MCN 301
Disaster Management

Module 1

Systems of earth

Module I

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.

Disaster

- Disaster is a catastrophic situation causing damage to life and property.
  - Natural
    - Earthquakes, floods, tsunamis etc
    - Can be predicted to an extent
  - Man made (Anthropogenic)
    - Transport & other accidents, radiation hazards etc
    - Can not be predicted
- High impact on the environment and ecology of a region.

Impact of Disasters

Ecosystem

- System that combines living organisms with the physical environment.
- Constituents of Ecosystem
  - Species
  - Physical Environment
- Biosphere - Complete ecosystem
  - Lithosphere
  - Atmosphere
  - Hydrosphere

Lithosphere

- Earth has four concentric zones.
- The innermost zone is the 'Inner core.
  - A solid mass of iron which has a radius of about 1,216 km,
- Covering the inner core is the outer core.
  - A layer of molten liquid containing nickel and iron. It is about 2,270 km thick.
- The outer core is covered by solid 'Mantle', which is about 2,900 km thick.
- The outermost hardened exterior zone is known as Crust. The crust varies in thickness from about 5 km.
- The crust and the mantle which is hard and brittle is lithosphere

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- Lithosphere is the outer layer (oceanic and continental) of earth that includes the crust and solid part of the mantle.
- Lithosphere interacts with atmosphere, hydrosphere and biosphere and forms Pedosphere.
- Pedosphere has both biotic and abiotic components.
- There are two types of lithosphere,
  - The oceanic lithosphere which is about 5 km to 8 km thick composed of basalt
  - The continental lithosphere which is 30 km to 40 km thick.

- Earth has seven major plates, which includes Africa, Antarctica, Australia, Eurasia, North America, South America and Pacifica, and a number of minor ones.
- A few important minor plates include Adria. Arabia, Caribbean. Nazca, Philippines, etc.
- These plates are composed of oceanic and continental lithosphere.
  - They move independently over the mantle relative to one another, below the outer rigid lithosphere.
- This area known as asthenosphere is about 100km to 200 km thick.
  - They move with at restricted independence from the seven large plates.

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- The plates periodically reorganise themselves with new plate boundaries being formed, while certain others closing up.
- In addition to these movements, the plates also change in shape.
- The plates have three different motions
  - They are Moving apart, thereby creating divergent boundaries
  - Gliding horizontally along each other, thereby creating wrench and transform boundaries
  - Moving towards one another, and creating convergent boundaries

Composition of Lithosphere

- The lithosphere contains minerals, rocks and soil.
- It has more than 100 chemical elements and most of them are rare.
- More than 99 percentage of the volume includes elements like oxygen, silicon, aluminium, iron, calcium, sodium, potassium and magnesium.

Elements of Earth's Crust

S.No.	Elements	Per cent
1	Oxygen	46.6
2	Silicon	27.7
3	Aluminum	8.1
4	Iron	5.0
5	Calcium	3.6
6	Sodium	2.8
7	Potassium	2.6
8	Magnesium	2.1

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- Only a few elements are present in pure forms in the earth's crust called native elements, they include copper, gold, lead, mercury, nickel, platinum and silver.
- These elements contained in ores are found in different combinations as minerals.
- Minerals are naturally occurring, inorganic, crystalline solids that have definite chemical compositions.
- Certain minerals are composed of single element.
  - For instance, diamond and graphite composed of only carbon.
- Number of minerals are there formed by more than one element.

Rocks

- Lithosphere has various types of rocks
- Rocks are naturally occurring hard and consolidated inorganic materials, composed of one or a large number of minerals.
- Certain other materials, like coal and limestone are developed from plant and animal remains.
- There are various types of rocks. They are:
  - Igneous Rocks: Formed by solidification of magma (interior)/ lava (earth surface).
  - Sedimentary Rocks: Formed by precipitation from solutions and consolidation of remnants of biotic components.
  - Metamorphic Rocks: Formed from pre-existing rocks.

Igneous Rocks

- These rocks are formed by solidification of magma in the interior, or lava on the surface of earth.
- Igneous rocks are composed of primary minerals, which are predominantly silicates.
- Igneous rocks sometimes overlap with sedimentary and metamorphic rocks.

Sedimentary Rocks

- Sedimentary rocks are formed by the precipitation from solutions, and consolidation of remnants of biotic components like plants and animals.
- These rocks contain both original primary minerals (Quartz, Mica) and altered as well as newly synthesised secondary minerals (Clay, calcite, gypsum).

Metamorphic Rocks

- Also known as Thermal rocks they are formed from pre-existing rocks (igneous or sedimentary) due to change in the temperature and pressure in solid state is known as metamorphic rocks.
- These rocks are formed when magma intrudes through pre-existing igneous or sedimentary rocks.
- All types of pre-existing rocks could undergo metamorphism.
- Further, igneous and metamorphic rocks get weathered and form sediments. These sediments get deposited and lithified into sedimentary rocks.

