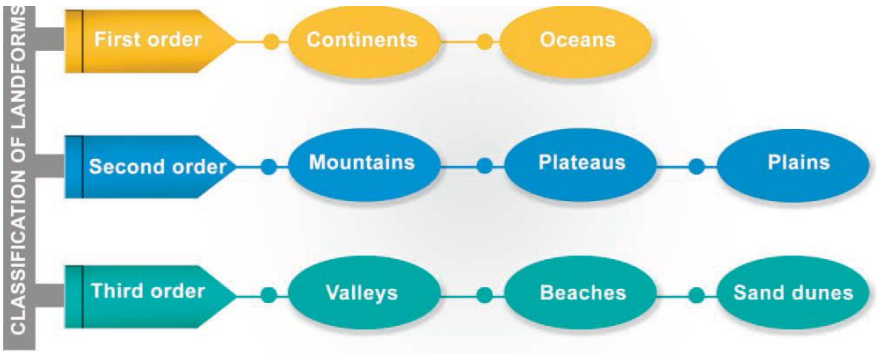
Physical Features
Part – I
6th Term I
Unit-2 Land and Oceans

- This is Pangea, the Super Continent, and the Sea around is Panthalasa. It was 200 million years ago, when these landmasses moved away from each other to gain the present position as continents and oceans."

- The Earth is covered by water which occupies 71 percent and land that occupies 29 percent of the Earth's surface. The surface of the Earth is not even, because it has lofty mountains, deep oceans and other landforms. These landforms can be classified as



First order landforms

- Continents and oceans are grouped as first order landforms. The vast land masses on Earth are called Continents and huge water bodies

are called Oceans. There are seven continents. They are Asia, Africa, North America, South America, Antarctica, Europe and Australia. Asia is the largest continent, whereas Australia is the smallest one.

Land classification - Sangam period

- Kurinji - Mountain and its environs
- Mullai - Forest and its surroundings
- Marutham - Agricultural land and its adjoining areas.
- Neithal - Sea and its environs
- Palai - Desert region

- Apart from continents, there are five oceans located on the Earth's surface. They are the Pacific, Atlantic, Indian, Southern and Arctic Ocean. Among these oceans, the Pacific Ocean is the largest and the Arctic Ocean is the smallest.

Isthumus : A narrow strip of land which connects two large landmasses or separates two large water bodies.

Second order landforms

- The second order landforms are categorised as mountains, plateaus and plains.

Mountains

- A landform that rises 600 metre above its surroundings and has steep slopes is called a mountain. Mountains are found in isolation or in groups. If the mountains extend for a larger area continuously, it is called a mountain range. These ranges stretch for hundreds or thousands of kilometre. The Himalayas of Asia, the Rocky Mountains of North America and the Andes of South America are such examples. The Andes mountain in South America is the longest mountain range (7,000 km) in the world. The highest point of a mountain is known as peak. Mt. Everest is the highest peak (8,848 m) in the world.

- Mountains are the sources of rivers. They provide shelter to flora and fauna. Here, tourism is an important activity. During summer, people go to mountain regions to enjoy the pleasing cool weather.

Udhagamandalam, Kodaikanal, Kolli hills, Yercaud and Yelagiri are some of the hill stations found in Tamil Nadu.

Plateaus

- Plateaus are the elevated portions of the Earth that have flat surfaces bounded by steep slopes. The elevation of plateaus may be a few hundred metre or several thousand metre. Tibetan Plateau is the highest plateau in the world. So, it is called as the 'Roof of the world'. The flat topped part of the plateau is called Tableland. The plateaus are generally rich in minerals. The Chotanagpur Plateau is one of the mineral rich plateaus in India. Therefore, mining is one of the major activities of the people living here. The Deccan Plateau in peninsular India is of volcanic origin.

Dharmapuri Plateau, Coimbatore Plateau and Madurai Plateau are found in Tamil Nadu.

Plains

- Plains are a flat and relatively low-lying lands. Plains are usually less than 200 metre above sea level. Sometimes they may be rolling or undulating. Most plains are formed by rivers and their tributaries and distributaries. These plains are used extensively for agriculture due to the availability of water and fertile soil. They are most suitable for human inhabitation. Hence, they are the highly populated regions of the world. The oldest civilisations like the Mesopotamian and the Indus civilisations developed in river plains. The Indo-Gangetic plain in North India is one of the largest plains in the world. The plains formed by river Cauvery and Vaigai are important plains found in Tamil Nadu. Coastal plains are the low lying lands adjacent to oceans and seas.

The plains have been the cradle of civilisations from the earliest times. **For example:** the Indus in India, the Nile valley in Egypt are some of the early civilisations which developed and flourished.

Third order landforms

- Third order landforms are formed on mountains, plateaus and plains mainly by erosional and depositional activities of rivers, glaciers, winds and waves. Valleys, beaches and sand dunes are some examples of third order landforms.

Erosion is the process of removal of surface material from the Earth's crust. The eroded materials are transported and deposited on the low lying areas. This process is called as Deposition

Oceans

- The Earth looks blue when we see it from space. This is because, two-thirds of it is covered by water. The water is found in oceans and seas. Oceans are vast expanse of water. Seas are water bodies partially or fully enclosed by land. As you have studied previously, there are five main oceans in the world.

The Pacific Ocean

- The Pacific Ocean is the largest and deepest ocean on the Earth. It covers about one-third of the Earth's total area and spreads for about 168.72 million sq.km. It is bounded by Asia and Australia in its west and North America and South America in its east. It stretches from the Arctic Ocean in the north to the Southern Ocean in the south.

If Mount Everest, which is the highest point (8,848 metres) was plugged into the Mariana Trench, still there would be 2,146 metres of water left. The depth in meters from mean sea level is denoted as m-

- This ocean's shape is roughly triangular with its apex in the north at the Bering Strait which connects the Pacific Ocean with the Arctic Ocean. The Bering Sea, the China Sea, the Sea of Japan, Tasman Sea and the Philippine Sea are some of the marginal seas of the Pacific Ocean. Indonesia, Philippines, Japan, Hawaii, New Zealand are some of the islands located in this Ocean. The deepest point Mariana Trench is 10,994 m- and is located in the Pacific Ocean. A chain of volcanoes is located around the Pacific Ocean called the Pacific Ring of Fire.

The Spanish navigator Ferdinand Magellan named the ocean Pacific, meaning calm or tranquil.

The Atlantic Ocean

- The Atlantic Ocean is the second largest ocean on the Earth. It covers one sixth of the Earth's total area and spreads for about 85.13 million sq.km . It is bounded by North America and South America in the west and Europe and Africa in the east. Like the Pacific, it stretches from the Arctic Ocean in the north to the Southern Ocean in the south. The shape of the Atlantic Ocean resembles the letter 'S'. The Strait of Gibraltar connects the Atlantic Ocean with the Mediterranean Sea. The Atlantic Ocean is the busiest shipping route between the Eastern and Western hemispheres. The deepest point is the Milwaukee Deep in the Puerto Rica Trench. It has a depth of about 8600 m-. The Caribbean Sea, the Gulf of Mexico, the North Sea, the Gulf of Guinea and the Mediterranean Sea are important marginal seas of the Atlantic Ocean. St. Helena, Newfoundland, Iceland and Falkland are some of the islands found in this ocean.

