize people's capacity to anticipate, cope with, resist and recover from disasters, rather than simply focusing on the vulnerability that limits them. Like vulnerability, capacity depends on social, economic, political, psychological, environmental and physical assets and the wider governance regimes - and like vulnerability it can be described using different terms.

For instance, capacity is sometimes described as the opposite of vulnerability, but this overlooks the fact that even poor and vulnerable people have capacities. Indeed, the starting point for capacity development is the existing knowledge, strengths, attributes and resources individuals, organizations or society has. Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management.

A related concept is 'coping capacity', which is the ability of people, organizations and systems, to use available skills and resources, to manage adverse conditions, risk or disasters. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during crises or adverse conditions. Coping capacity also depends on adequate household assets and supportive social and governance relations and can be thought of as a component of wider capacity development for disaster risk reduction.

Capacity development is the process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals. It is a concept that extends the term of capacity -building to encompass all aspects of creating and sustaining capacity growth over time. It involves learning and various types of training, but also continuous efforts to develop institutions, political awareness, financial resources, technology systems and the wider enabling environment.

RESILIENCE

Resilience is about anticipating, planning and reducing disaster risk to effectively protect persons, communities and countries, their livelihoods, health, cultural heritage, socio-economic assets and ecosystems. The ideas of 'bounce back', 'spring forward' and 'build back better' are often used in the context of resilience.

Resilience is related to 'capacity' and 'coping capacity' and often understood as follows:

- Resilience: the ability to flourish in the face of disaster risk
- Capacity: strengths and resources available to anticipate, cope with, resist and recover from disasters
- Coping capacity: the ability to face and manage disasters

Resilience is a term shared by many disciplines (e.g. psychology, engineering and ecology) and has been used in disaster studies since the 1970s. For many specialists, resilience is believed to be the opposite of vulnerability and, likewise, similar to capacity, while others view capacities more as attributes of individuals and households and resilience as the coming together of capacities with the social, institutional and informational services that enable their effective use. Resilience also emphasizes the importance of not only effectively managing change but also improving well-being in the face of multiple risks and shocks.

DISASTER RISK REDUCTION

Disaster risk reduction (DRR) is a systematic approach to identifying, assessing and reducing the risks of disaster. It aims to reduce socio-economic vulnerabilities to disaster as well as dealing with the environmental and other hazards that trigger them. Here it has been strongly influenced by the mass of research on vulnerability that has appeared in print since the mid-1970s as well as the mapping of natural disaster risks. Disaster risk reduction is the responsibility of development and relief agencies alike. It should be an integral part of the way such organizations do their work, not an add-on or one-off action. Disaster risk reduction is very wide-ranging: Its scope is much broader and deeper than conventional emergency management. There is potential for Disaster risk reduction initiatives in just about every sector of development and humanitarian work. Disaster risk is an indicator of poor development, so reducing disaster risk requires integrating DRR and DRM practice into the sustainable development goals. We need to manage risks, not just disasters.

The most commonly cited definition of Disaster risk reduction is one used by UN agencies such as United Nations Office for Disaster Risk Reduction (UNDDR) and the United Nations Development Programme (UNDP): "The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development."

DISASTER RISK MANAGEMENT

Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses.

EARLY WARNING SYSTEMS

An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events.

DISASTER PREPAREDNESS

The knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters.

Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response to sustained recovery.

Preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, the stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities. The related term “readiness” describes the ability to quickly and appropriately respond when required.

DISASTER PREVENTION

Prevention is defined as those activities taken to prevent a natural phenomenon or potential hazard from having harmful effects on either people or economic assets. Delayed actions drain the economy and the resources for emergency response within a region. For developing nations, prevention is perhaps the most critical components in managing disasters, however, it is clearly one of the most difficult to promote. Prevention planning is based on two issues: hazard identification (identifying the actual threats facing a community) and vulnerability assessment (evaluating the risk and capacity of a community to handle the consequences of the disaster). Once these issues put in order of priority, emergency managers can determine the appropriate prevention strategies. Disaster prevention refers to measures taken to eliminate the root causes that make people vulnerable to disaster.

DISASTER MITIGATION

Mitigation is permanent reduction of the risk of a disaster. Primary mitigation refers to reducing the resistance of the hazard and reducing vulnerability. Secondary mitigation refers to reducing the effects of the hazard (preparedness). Mitigation includes recognizing that disasters will occur; attempts are made to reduce the harmful effects of a disaster, and to limit their impact on human suffering and economic assets.

DISASTER RESPONSE

Response is the set of activities implemented after the impact of a disaster in order to assess the needs, reduce the suffering, limit the spread and the consequences of the disaster, open the way to rehabilitation.

DAMAGE ASSESSMENT

Damage assessment is an important tool for retrospective and prospective analysis of disasters to assimilate the extent of impact of a disaster. This forms the basis for future disaster preparedness and preventive planning. It is essential in determining: what happened, what the effects were, which areas were hardest hit, what situations must be given priority and what types of assistance are needed, for example, Local, State, or Union? Emergency response can be more effective, equipment and personnel can be better used, and help can be provided quicker if a thorough damage assessment is performed beforehand.

CRISIS COUNSELING

The objective of crisis counseling is to assist individuals and communities in recovering from the effects of natural and human-caused disasters through the provision of community-based outreach and psychoeducational services. Crisis counseling supports short-term interventions that involve assisting disaster survivors in understanding their current situation and reactions, mitigating stress, developing coping strategies, providing emotional support, and encouraging linkages with other individuals and agencies that help survivors in their recovery process.

NEEDS ASSESSMENT

The Post-Disaster Needs Assessment (PDNA) is an internationally accepted methodology for determining the physical damages, economic losses, and costs of meeting recovery needs after a natural disaster through a government-led process.

Prepared by

Muhammed Khais A

Assistant Professor

Dept. of ME

CE Perumon