Soil

- Soil is the surface layer of the land
- It is a natural body that contains a variable mixture of broken and weathered materials and decaying organic matter, which covers the earth in a thin layer.
- It takes long period of time for the soil to form through the natural process.
- The formation takes place from the weathering and decomposition of rocks and minerals.
- Soil is a dynamic layer of earth's crust which is constantly changing and developing. The upper limit of soil is air or water and its lateral margins grade to deep water or barren areas of rock or even ice.

Types of Soil

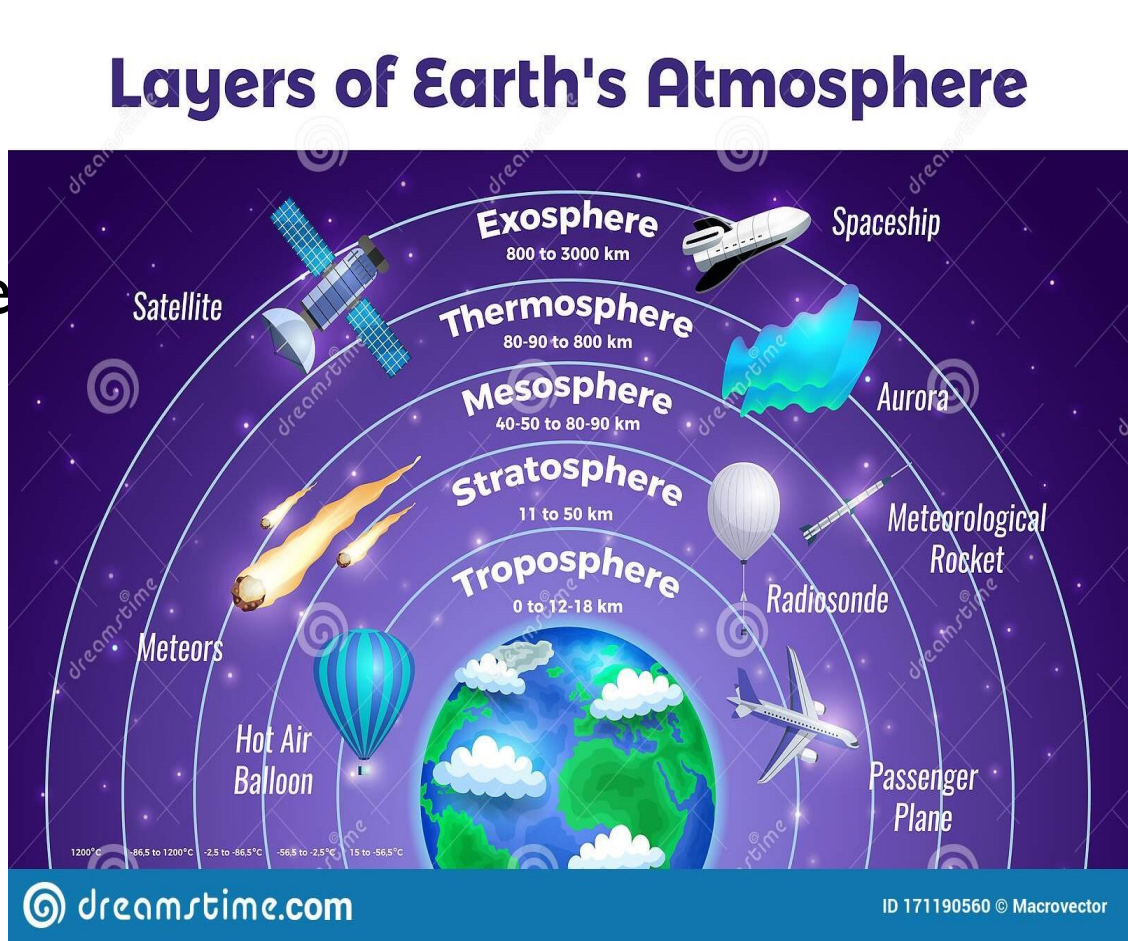
S. No.	Soil	Details
1	Volcanic ash	Volcanic ash is fine grained, and has the property of weathering relatively easily. Plants invade a new deposit of volcanic ash quickly and colonise it very fast. This could happen even within a few years' time. The soils that result from volcanic ash, known as Andisols, are fine textured. It is fertile and normally rich in organic matter and plant nutrients. These soils are likely to be found in places where there are active and recently extinct volcanoes. It is estimated that these soils cover approximately 124 million ha of land (0.84 per cent of earth's surface).
2	Granite	Granite is a coarse-grained rock. It has about 25 per cent quartz and 65 per cent orthoclase. It may also have small amounts of mica and hornblende. Soils that develop from granite are usually sandy in nature. They are normally low in nutrient content, with characteristics like being friable, permeable, acidic, and low in base status. This soil has very little cohesion or consolidation, and is highly susceptible to erosion.
3	Limestone	Limestone rocks mainly contain calcite. They also have considerable quantities of impurities of other carbonates, silt, clay, quartz, iron, and so on. Soils that result from limestone are clayey. It could also be in the form of clay loams and sandy loams.
4	Sandstone	Sandstone mostly consists of sand sized quartz. It could also have impurities such as feldspar and mica, and other agents, like silica, iron, and lime. Soils that are formed from sandstone are not fertile, usually coarse textured and acidic in nature. However, the characteristics of sandstone soils are dependent on the particular type of sandstone—whether grain size or mineralogical composition.
5	Basalt	Basalt is fine textured in nature. It is rich in ferromagnesian and calcic plagioclase minerals. Basalt gets weathered relatively easily to form fine-grained clay minerals. The soils that originate from Basalt are fine textured in nature. It has good amount of the minerals and has a high base status.