The Indian Ocean

- The Indian Ocean is the third largest ocean on the Earth's surface. It covers an area of about 70.56 million sq.km. It is named after India. It is triangular in shape and bounded by Africa in the west, Asia in the north and Australia in the east. The Andaman and Nicobar Islands, Lakshadweep, Maldives, Sri Lanka, Mauritius and the Reunion Islands are some of the islands located in the Indian Ocean. Malacca strait connects the Indian Ocean and the Pacific Ocean.

Palk Strait connects the Bay of Bengal and Palk Bay.

- The Bay of Bengal, the Arabian Sea, the Persian Gulf and the Red Sea are some of the important marginal seas of the Indian Ocean. The Java trench (7,725 m-) is the deepest point in the Indian Ocean.

- 6° Channel separates Indira Point and Indonesia
- 8° Channel separates Maldives and Minicoy islands
- 9° Channel separates Lakshadweep Islands and Minicoy islands

- 10° Channel separates Andaman and Nicobar Islands

The Southern Ocean

- The Southern Ocean surrounds the continent of Antarctica and is enclosed by the 60°S latitude. It covers an area of 21.96 million sq.km. It is bordered by the southern parts of the Pacific, the Atlantic and the Indian Oceans. The Ross Sea, the Weddell Sea and the Davis Sea are the marginal seas of this Ocean. Farewell Island, Bowman Island and Hearst Island are some of the islands located in this ocean. The water in this ocean is very cold. Much of it is covered by sea ice. The deepest point in this ocean is South Sandwich Trench with a depth of 7,235 m-.

The Arctic Ocean

- The Arctic Ocean is the smallest ocean. It covers an area of 15.56 million sq.km. It lies within the Arctic Circle. It remains frozen for most of the year. The Norwegian Sea, the Greenland Sea, the East Siberian Sea and the Barents Sea are some of the marginal seas of this ocean. Greenland, New Siberian Island and Novaya Zemlya Island are some of the islands located in the Arctic Ocean. The North Pole is situated in the middle of the Arctic Ocean. The Eurasian Basin is the deepest point in the Arctic Ocean, which is about 5,449 m- in depth.

6th Term -3
Unit-1 Asia and Europe

ASIA

- Asia is the largest and the most populous continent in the world. It covers about 30 percent of the world's land area and about 60 percent of the world's population. Most of the land of Asia lies in the northern hemisphere. It has different types of physical and cultural features. Lofty mountains, plateaus, plains, islands and peninsulas are the major physiographic features of Asia. Many perennial rivers flow through different parts of Asia. These river valleys are the cradles of ancient civilizations (Indus valley, Mesopotamian and Chinese civilizations). Let us know more about our home continent.

Location and Area

- Asia extends from 10˚11' South to 81˚12' North latitudes and from 26˚2' East to 169˚40' West, longitudes. It spreads for an area of 44 million km2.

Boundaries

- Asia is surrounded by the Arctic Ocean in the north, Pacific Ocean in the east, Indian Ocean in the south and the Ural Mountains, Caucasus Mountains, Red Sea, Mediterranean Sea, Caspian Sea and Black Sea in the west. The Suez Canal separates Asia from Africa. The narrow Bering Strait separates Asia from North America.

Political Divisions

- There are forty eight countries in Asia. The countries are grouped into several realms based on landscape and political status such as 1.East Asia 2.Southeast Asia 3.South Asia 4.Southwest and 5.Central Asia

Physiographic Divisions

- Asia is the land of long mountain ranges, snow-capped high mountains, vast plateaus, extensive plains, river valleys and sea coasts. These diverse physical features encourage the people of this continent

to involve in diverse economic activities. The physiography of Asia can be divided into five major groups. They are;

1. The Northern lowlands
2. The Central High Mountains
3. The Southern Plateaus
4. The Great Plains and
5. The Island Groups

1. **The Northern Lowlands**: The most extensive lowland in Asia is the Siberian plain. It extends from the Ural Mountains in the west to the Verkhoyansk Range in the east.
2. **The Central Highlands:** The central highlands stretches from Turkey to the Bering Strait. There are two knots found in Asia. They are 1. The Pamir Knot 2.The Armenian Knot.

- The Hindukush range, the Sulaiman range, the Himalayan range and the Tian Shan range radiate from the Pamir Knot. The Hindukush range continues westward as the Elburz, whereas the Sulaiman range continues south west as the Zagros range. The Elburz and the Zagros converge at the Armenian knot. The Taurus and the Pontine ranges radiate from the Armenian knot. The other important mountain ranges are the great Khingan, the Altai, the Verkoyansk and the Arakan yoma. The Himalayan mountain range is the highest mountain range in the world Mt. Everest (8848 m) is the highest peak in Asia, as well as the world. The lowest point in the world is located in Dead Sea in Asia. Intermundane plateaus are found in these mountain ranges. The important plateaus are 1. The plateau of Anatolia (Pontine to Taurus) 2. The plateau of Iran (Elburz to Zagros mt) 3. The plateau of Tibet (Kunlun to Himalayas)

The Southern Plateaus: The southern plateaus are relatively lower than the northern plateaus. The four important southern plateaus are the Arabian Plateau (Saudi Arabia), Deccan Plateau (India), Shan Plateau (Myanmar) and the Yunnan Plateau (China). Among these plateaus, the Arabian Plateau is the largest Plateau.

The Great Plains: The great plains are formed by the major rivers of Asia. They are the West Siberian plain (Ob and Yenisey), Manchurian Plain (Amur), Great Plain of China (Yangtze and Sikiang), Indo-Gangetic Plain (Indus and Ganga), Mesopotamian plain (Tigris and Euphrates) and the Irrawaddy plain (Irrawaddy).

The Island Groups

- Numerous islands are found in the Pacific coast of Southeast Asia. Kuril, Taiwan, Singapore and Borneo are the important island groups.

The Philippines, Japan islands and Indonesia are the major archipelagos in Asia. Smaller archipelagos are also located in the Indian Ocean such as the islands of Maldives and Lakshadweep in the Arabian Sea. Bahrain is in the Persian Gulf. Sri Lanka is an island, which is located in the Bay of Bengal.

Drainage

- The rivers of Asia originate mostly from the central highlands. The Ob, Yenise and Lena are the major rivers that flow towards the north and drain into the Arctic Ocean. These rivers remain frozen during winter. On the other hand, South Asia has many perennial rivers (e.g.) Brahmaputra, Indus, Ganga and Irrawaddy which originate from the snow covered high mountains that do not freeze during winter. The Euphrates and Tigris flow in West Asia. The Amur, Huang He, Yangtze and Mekong rivers flow in the south and south eastern parts of Asia. Yangtze is the longest river in Asia.