Functions of Soil

- It provides mechanical support to the plant
- It has the ability of holding water as it has the property of porosity. This ability makes soil a reservoir of water
- Soil provides micro and macro nutrients, as well as ideal pH required for the growth of the micro-organisms, plants and animals.
- Soil prevents excessive leaching of nutrients.
- Soil houses bacteria that fix nitrogen and other elements; fungi, protozoa and other micro-organisms. These organisms aids in the decomposition of organic matter

Atmosphere

- Layers of Atmosphere – Based on temperature
  - Troposphere
  - Stratosphere
  - Mesosphere
  - Thermosphere



Troposphere

- The bottom dense part, containing 70 percent of the mass, close to the ground is troposphere.
- It reaches up to 11 km from the ground. Clouds, storms, fog and haze are found only in troposphere.
- The temperature in this layer decreases at about -6.4°C/km with height.
- This decrease of temperature with altitude is called lapse rate.
- The boarder of troposphere is called Tropopause. Tropopause acts like a lid over troposphere.
- Temperature stops decreasing with height from tropopause.

Stratosphere

- This is a clear layer above troposphere that extends to a height of about 50 km from earth's surface.
- This layer does not have clouds, storms or dust. Clouds are not formed since water vapour is absent.
- Ozonosphere is an important layer found within stratosphere.
- Ozone (O3) is found in this layer.
- Ozone absorbs and prevents the harmful ultraviolet radiations from reaching earth, thereby protecting life.
- The maximum concentration of ozone occurs at 22 km from the ground level.
- Above the stratosphere, there is a small layer called stratopause where temperature neither increases nor decreases with height.

Mesosphere

- The portion of the atmosphere above stratosphere, between 50 km and 80 km is known as mesosphere.
- It starts from the edge of Stratopause.
- Though the temperature in mesosphere near stratosphere is higher by about 10°, it falls to -75°C at 80 km.
- The density of air at this height is about 1/1000 as that of sea level.
- Mesosphere plays a crucial role in radio communication as ionisation occurs here.
- The sunlight passing through this layer converts individual molecules to charged ions. These ionised particles are concentrated as a zone in this layer, which is named D-layer. The D-layer reflects radio waves transmitted from earth.
- Just above the mesosphere is a small layer called Mesopause, where temperature is stable.

Thermosphere

- Thermosphere extends from 80 km to about 60,000 km from earth. Here the temperature increases to about 2000°C.
- The property of thermosphere is radically different from the others. Ions are abundant in thermosphere.
- In thermosphere that most of the approaching meteoroids burn up before reaching earth.

Ozone Layer

- Ozonosphere is found within stratosphere.
- Ozone (O3) is found in this layer.
- Ozone absorbs and prevents the harmful ultraviolet radiations from reaching earth, thereby protecting life.
- Without Ozone layer, life would not have been possible on earth.
- The maximum concentration of ozone occurs at 22 km from the ground level.

Depletion of Ozone Layer

- Due to human activities ozone layer is becoming thin, and is called ozone depletion.
- **Ozone Oxygen Cycle**
  - The ozone layer is located in the lower part of the stratosphere between 15 km and 35 km.
  - Concentration of ozone is the maximum at about 25-30 km.
  - The level of ozone is maintained at this level by Ozone-Oxygen Cycle.
  - When ultra-violet radiation that spread out from the sun strikes the oxygen molecule (O_2), it splits the molecule into two individual oxygen atoms (O+O).
  - The oxygen atoms, thus produced, combines with O_2 molecule and produce ozone molecule (O_3).