S. No	Name of the River	Origin	Outflow	Length in KM
1.	Yangtze	Tibetan plateau	East China sea	6,350
2.	Huang He	Tibetan plateau	Gulf of Pohai	5,464
3.	Mekong	Tibetan plateau	South China sea	4,350
4.	Yenisei	Tannuala Mountain	Arctic Ocean	4,090
5.	Ob	Altai Mountain	Gulf of Ob	3,650
6.	Brahmaputra	Himalayas	Bay of Bengal	2,900
7.	Indus	Himalayas	Arabian Sea	3,610
8.	Amur	Confluence of Shika and	Tatar Strait	2,824

		Argun rivers		
9.	Ganga	Himalayas	Bay of Bengal	2,525
10.	Irrawaddy	North Myanmar	Bay of Bengal	2,170

Climate

- Asia exhibits a variety of climate. The northern part of Asia experiences severe long winter and cool summer. (Winter -37°C and Summer 10°C). Precipitation is in the form of snow (250 mm to 300 mm).The north eastern part of Asia experiences cold winter and warm summer and a moderate rainfall of 50 mm to 250 mm. The south, south east and eastern parts of Asia are strongly influenced by monsoon winds. Summer is hot and humid while winter is cool and dry. The summer monsoon winds bring heavy rainfall to India, Bangladesh, Indo-China, Philippines and Southern China (1500 mm to 2500 mm). In India, Mawsynram (11871 mm) receives the highest rainfall. So, this place is called the wettest place in the world. The areas found in and around the equator have uniform climate throughout the year. There is no winter. The average temperature is 27°C and the mean rainfall is 1270 mm.

- The west and central parts of Asia have hot, dry climate. The temperature is very high during the day and very low during the night. Rainfall varies from 25 mm to 200 mm. The West coastal fringe of Asia (along the Mediterranean Sea) receives rainfall in winter and is warm in summer. Deserts are found along the western part of Asia. The major hot deserts are the Arabian (Saudi Arabia) and Thar (India and Pakistan) deserts. The cold deserts of Asia are Gobi and Taklamakan. The largest desert in Asia is the Arabian Desert.

Natural Vegetation

- Natural vegetation depends upon rainfall, temperature and soil. As Asia stretches from the equator to poles, all types of vegetation are found here. Some rare species are found in Asia. (Orang- Utan, Komodo Dragon, Giant panda). The Asian flora and fauna are listed below:

S. No	Climate	Location	Flora	Fauna
1.	High Temperature, High rainfall	Indonesia, Malaysia, Singapore Sri Lanka	Evergreen trees- Mahogany, Rubber, Rosewood, Sal	Rhinoceros, tiger, Babirusa, Orangutan, Komoda Dragon
2.	Summer rainfall, Dry winter	India, Vietnam, Cambodia, Thailand, Southern China	Deciduous trees – Teak, Sandal Wood, Bamboo	Tiger, Elephant, Indian Cobra, viper
3.	Extreme temperatures	Arabian desert, North, North West India	Cactus, Dates (Oasis), Thorny shrubs, Babul tree	Bactrian Camel, The Sand grouse, desert oryx
4.	Dry winter, Warm summer	East China, Japan, North and South Korea	Cherry, Apricot, Plum	Giant Panda, Japanese macaque
5.	Warm Summer and winter rainfall	Israel, Lebanon, Turkey, Syria	Figs, Olives, Citrus fruits	Lynx, Jackrabbit
6.	Long and dry winter, short and cool summer	Siberia, Himalayas	Coniferous trees– Pine, Fir, Spruce	Siberian Tiger, Brown bear, Wolf
7.	Permanent snow cover	Beyond the snow line	Lichen, mosses Grass	Polar bear, Lemming, Reindeer, Arctic fox

Resource Base and Economic Activities of Asia

Mineral Resources

- Asia has a variety of mineral deposits. It holds an important place in the production of Iron, Coal, Manganese, Bauxite, Zinc, Tungsten, Petroleum, Tin etc. Oil and Natural Gas found in the west Asian countries. One third of the world's oil is produced in Asia. Among the west Asian countries, Iran has a considerable wealth of mineral resources. The important minerals found in Asia are:

  - ✓ **Iron Ore:** Asia has the largest deposits of iron ore in the world. China and India are the important iron ore deposit countries of

Asia. Turkey, Philippines, Malaysia, Thailand, Myanmar etc., are a few other countries that have iron ore deposits.

- ✓ **Coal:** Coal is a fossil fuel. Asia has the largest deposits of coal in the world. China and India are the largest producers of coal in Asia.

- ✓ **Petroleum:** Petroleum is a mineral oil. The largest petroleum reserves are found in South West Asia. The important petroleum producing countries are Saudi Arabia, Kuwait, Iran, Bahrain, Qatar and UAE. South China, Malaysia, Brunei, Indonesia, India, Russia are the other important petroleum producing countries in Asia.

- Bauxite is found in India and Indonesia. India is the largest producer of Mica in the world. Tin is found in Myanmar, Thailand, Malaysia and Indonesia.

Agriculture

- Only about 18 percent of the total area is cultivable in Asia. Agriculture is the chief occupation of the people here. The river valleys in the South, South East and East Asia have rich alluvial soil. Agriculture is intensively practised in the riverine plains of Asia. However, some areas are not suitable for agricultural practices. **India** has the largest area of arable lands in Asia. Most of the west Asian countries cultivate their crops where the ground water level is nearer to the surface. Iraq practices agricultural activities based on the availability of rainfall and supply of water from Euphrates and Tigris rivers.

- Rice and Wheat are the staple food crops in Asia. China and India are the leading producers of rice in the world. Other important rice producing countries are Myanmar, Japan, Bangladesh and Thailand. Monsoon Asia is suitable for rice cultivation because of the abundant rainfall, fertile plains and availability of labour. Thailand is called the Rice bowl of South East Asia. Wheat is grown in the temperate regions of Asia. Russia, India, China and Pakistan are the leading producers of wheat in Asia. Millets like Bajra, Jower, Ragi and Sorgham are grown in the drier parts of Asia. These are widely cultivated in India, Pakistan

and a few gulf countries. Apart from these, pulses, spices and oil seeds are also cultivated in various parts of Asia.

- Jute and cotton are the important natural fibres cultivated in Asia. One third of the world's cotton is produced by Asia. The major cotton producing countries are India, China, Russia and Kazakhstan. India, Pakistan, China and Bangladesh are the leading producers of jute. The tropical wet and dry climate is suitable for sugarcane cultivation in Asia. India, Indonesia and Philippines are the major producers of sugarcane. Coffee, Tea, Rubber, Palm trees and Cocoa are the important plantation crops. India, Sri Lanka, Thailand, Vietnam, Malaysia and Indonesia are importantan producers of plantation crops. Malaysia and Thailand are the leading producers of natural rubber. Dates are produced in west Asia, among the countries Iran is the largest producer of dates in the world.