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- This reaction is aided by either Nitrogen (N_2) or Oxygen, which absorbs the excess energy that is liberated. Ozone thus formed will be split by ultra-violet rays into a molecule of oxygen (O_2) and an atom of oxygen (O).
- It is through this repeated circular ozone and oxygen formation that the concentration of ozone is maintained in the stratosphere.
- The concentration of ozone in the atmosphere is determined by the rate of its formation and destruction in the above manner.
- Due to severe depletion of ozone in the atmosphere 'ozone holes' are created.
- Ozone holes, which were discovered in 1985, are overhead areas having less than 220 Dobson Units (DU).

Depletion by CFCs and BFCs

- CFCs and BFCs are stable compounds in the atmosphere that have the property of living longer (50 to 100 years). Due to their long life, they rise up to the stratosphere.
- Through the action of UV radiation from the Sun on these compounds, Chlorine (Cl) and Bromine (Br) radicals are released. These radicals act as catalysts, and initiate breaking down of ozone molecules.
- It is estimated that a single such radical of either Cl or Br is capable of breaking down over a lakh of ozone molecules.
- Due action, Ozone concentration is decreasing at a drastic rate of four percent per decade.
- As a result of the inherent long life of CFCs and BFCs, they continue to deplete ozone layer in a recurrent manner.

Depletion by Nitric Oxide

- One molecule of nitric oxide (NO) combines with ozone (O_3); it gets oxidised to nitrogen dioxide (NO_2) and Oxygen (O_2).
- This NO_2 combines with another O_3 molecule to become NO_3 (Nitrate) and O_2. The NO_2 and NO_3 then combine to form N_2O_5 (Dinitrogen pentoxide).
- Even the atomic oxygen(O) readily combines with NO_2 to yield NO3.
- Due to this series of actions and reactions, ozone is completely utilised, and thereby depleted.
- Large quantities of nitrogen are emitted by aircrafts that community decided to withdraw the operation of jet aircrafts that emit oxides of nitrogen to reduce the depletion of ozone.

Green House Effect

- Certain physical processes that takes place in the troposphere are responsible for the weather and climate of that particular place.
- Principles of Meteorology
  - Incoming solar radiation
  - Outgoing radiation.

Incoming Solar Radiation

- Atmosphere behaves like a complex mega heat engine.
- A large number of processes like air movements (storms and cyclones), evaporation and formation of clouds, precipitation, etc. take place in the atmosphere.
- The Incoming Solar Radiation (Insolation) supplies the required energy and drives these process.
- Only two in a billionth of the solar energy reaches Earth, of which only a small portion is responsible for the physical and biological processes.

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- Solar radiation contains X-rays, gamma rays, ultraviolet (UV) rays, visible light, infrared rays, microwaves, radio waves etc.
- Of all the energy received by earth: UV, visible and infrared portions constitute over 95 per cent.
- The harmful UV radiation is prevented from reaching earth by the ozone layer.
- The solar radiation which ultimately reaches the earth comprises mainly of visible light, which is composed of seven colours.
- While travelling through the atmosphere, a portion of the radiation energy is reflected by clouds, and some are scattered and absorbed by gases and particles.
  - The scattered radiation that reaches earth is called diffuse radiation.
  - Only a small quantity of the scattered radiation (22 per cent) reaches earth's surface.

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- The radiation energy is reflected by clouds, scattered and absorbed by gases and particles.
- The solar radiation that reflects back (albedo) is based on the surface characteristics.

Radiation	Percentage
Reaches directly	31%
Cloud reflection	25%
Dust reflection	5%
Absorbed by clouds and other molecules	17%
Scattered radiation reaches earth	22%

Outgoing Radiation

- If the entire energy that is received from sun retained in its earth's surface, the planet would be very hot and would become an inhabitable place.
- The earth, after heating up of its surface, reflects a certain amount of energy. Some of this heat energy is transmitted to the upper layers of air through conduction.
- The heat energy so emitted from the earth's surface is in the form of long wave radiation, and is called outgoing radiation.
- While a portion of the outgoing radiation is absorbed by certain gases in the atmosphere and retained as heat energy and the remaining energy escapes into the outer space.
- Gases capable of absorbing outgoing radiation are CO_2, CO, water vapour, etc. They are called Green House Gases (GHG).

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- Due to the effect of Green house gases, Earth is prevented from cooling down drastically. GHGs thus act like a blanket and provide earth with an ideal climate for life to flourish.
- This is known as Green house effect.
- The intensity of Green house effect varies from place to place depending upon the concentration of GHGs.

Weather

- When radiation from insolation strikes earth, its top layer gets heated.
- The heat energy so created through the interplay of insolation and outgoing radiation is transferred to the overlying atmosphere through activities like conduction and convection.
- Due to this, as well as the movement of earth, air moves in all directions-both horizontally and vertically. This movement of air is the basis of weather.
- Weather is the atmospheric conditions that exist for a short duration which can span over few hours to a number of days.
  - Weather conditions can fluctuate very often.
- The average weather or atmospheric conditions over a fairly long period of time like months, years or even decades; in a particular area is called climate.
- Phrases related to weather
  - Temperature, Humidity, Precipitation, etc

Temperature

- Temperature is the index of heat that is sensible.
  - It indicates the kinetic energy of molecules, or the speed at which the molecules moves.
- While in air and water, molecules keep on moving and change their location very often and in solids the molecules involve in a vibration movement and not moving.
- The speed at which this vibration takes place is described as temperature.
- A body having higher temperature has the property of transmitting it to another one having lower temperature.
- Temperature is measured using thermometer, and is reported in either Celsius, Kelvin or Fahrenheit scales.

Temperature Variations in Troposphere

- The earth's temperature varies in an altitudinal and horizontal manner in the troposphere.

1. Altitudinal Variation:

- In the troposphere, temperature decreases with height. It decreases at a rate of -6.4°C/km(lapse rate).
- The lapse rate is not uniform and it varies due to different conditions like pollution in the atmosphere.

1. Horizontal Temperature Variation

- Temperature varies at different times of the day at different locations due to various reasons and factors. It also varies at different months and seasons of the year. Few reasons for this variation are:
  - The hour of the day: More solar energy is received during the noon, when sun's rays strike vertically overhead; than hours in the morning hours, when the rays strike at angles.
  - Insolation: The phenomenon of day and night occurs as a result of the revolution and rotation of earth. Due to revolution one half of the globe is exposed to sunlight and the other half is in darkness. The temperature of any given area is based on the insolation of that area. The length of daylight and the angle at which the rays fall on earth also determine the amount of insolation and the temperature of that particular area.

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- Distance from the Equator: The sun rays strike in perpendicular manner on the equator. Near to the poles it strikes at an angle. Due to this, areas farther away from equator will experience lesser temperature as compared to the areas near the equator.
- The tilt of the axis: The earth's axis is tilted at angle of 66½ degrees to the plane of the ecliptic. This tilt is maintained throughout its orbit. This tilting of the axis leads to seasonal variations. Due to this, the months closer to June are summer months in this hemisphere. During this period, the northern hemisphere receives greater amount of solar energy, and hence, higher temperature. Places near to the equator receive more solar energy resulting in higher temperature

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- The Surface: The heating of earth's surface differs according to the type of the surface in an area. For instance, rocky surfaces get heated rapidly, while water takes considerably long time to get heated up. In the same way, rocky surfaces loose heat rapidly as against water which loose heat slowly. In any given place, different types of surfaces exist. Hence, there will be a mixture of heating and cooling properties.

Cyclones

- The atmospheric pressure in a given area has an important role to play with respect to the formation of a cyclone. When a flow of air moves along curved isobars which is a net centripetal acceleration pulls it toward the centre of a curvature, making the air to rotate. Such wind (called gradient wind) is called cyclone
- If the movement of the gradient wind is in the anticlockwise direction in the northern hemisphere. it is called cyclone and anticyclone in southern hemisphere.
- In the southern hemisphere, the clockwise motion of gradient wind is called cyclone and anticyclone in northern hemisphere.
- During a cyclone, the surface air moves towards the centre having low pressure and hence converges. The converged air has the property of ascending in the centre within the low pressure area.
- The reverse happens in a high pressure area. Air tends to sink in the centre of a high pressure area during anticyclones.

Atmospheric Circulations

- When Earth rotates on its axis, the rotation causes the deflection in the wind flow due to Coriolis force.
- In addition to this, a low pressure belt is formed over the tropical regions, since the equatorial region is heated throughout the year.
  - This belt is called the Inter-Tropical Convergent Zone (ITCZ). This zone is also known as doldrums.
- This is not a conspicuous belt, but a discontinuous one that fluctuates in its position and intensity.