1. **Fishing:** Fishing is an important economic activity in Asia. It is prevalent in open seas as well as inland water bodies. China and Japan are the leading fishing nations. In Cambodia, Tonle Sap lake is one of the world's richest sources of fresh water fishing. Bay of Bengal is the major fishing ground for India, Sri Lanka, Myanmar and Bangladesh. Fishing is the mainstay of the national economy in Maldives. Pearl fishing (Bahrein) is popular in the eastern coast of Arabia.

2. **Industrial Regions:** In China, Manchurian, Shanghai- Wuhan, Peking—Shenyang, Guangdone - Hongkong regions are the major industrial regions. In Japan, the major regions are Tokyo, Yokohama and Osaka-Kyoto regions. In India, Mumbai, Ahmedabad, Coimbatore, Bengaluru and Chottanagpur are the important industrial regions.

3. **Transport:** Transport is the backbone of the economic development of a region. Many Asian countries are developing their transport network for their economic progress. Roadway is the most common mode of transport in Asia.

4. **Roadways:** The Asian Highway connects Tokyo in the east to Turkey in the west, Russia in the north to Indonesia in the south and the total length of road is 1,41,000 km. It passes through 32 countries. The Asian Highway 1(AH 1) is the longest highway among the Asian

Highway Network (20557 km). It connects Tokyo to Turkey. The Asian Highway 43 (AH 43) runs from Agra in India to Matara in Sri Lanka (3024 km).

5. **Railways:** The Trans - Siberian Railways (9258 km) is the longest rail route in the world. It is a transcontinental railway line which connects Leningrad and Vladivostok. The Trans Asian Railway links Singapore and Istanbul in Turkey. The Shinkansen, bullet train is the world famous super express train that runs between Osaka and Tokyo in Japan at a speed of 352 km/h. The Indian railway network is the second largest railway network in Asia.

6. **Waterways:** The Cape of Good Hope route connects Europe to South Asia. The Trans Pacific route connects the ports of eastern Asia to the ports of western American countries. The Suez Canal route passes through the heart of the world trade route and connects Europe with South and Southeast Asia. Tokyo, Shanghai, Singapore, Hong Kong, Chennai, Mumbai, Karachi and Dubai are the important seaports in Asia.

Cultural Mosaic of Asia

1. **Population:** Asia is the most populated continent in the world. Approximately six-tenth of the world's population lives in Asia. The population is unevenly distributed because of various physical features. China and India alone covers three fifth of Asia's population. Apart from these two countries, Bangladesh, Indonesia, Japan, Pakistan and Philippines have more than 100 million populations. The population density in Asia is 143 persons per Km2. India, Japan, Bangladesh and Singapore have high population density. River plains and industrial regions have high density of population, whereas low density is found in the interior parts of Asia.

2. **Religion & Language:** Hinduism, Islam, Buddhism Christianity and Sikhism are the major creeds in Asia. The minor creeds Zoroastrianism, Jainism, Shintoism, Confucianism and Taoism are also practised in Asia. Mandarin, English, Indonesian, Japanese, Arabic, Korea, Vietnamese and Hindi are the most widely spoken languages in Asia.

3. **Art and Architecture:** Asia is the home land of three civilizations. (Mesopotamian, Indus valley and Chinese civilizations).These three

contributed to the architectural works at an early stage. Among the seven wonders of the world, two are located in Asia (The Tajmahal in India, The Great wall of China).The people of Yemen built a mud skyscraper thousands of years ago. Ankorwat in Cambodia, Buddhist Temple in East and Southeast Asia, Mosques in west Asia and the temples and forts in India are fine examples of Asian architecture.

4. **Food:** Rice, Wheat, Maize and Barley are the staple food in Asia. Dairy products, fruits and nuts are also consumed. In East Asia, bread and noodles are the staple food where rice is not available. Tea, Coffee and green tea are the chief beverages. In West Asia, meat, herbs and olive oil are the prime ingredients in their food.

5. **Dance and Music:** In Asia, Yangee, Dragon Dance, Kabaki are popular in East Asia Ram Thai in Thailand, Bhangra, Kathak and Bharathanatyam in India are also important dances in Asia. Sufi music and Arabic classical music are common in west Asia. Tinikling is the national dance of Philippines.

6. **Festivals:** The mid-autumn festival / moon festival in China, Taiwan and Vietnam. Holi and Mahara Sankaranthi / Pongal in major parts of India and Sukkoth in Israel are the important harvest festivals of Asia. The snow sculpture festival, Chinese New Year, Thaipusam, Diwali, Taiwan Lantern festival, Songkran, winter light festival are also some of the famous festivals in Asia.

7. **Land of contrasts:** Asia is the biggest continent. It has different types of land features such as mountain, plateau, plain, valley, bay, island etc. It also has different climatic conditions from the equator to polar region. Apart from this, many races, languages, religions and cultures are followed by people who live in Asia. So, Asia is called 'the land of contrasts'.

NOTE

- There are 12 landlocked countries in Asia. Among these, only one is doubly landlocked which means it is surrounded entirely by other landlocked countries. That is UZBEKISTAN. It is surrounded by 5 countries(Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan)
- 'Knot' refers to the convergence of mountain ranges.

- ❖ Tibet is called the 'Roof of the world' and it is also known as the third pole because of its cold weather, largest reserve of freshwater and inhospitable environment.
- ❖ The Three Gorges dam has been constructed across the river Yangtze. It is the largest power station dam in the world. It fulfills ten percent of power needs of China.
- ❖ A Desert is a large area that gets very low rainfall and very few plants and animals. There are two types of deserts found in Asia, Hot and cold deserts.
- ❖ Rub'al Khali desert is the largest, continuous sandy desert in the world. It is found in the south-eastern part of Saudi Arabia.
- ❖ **Banaue rice terrace:** The Banaue rice terraces were built 2000 year ago by the Ifugaos people in the Philippines. It is located approximately about 1524 m above sea level.
- ❖ **Ankorwat**: It is a world heritage site. It was built by king Suriya Varma II in 1100 AD(CE) at Cambodia. 'Ankorwat' means 'the city of temples' in Khmer language. It is the largest Hindu Temple in the world.

Europe

- Europe is the sixth largest continent in size and the third largest in population in the world. It has diverse landforms and people. It is the birth place of western civilizations (Roman and Greek), democracy and Industrial Revolution. It is the most developed continent in the world. Let us explore the continent.

Location and size

- Europe spreads from 34º 51' North latitude to 81º 47' North latitude and from 24º33' West longitude to 69º 03' East longitude. The Prime Meridian 0º longitude passes through Greenwich in England.

Europe is found in the northern hemisphere and it covers an area of 10.5 million sq.km. It is surrounded by the Arctic Ocean in the North, the Black Sea and Mediterranean Sea in the south, the Atlantic Ocean in the west and the Ural mountains in the east. So it looks like a giant peninsula.