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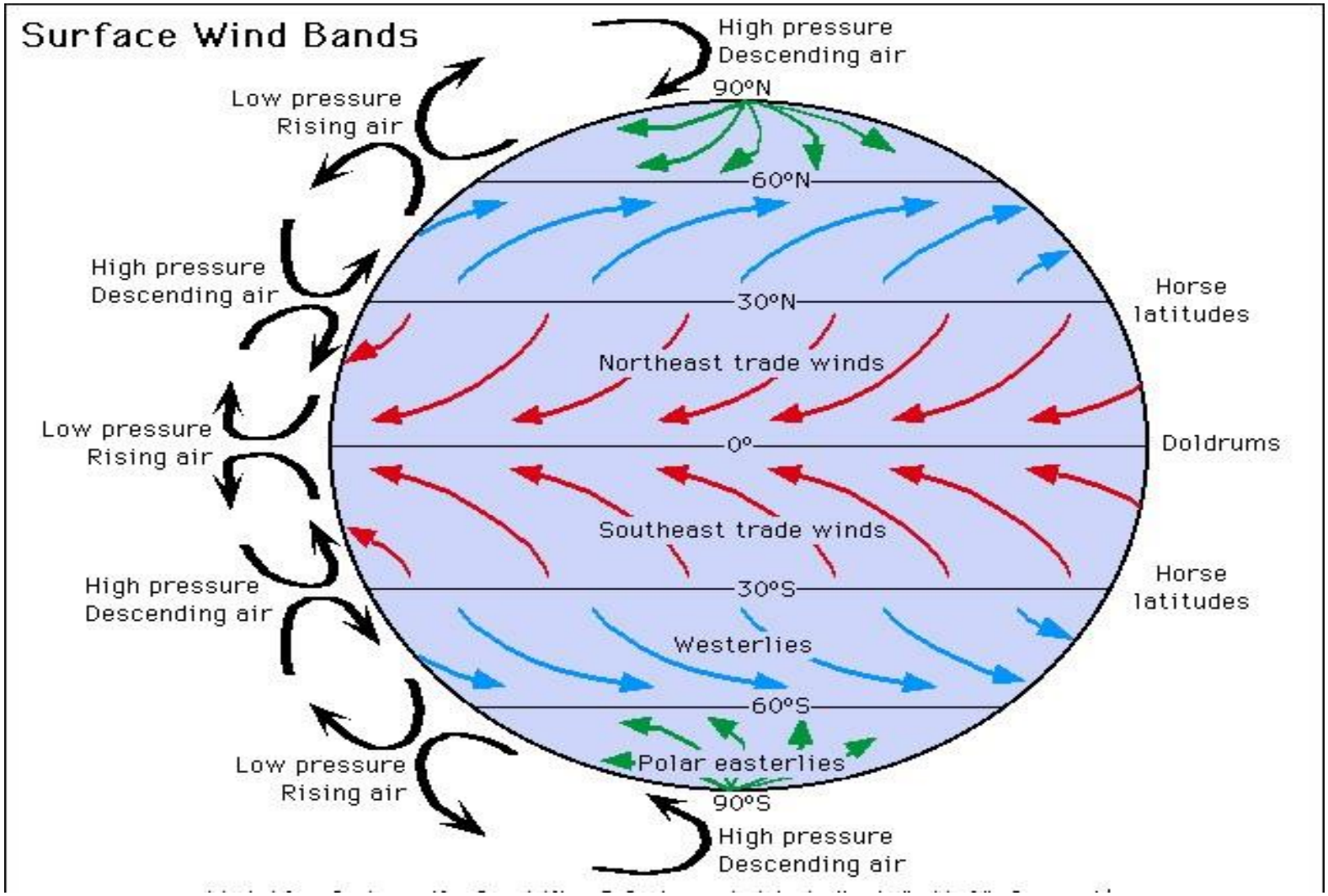
Surface Wind Bands
High pressure
Descending air
90°N
Low pressure
Rising air
60°N
High pressure
Descending air
30°N
Horse
latitudes
Northeast trade winds
Low pressure
Rising air
0°
Doldrums
Southeast trade winds
High pressure
Descending air
30°S
Horse
latitudes
Westerlies
60°S
Low pressure
Rising air
Polar easterlies
90°S
High pressure
Descending air

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- **Atmospheric circulation:** Even with disruptions like weather fronts and storms, there is a consistent pattern to how air moves around our planet's atmosphere.
- This is caused because the Sun heats the Earth more at the equator than at the poles. It's also affected by the spin of the Earth.
- In the tropics, near the equator, warm air rises. When it gets about 10-15 km (6-9 miles) above the Earth surface it starts to flow away from the equator and towards the poles.
- Air that rose just north of the equator flows north. Air that rose just south of the equator flows south.
- When the air cools, it drops back to the ground, flows back towards the Equator, and warm again. The, now, warmed air rises again, and the pattern repeats. This pattern, known as convection, happens on a global scale. It also happens on a small scale within individual storms.

The Indian Monsoon

- Monsoon is a regional wind that blows towards land at a certain season and blow from the landmasses during other season.
  - These wind blows in the opposite direction in summer and winter.
- Though monsoon winds blow over all parts of the world, it is well-developed over India and the South-east Asian regions. The Indian subcontinent has two types of winds.