Physical Divisions

- Europe has diversified physical features such as mountains, plains, plateaus, peninsulas, bays, islands and river basins. It can be divided into four physical divisions.

1. The North Western Highlands
2. The Central Plateaus/High land
3. The Alpine Mountain system
4. The North European plains

1. **The North Western highlands:** This region includes the mountains and plateaus of Norway, Sweden, Finland, Scotland and Iceland. This region has the most beautiful fjord coast. It was created by glaciations in the past. This region has a lot of lakes, which serve as reservoirs for producing hydroelectricity. Norway and Sweden are the largest producers of hydroelectricity in the world.
2. **The Central Plateaus:** The plateaus are found in east west direction across central Europe. Many rivers in Europe such as, the Danube, the Volga and the Tagus originate from this plateau. The important plateaus of this region are The Pennines (England), The Meseta (Spain), The Central Massif and Jura (France). The Black forest (Germany) in these region has rich mineral resources. The Pennines is called the backbone of England.
3. **The Alpine Mountain System**: The alpine mountain system consists of a chain of young fold mountains found in the southern part of Europe. The important mountain ranges are the Sierra Nevada, the Pyrenees, the Alps, the Apennines, the Dinaric Alps, the Caucasus and the Carpathian. The Pyrenees forms a natural boundary between Spain and France. The highest peak in Europe is Mt. Elburz (5645 m) in the Caucasus range. The Mont Blanc (4,807 m) found in the Alps is the second highest peak in the Alpine System. There are several active volcanoes found in the Alpine mountain system. Mt. Etna, Mt. Vesuvius and Mt. Stromboli are the important volcanoes found in Europe. Earthquakes are

common in this region. The Stromboli is called the 'light house of the Mediterranean'.

4. **The North European plain**: The north European plain stretches from the Atlantic Ocean in the west to the Ural Mountains in the east. On the north, it is surrounded by the Baltic Sea and on the South by the alpine mountain. It is narrow in the West and wide towards the East. Major European rivers such as the Seine, the Rhine, the Danube and the Don criss-cross this region and deposit their alluvium. The Andalusian Plain, The Hungarian Plain and the Wallachian Plain are also found in this region. It has rich deposits of coal and iron ore. The north European plain is densely populated region and cities like Paris, Moscow and Berlin are located here.

S. No	Rivers	Length (km)	Source	Out flow
1.	Volga	3,692	Valdes plateau	Caspian Sea
2.	Danube	2,860	Black forest	Black Sea
3.	Dnieper	2,145	Valdai Hills	Black Sea
4.	Rhine	1,230	Alps (Switzerland)	North Sea
5.	Rhone	813	Swiss Alps	Mediterranean Sea
6.	Po	652	Cottian Alps	Adriatic Sea
7.	Thames	346	Kemble	North Sea

Drainage

- The rivers play an important role in the development of Europe. These rivers are used to irrigate farmland and also help to produce electricity. Most of the rivers originate in the Alps and the central plateau of Europe. These rivers are useful for inland navigation in central and Eastern Europe. The Volga is the longest river in Europe. The river Danube passes through nine countries in Europe.

Climate

- The climate of Europe varies from the subtropical to the polar climate. The Mediterranean climate of the south has warm summer and rainy winter. The western and north western parts have a mild, generally humid climate, influenced by the North Atlantic Drift. In

central and eastern Europe, the climate is humid continental-type. In the northeast, subarctic and tundra climates are found. The whole of Europe is subject to the moderating influence of prevailing westerly winds from the Atlantic Ocean.

Natural vegetation: The natural vegetation of Europe can be classified as follows:
1. Tundra, 2. Taiga or Coniferous, 3. Mixed Forest, 4. Mediterranean Forest , 5. Grassland

- The Arctic and northern Scandinavian highland have Tundra type of vegetation made up of lichens and mosses. Coniferous or Taiga vegetation's are found to the south of the Tundra region in Norway, Sweden, Finland, Germany, Poland and Austria. Pine, fir, spruce and larch are the important tree varieties of taiga forest.

The mixed forest comprising of birch, beech, poplar, oak and maple trees found in the western part of Europe particularly in western France, Belgium, Denmark, Britain etc. Mediterranean trees like cypress, cork, oak, olive and cedar are found along the borders of the Mediterranean Sea. Eastern Europe is covered by grasslands (Steppe).

Resources Base and Economic Activities of Europe

- Availability of resources, efficient educated work force, research, contact with other nations and innovations have transformed Europe into a modern and economically developed continent in the world. Europe is an industrially developed continent in the world. It has great diversity in its topography, climate and soil. These interact to produce varied patterns of agricultural activities such as Mediterranean agriculture, Dairy farming, mixed livestock and crop farming and horticulture (Truck Farming) Wheat is the dominant crop throughout Europe. Barley, Oats, sugar beet, rye, potatoes and hay are also common crops. Corn (maize) is an important crop in the lower Danubian lowlands and south western European Russia, France and Italy. Rice (northern Italy) and citrus fruits, olive trees (Spain, Sicily) depend on irrigation.

- The northernmost countries grow few cereals (mainly oats) and concentrate on animal husbandry, especially cattle and dairying. Mixed farming and the use of well-tried crop rotations are widely practised. Viticulture is mostly practised in Italy, France and Germany.

As for industrial crops, European Russia, Ukraine, and Belarus are large producers of flax and hemp, sugar beets and sunflower seeds. Tobacco is grown in Belarus and is also important in Bulgaria, Italy, and Macedonian Greece. European Russia, Sweden and Finland are the major producers of softwood and hardwood. Fishing is a large industry in Norway, Iceland, Russia, Denmark, the United Kingdom, the Netherlands etc., The Dogger Bank in North Sea is an important fishing ground in Europe.

Industries

- Europe produces a significant portion of the world's steel and iron ore. Shipbuilding, motor-vehicle and aircraft construction are widely distributed all over Europe. Europe is also a large producer of pharmaceutical drugs. A wide range of small-scale industries (i.e., those that produce nondurable goods) is found throughout Europe. Some countries have a reputation for specialty goods, as in the case of English, Italian, and Dutch bicycles, Swedish and Finnish glass, Parisian perfumes and fashion goods and Swiss precision instruments.

Cultural Mosaic of Europe

- Europe is the third most populous continent, after Asia and Africa. The population of Europe was 742 million in 2018, which accounted for 9.73% of the world's population. The population density in Europe is 34 persons / km2. High population density is often associated with the coalfields of Europe. Other populous areas are sustained by mining, manufacturing, commerce, offering large market, labour forces and productive agriculture. Monaco, Malta, San Marino, and the Netherlands are the most densely populated countries; Iceland and Norway have very low density of population. In general, population is scantiest in the mountain regions, some highlands, arid parts of Spain and the Arctic regions of Russia. Monaco has the highest density of population in Europe (26,105 persons / km2) as well as in the world. Iceland has a very low density of population (3 persons/ km2).

Religion & Language

- Europe is a continent of great linguistic and cultural difference. English, Spanish, Portuguese, French, Italian and Slavic are the broadly spoken languages in Europe. Christianity is the major religion in Europe. A considerable number of Hindus, Muslims and Jews are

spread throughout Europe. More than 90 percent of the people belong to the Caucasoid race.

Art and Architecture

- European art and architecture mostly reveals the ordinary human being and is popular all over the world. Acropolis, the Colosseum, the statue of David, The thinker, Eiffel tower, Big Ben, Pisa Tower and Mona Lisa are some of the master pieces of art and architecture in Europe.

Food and Festivals

- Bread, fish, meat, potatoes and dairy products are the staple food in Europe. The Europeans celebrate both religious and holiday festivals. Christmas, Easter, Good Friday, the Saint Day, Redentore, Tomatina and Carnival are the important festivals of Europe. They play Rugby, foot-ball, basket-ball, ice hockey and skiing. Bull fighting in Spain is the world's attractive game.

A Comparison of Asia and Europe

- Asia and Europe are integrated geographically and separated politically. Europe is the giant peninsula of Asia. Both the Himalayas (Asia) and the Alps (Europe) were formed during the same geological period. The Steppe grass lands and coniferous forests are spread over several hundred kilometres from Europe to Asia. Generally, the plains are found in the northern part and the mountains in the southern part in both the continents. The two continents are the homeland of ancient civilizations. From the ancient period, these two continents had trade relationship through the silk route and the spice route. Despite the various geographical similarities, these two continents have striking differences.

NOTE

- Europe is called as the 'Peninsula of Peninsulas'.
- **European Union:** The European Union (EU) is an economic and political union of 28 member countries for their welfare. It has own flag and the com
- **The Netherlands:** About 25 percent of the Netherlands lies below sea level. So they have built dikes. They have reclaimed new land

from the sea with the help of dikes. These reclaimed lands are called polders. mon currency, the Euro (€).

- **Fjord:** A fjord is a narrow and deep sea inlet between steep cliffs. It helps in the following ways.
  - ✓ It reduces the speed of wind, irrespective of its direction.
  - ✓ The force of sea waves are also controlled.

  Hence, areas with fjords are best suited for natural harbours.
- **Black forest**: The lush and dark coloured fig and pine trees give black colour to this region.
- **The Matterhorn**: The pyramid-shaped Matterhorn Mountain is located in the Swiss Alps a height of 4478 m. It is popular for its shape.
- **Climate Divider:** The Alps Mountain separates the Mediterranean climate from the cold climate of the north.
- **North Atlantic Drift** is a warm ocean current which brings warmth to the western Europe. The westerly wind further transports warmth across Europe.

Asia	Europe
1. It is the largest continent, both by area and population.	1. It is the smallest continent by area and the most developed.
2. It extends from 10° 11′ 81° 12′ N latitudes. That is from the equatorial region to the polar region.	2. It extends from 34°51′N to 81° 47′N latitudes. That is, from the sub-tropical region to the polar region.
3. It is located on the eastern hemisphere	3. It is located at the centre of the earth.
4. The Bering Strait separates Asia and North America.	4. The Strait of Gibraltar separates Europe from Asia
5. The Arabian, Indo China, India and Korea are the important peninsulas in Asia.	5. The Scandinavian, Iberian, Italian and Balkan are the important peninsulas in Europe.
6. The important parallels such as the Equator, Tropic of Cancer, Arctic Circle pass through it.	6. Only the Arctic Circle passes through it.
7. All kinds of climatic conditions are found here. It also enjoys the distinctive monsoon type	7. It lies largely in the temperate zone. It enjoys the distinctive Mediterranean type of climate.

of climate Southern Asia receives summer rainfall.	Southern Europe receives winter rainfall.
8. Both hot and cold deserts are located here.	8. There are no deserts here.
9. It has a variety of mineral deposits.	9. Mineral resources are limited, except for coal & iron.
10. Plantation crops such as tea, rubber and dates are largely cultivated in Asia.	10. Citrus fruits, olives and grapes are cultivated mostly in Asia.
11. A majority of people in Asia are involved in primary activities.	11. A majority of people in Europe are involved in secondary and tertiary

5. Globe

Directions

- The directions on the ground are always shown with respect to the North. If we know the North, then it is easy to find the other directions, namely South, East and West. These are the four cardinal directions. We know that the Sun rises in the East and sets in the West. If we stand facing the sun in the morning, then we face the east. The west is towards our back. The left hand points towards the north and the right hand points towards the south. We should always keep this in mind.

Globe

- We live on the planet Earth, which is found third from the Sun. Since the Earth is huge and we live on a very small area, we are not able to see the Earth as a whole. But, when we travel to space, we can see the Earth as a whole. So, in order to see the shape of the Earth as a whole and to know its unique features, a three dimensional model of the Earth was created with a specific scale. The Earth which is spherical, is flat at the poles and bulges at the Equator. The Earth cannot be compared with any other geometrical shape as it has a very unique shape. Hence, its shape is called a geoid (earth shaped). The Earth moves around the Sun. It also rotates from the West to East on its axis at an inclination of 23 ½°. The globe is also inclined at an angle of 23 ½°. The axis is an imaginary line. It is not actually found on the Earth.

Lines on the Globe: There are imaginary lines which are drawn on the globe horizontally and vertically to find a location and calculate distance and time. These imaginary lines are called lines of latitudes and longitudes.

Latitudes

The imaginary lines which are drawn horizontally on East - West direction on the Earth are called the lines or parallels of latitudes. The 0° line of latitude which divides the Earth into two halves is known as the Equator. From the Equator, parallel lines are drawn towards the North and South poles at equal intervals. The latitudinal extent between 1° line

of latitude on Earth is 111 km. Since the Earth is geoid shaped, the length of the lines of latitude decreases from the Equator towards the South and North Poles. The 90° North and South Poles are not found as lines, but as points.

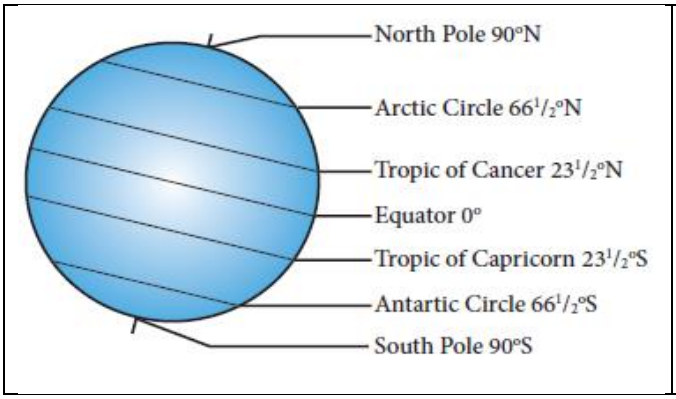
- The lines of latitude that are drawn horizontally between the Equator and the North Pole are called 'Northern latitudes' and those which are found between the Equator and the South Pole are called 'Southern Latitudes'. The lines of latitude consist of 89 parallels in the Northern Hemisphere and 89 parallels in the Southern Hemisphere, one at the Equator and the two poles are found as points. Totally, there are 181 parallels found on earth.