1. South-West Monsoon
2. North-East Monsoon

South-West Monsoon

- The south-east trade winds originate from the southern hemisphere in the Indian Ocean. When these winds cross the equator, they get deflected towards the right by the Coriolis force, becoming the south-west trade winds. These winds gather large quantities of moisture as they pass over the Indian Ocean.
- As the SW monsoon winds approaches the Indian Peninsula, they are diverted into two-the Arabian Sea Branch and the Bay of Bengal Branch.
- When the moisture laden Arabian Sea branch reaches the south-western side of India, they are blocked by the Western Ghats.

- When the mountain range blocks the horizontal flow, the wind ascends along the slope of the mountain range, gets cooled down and form clouds. These clouds then results in precipitation.
- Kerala gets the south-west monsoon mostly during early June every year.
- These winds then take a west turn and continue their journey, and spread over the northern parts of India bringing in rains to these areas.
- Monsoon winds normally reach Delhi in the first week of July and could last till end September/early October.

North-East Monsoon

- The Inter-Tropical Convergent Zone (ITCZ) moves to the south of the equator, when the position of the sun shifts to the southern hemisphere. This leads to the reversal of winds, and the winds start blowing from the north-eastern direction towards the ITCZ. These winds are known as the north-east monsoon winds or the north-east trade winds.
- Since North-East winds originate mainly from the land masses of the north-east region of India, they are relatively dry.
- When these winds pass over the Bay Bengal towards south, they gather moisture and cause rainfalls over parts of Odisha, Andhra Pradesh and Tamil Nadu.
- Cyclone formation is common over Bay of Bengal during the north-east monsoon season. The cyclones also bring in abundant rainfall over Odisha, Andhra Pradesh, Telengana and Tamil Nadu.

Impact of Monsoons on Life in India

- Positive
  - About 64% of people in India depend on agriculture for their livelihood and agriculture itself is based on monsoon.
  - Agricultural prosperity of India depends very much on timely and adequately distributed rainfall. If it fails, agriculture is adversely affected particularly in those regions where means of irrigation are not developed.
  - Regional variations in monsoon climate help in growing various types of crops.
  - Regional monsoon variation in India is reflected in the vast variety of food, clothes and house types.
  - Monsoon rain helps recharge dams and reservoirs, which is further used for the generation of hydro-electric power.

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- Negative
  - Variability of rainfall brings droughts or floods every year in some parts of the country.
  - Sudden monsoon burst creates a problem of soil erosion over large areas in India.
  - In hilly areas sudden rainfall brings landslide which damages natural and physical infrastructure subsequently disrupting human life economically as well as socially.

Hydrosphere

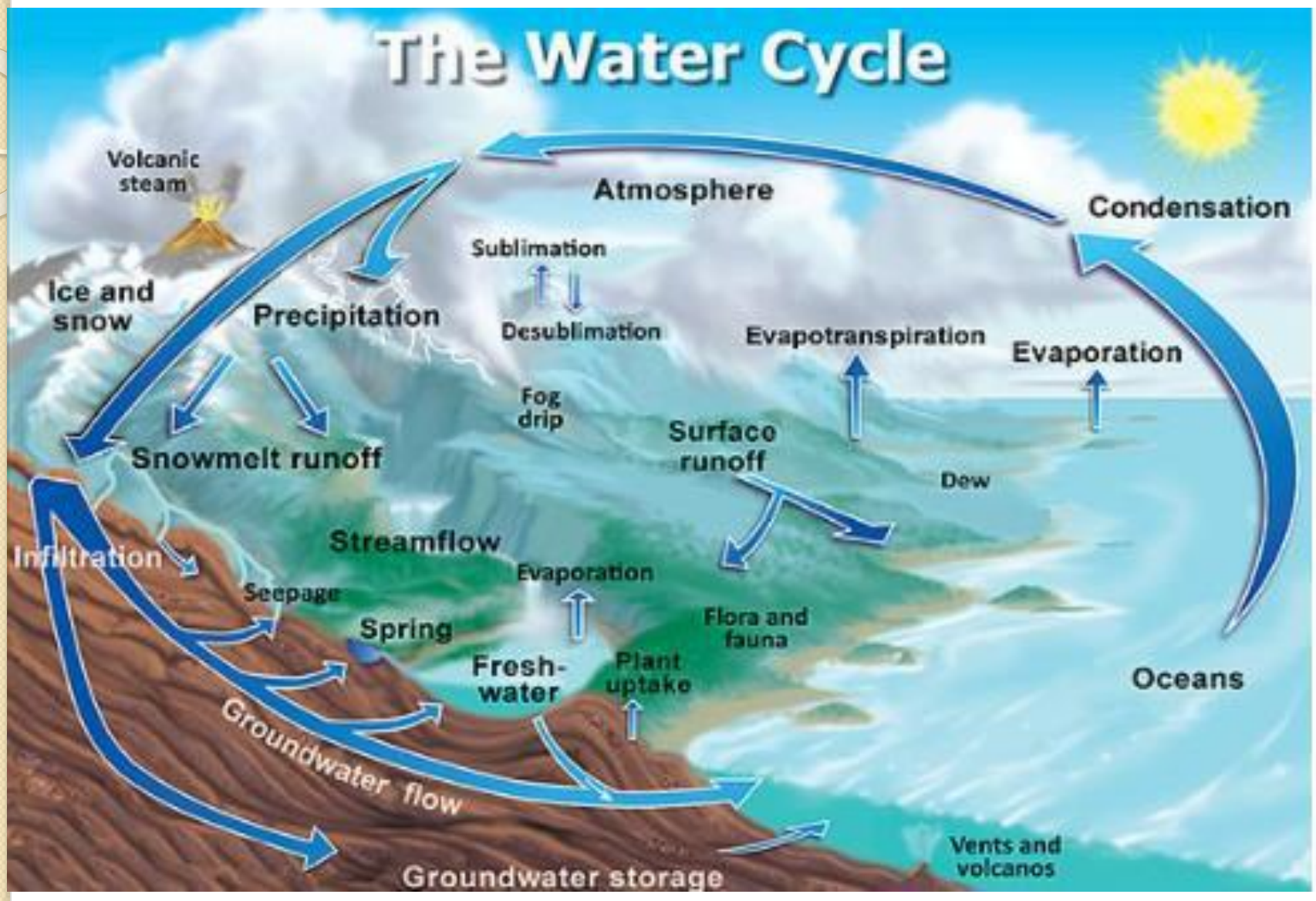
- Hydrosphere forms over 70% over the earth's surface.
- Water is found in oceans as well as on land.
- Life is made possible on earth, due to the availability of water.
- The hydrosphere has direct influence on climate and weather conditions on earth.
- This is due to the worldwide oceanic circulations.
- The average depth of ocean is about 3.7kms
- The floor of ocean has mountain ranges and valleys, isolated volcanic peaks and vast plains.

Water in oceans

- Water in ocean is saline in nature.
- The salinity occurs mainly due to the presence of dissolved salt in it. Among the salts, NaCl is of high concentration.
- Salt is lost to the atmosphere, when wind blows off. The salt in the atmosphere enables water molecules to stick to it and falls on land with rain/snow.
- Oceans also influence climate, through their ability to absorb solar energy and transfer it to the world through "Oceanic circulations".

Water on land

- Fresh water constitutes the basis of life on land.
- On land , water is found in all three forms.
- In liquid form, water is found in lake, rivers, streams, ground water and soil moisture.
- In solid form, water is found in the form of glacial ice, ice caps and ground ice.
- The fresh water on the surface of the earth is eventually interchanged between the earths surface and atmosphere.
- This cycle is called water cycle or hydrological cycle.


The Water Cycle
Volcanic steam
Atmosphere
Condensation
Sublimation
Ice and snow
Precipitation
Desublimation
Evapotranspiration
Evaporation
Fog drip
Surface runoff
Snowmelt runoff
Dew
Streamflow
Infiltration
Evaporation
Seepage
Spring
Flora and fauna
Fresh-water
Plant uptake
Oceans
Groundwater flow
Vents and volcanos
Groundwater storage

BIOSPHERE

- Biosphere is a giant ecosystem that consist of two major ecosystems.
  - Terrestrial ecosystems
  - Aquatic ecosystems
- Both are further categorized into natural and artificial ecosystems.
  - Natural Terrestrial ecosystems contains mountains, grasslands, forest, desert etc. and Artificial Terrestrial ecosystems consist of crop field, garden etc.
  - Natural Aquatic ecosystems contains marine and fresh water ecosystem and Artificial Aquatic ecosystems consist of aquarium and sewage ecosystem.

Terrestrial ecosystem

- A terrestrial ecosystem is a land-based community of organisms and the interactions of biotic and abiotic components in a given area. Examples of terrestrial ecosystems include the deciduous forests, tropical rainforests, grasslands, and deserts.
- They are categorized into two
  - Natural Terrestrial ecosystems- no human intervention
  - Artificial Terrestrial ecosystems- human intervention is there. Emerged due to industrial revolution and increased need of humans.

Aquatic ecosystems

- An aquatic ecosystem is an ecosystem in and surrounding a body of water. ... Communities of organisms that are dependent on each other and on their environment live in aquatic ecosystems. The two main types of aquatic ecosystems are
  - Natural Aquatic ecosystems-marine ecosystems and freshwater ecosystems.
  - Artificial Aquatic ecosystems- aquarium and sewage ecosystem.