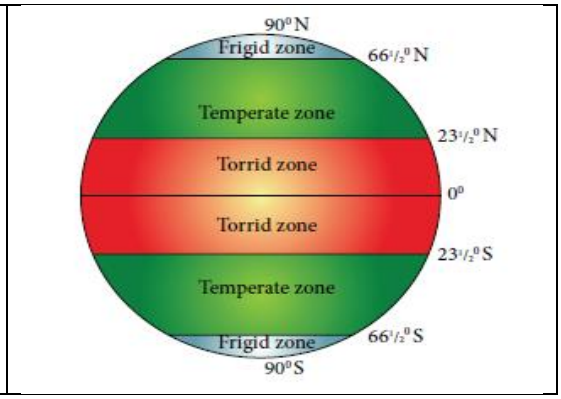
✓ **Northern Hemisphere:** The area of the Earth found between the Equator (00) and the North Pole (90°N) is called the Northern Hemisphere.

✓ **Southern Hemisphere:** The area of the Earth from the equator (0°) to the South Pole (90°S) is called the Southern Hemisphere. The location of any country or place is based on this division of the hemispheres.

✓ **Important lines of latitude:** The earth rotates on its axis at an inclination of 23½°. It also revolves around the sun while rotating. Based on the angle at which the sun's rays fall on the earth, certain lines of latitude gain significance.

- The Sun's rays do not fall equally on all parts of the earth. They fall vertically over the Equator and slanting towards the poles. Thus, all the places on earth do not have the same amount of temperature. Based on the amount of heat received from the Sun, the lines of latitude help in dividing the earth into different climatic zones.





Torrid Zone: The region from the Equator towards the Tropic of Cancer (23½°N) and the Tropic of Capricorn (23½°S) is called the Torrid Zone. The Sun's rays fall vertically over this region and the average temperature is very high. Hence this region is known as the Torrid Zone.

Temperate Zone: From the Tropic of Cancer (23½°N) to the Arctic Circle (66½°N) and from the Tropic of Capricorn (23½°S) to the Antarctic Circle (66½°S), the Sun's rays fall slantingly. Moderate temperature prevails in this region. Hence, this region is called Temperate Zone.

Frigid Zone : From the Arctic Circle (66½°N) to the North Pole (900N) and from the Antarctic Circle (66½°S) to the South Pole (90°S), the Sun's rays fall further inclined, through out the year. The temperature is very low. Hence, this region is known as Frigid Zone.

Longitudes

- The imaginary lines drawn vertically connecting the North Pole and the South Pole are called lines or meridians of longitude. These lines of longitude are seen as semi circles. The 0° line of longitude is called the Prime Meridian. There are 180 lines of longitude towards the East and West from the Prime Meridian. So, there are totally 360 lines of longitude. These lines converge at the poles. The 180° W and 180° E line of longitude are the same line. The lines of longitude that are found between the Prime Meridian and the 180° East line of longitude are called 'Eastern Longitudes' and the lines of longitude that are found between the Prime Meridian (0°) and the 180° West line of longitude are called 'Western Longitudes'. Two opposite meridians form a great circle

  - ✓ **Eastern Hemisphere:** The part of the Earth between the 0° line of longitude and the 180° East line of longitude is known as the Eastern Hemisphere.
  - ✓ **Western Hemisphere:** The part of the Earth from 0° line of longitude to 180° West line of longitude is called as Western Hemisphere.

Significant Lines of Longitude

Greenwich Meridian

- The Royal Astronomical Observatory is located at Greenwich near London in England. According to the International Meridian Conference held in 1884 in Washington DC in the U.S.A. all nations agreed on choosing the Greenwich Meridian as the international standard meridian (0°). This line of longitude is called the Prime Meridian and it is also known as the Greenwich Meridian because it passes through Greenwich.

International Date Line

- The 180o line of longitude has been fixed as the International Date Line, drawn on the Pacific Ocean between Alaska and Russia through Bering Strait. If a person crosses this line from the West to East, he loses a day. On the other hand, when he crosses from the East to West, he gains a day. Based on this, the date is fixed for different countries or regions of the world.

Earth Grid: The imaginary lines of latitude and longitude form a grid like pattern on the surface of the earth, known as the 'Earth grid' or 'Geographic grid'. To locate a place exactly on earth, the latitudinal and longitudinal extensions are required.

Longitude and Time: As many as 360 lines of longitude are drawn to connect the North and South Poles around the Earth 180° on the Eastern Hemisphere and 180° on the Western Hemisphere. Time is calculated on the basis of the lines of longitude.

Local Time

- When the sun is overhead on a particular line of longitude, it is 12 noon at all the places located on that line of longitude. This is called local time. The Sun is overhead on a line of longitude only once in a day. So the local time differs for every line of longitude. When the Sun is overhead the Greenwich Meridian at 12 noon, it is the local time of that place. The world time is calculated by this standard line of longitude. It is known as the Greenwich Mean Time (GMT). For example, if the time is 12 noon at Greenwich Meridian, it is 12:04 p.m.

at 1°E line of longitude and 11:56 a.m. at 1°W line of longitude. So, as one moves towards the east from any meridian the time increases. And if one moves towards the west from any meridian, time decreases.

Standard Time

- Local time is calculated when the sun is overhead at noon. Many lines of longitude may pass through a country. Countries may or may not observe a common time. The standard time of a country or a part of it is calculated keeping a particular meridian as a standard one. The meridians are selected in multiples of 15° or 7 ½°. It is done in such a way that the variation of standard time from the Greenwich is expressed either as 1 hour or ½ an hour.

Indian Standard Time

- The longitudinal extent of India is from 68°7′ E to 97°25′ E. As many as twenty nine lines of longitude pass through India. Having 29 standard time is not logical. Hence 82½° E line of longitude is observed as the Prime Meridian to calculate the Indian Standard Time (IST). The world has 24 time zones. Some countries have a great longitudinal extent. So they have more than one standard time. Example: Russia has 7 time zones.

NOTE

- The surface area of the Earth is 510.1 million square kilometres.
- Ptolemy, a Greco – Roman mathematician, astronomer and geographer, was the first person to draw the lines of latitude and longitude on a map. In his book, 'Geographia' a detailed description about the Earth's surface, its size and circumference and many locations based on the lines of latitude and longitude are given.
- The first globe was created by the Greeks in the year 150 AD(CE).
- The Indian astronomer Aryabhatta - I has mentioned in his book. 'Aryabhatta Sidhantha'. 'The stars in the sky seem to move towards the West because of the Earth's roation on its axis'.
- The Equator is the longest of all lines of latitude. Hence, it is also known as 'The Great Circle'.
- 0°N and S – 23½°N and S lines of latitudes are called – Low

latitudes

- ❖ 23½°N and S – 66½°N and S lines of latitudes are called – Middle Latitudes

- ❖ 66½°N and S – 90°N and S lines of latitudes are called – High Latitudes

- ❖ Some lines of latitude are also called by the following names in Tamil.

  - ✓ Latitude - ahalangu (அகலாங்கு)
  - ✓ Longitude - nettangu (நெட்டாங்கு)
  - ✓ Equator - nilanaduvarai (நிலநடுவரை)
  - ✓ Tropic of Cancer - kadagavarai (கடகவரை)
  - ✓ Tropic of Capricorn - magaravarai (மகரவரை)

- ❖ The lines of longitude are found as semi circles covering 111 km at the Equator, 79 km at 45° latitude and no space between the lines at the poles.

- ❖ The International Date Line is not straight. If the line is drawn straight, two places in the same country would have different dates. So the International Date Line is found zigzag in certain places to avoid confusion.

Fact

- ❖ The Earth takes one day to rotate on its axis.
  - ✓ 1 day = 24 hours
  - ✓ 1 hour = 60 minutes
  - ✓ 24 hours = 24 x 60 = 1440 minutes
  - ✓ The angle of the earth = 360 °
  - ✓ 360 ° = 360 Longitudes
  - ✓ 360 ° = 1440 minutes
  - ✓ So 1 ° = 1440 360 = 4 minutes
  - ✓ In 4 minutes = 1°rotation
  - ✓ In 60 minutes = 60 4 = 15° rotation
  - ✓ So, in an hour (60 minutes) the earth rotates 15°

- ❖ The word meridian is derived from the Latin word 'Meridianus'.

It means mid-day. (Medius – Middle, dies – day). So, meridian means the position of the Sun found overhead at a place at noon.

- a.m. means 'anti Meridiem' (anti – before) – Before Noon.
- p.m. means 'post Meridiem' (Post – after/later) – After noon.

- The 82½° E line of longitude passes through Mirzapur near Allahabad in Uttar Pradesh. This is located at an equal distance from Ghuar Mota in Gujarat and Kibithu in Arunachal Pradesh.

7th Term I

Unit II – Landforms

Introduction

- We have learnt that the surface of the earth is not the same everywhere. The earth has an infinite variety of landforms named mountains, plateaus, plains, valley etc., Some parts of the lithosphere may be rugged and some flat. These landforms are a result of two processes – the endogenic process and the exogenic process. The endogenic process (internal process) leads to the upliftment and sinking of the earth's surface at several places. The exogenic process (external process) is the continuous wearing down and rebuilding of the land surface.

- Gradation is the process of levelling of highlands through erosion and filling up of lowlands through deposition.

Landforms

- The landscape is being continuously worn away by two processes – weathering and erosion. Weathering is the breaking and falling apart into small pieces of the rocks on the earth's surface. Erosion is the wearing away of the landscape by different agents like water, wind, ice and sea waves. The eroded material is carried away by water, wind, etc. and eventually deposited. This process of erosion and deposition create different landforms on the surface of the earth.

River

- The water flowing from its source to river mouth, along a definite course is called a River. Rivers generally originate from a mountain or hill.

- The place of origin of the river is known as its Source. The place where it joins a lake or sea or an ocean is known as the River mouth.

- The running water in the river erodes the landscape, which creates a steep-sided valley like the letter 'V' known as 'V' shaped valley.

Tributary: A stream or river that flows into and joins a main river.
Distributary: A stream that branches off and flows away from a main stream.

- Falling of river water over a vertical step in the river bed is called waterfall. It is formed when the soft rocks are removed by erosion. E.g. Coutrallam falls across the river Chittar in Tamil Nadu.

The highest waterfall is Angel Falls of Venezuela in South America. The other waterfalls are Niagara Falls located on the border between Canada and USA in North America and Victoria Falls on the borders of Zambia and Zimbabwe in Africa.

- Plunge pool is a hollow feature at the base of a waterfall which is formed by cavitation. Alluvial fan is a deposition of sediment occurs at which the river enters a plain or the foot-hills.

- As the river enters the plain it twists and turns forming large bends known as Meanders. Eg. Meanders along the River Vellar near Sethiyathope in Cuddalore District, Tamil Nadu.

- Due to continuous erosion and deposition along the sides of the meander, the ends of the meander loop comes closer and closer. In due course of time the meander loop cuts off from the river and forms a cut-off lake, also called an Ox-bow lake.

The term 'Meander' has been named on the basis of Meander River of Asia Minor (Turkey), it flows through numerous curves and turns.

- At times the river overflows its banks. This leads to the flooding of the neighbouring areas. As the river floods, it deposits layers of fine soil and other material called sediments along its banks. This leads to the formation of a flat fertile floodplain. The raised banks are called levees.

- As the river approaches the sea, the speed of the flowing water decreases and the river begins to break up into a number of streams called distributaries. The velocity of the river becomes so slow that it begins to deposit its load. Each distributary forms its own mouth. The collection of sediments from all the mouths form Delta. Deltas are excellent productive lands. They have more minerals which favour cultivation. E.g. Cauvery delta, Ganges delta, Mississippi delta.

Glacier

- A large body of ice moving slowly down a slope or valley due to gravity is called a glacier. Glaciers are grouped into Mountain or Valley Glaciers and Continental Glaciers.

Continental Glacier: The glacier covering vast areas of a continent with thick ice sheets. E.g. Antarctica, Greenland

- Mountain or Valley Glacier is a stream of ice, flowing along a valley. It usually follows former river courses and are bounded by steep sides. E.g. The Himalayas and the Alps.

- Glaciers erode the landscape by levelling soil and stones to expose the solid rock below. Cirque is a glacially eroded rock basin, with a steep side wall and steep head wall, surrounding an armchair-shaped depression. E.g. Corrie – Scotland (United Kingdom), Kar – Germany.

- As the ice melts, they get filled up the cirque with water and become beautiful lakes in the mountains called as Tarn Lake. When two adjacent cirques erode towards each other, the previously rounded landscape is transformed into a narrow rocky, steep – sided ridge called Aretes.

- U' Shaped Valley is found beneath the glaciers which is deepened and widened by the lateral and vertical erosion. The material carried by the glacier such as rocks - big and small, sand and silt get deposited. These deposits form glacial moraines.

Wind

- Have you ever visited a desert? Try to collect some pictures of sand dunes. An active agent of erosion and deposition in the deserts is wind. In deserts you can see rocks in the shape of a mushroom, commonly called mushroom rocks.

- Winds erode the lower section of the rock more than the upper part. Therefore, such rocks have narrower base and wider top. An isolated residual hill, standing like a pillar with rounded tops are called Inselbergs. E.g. Inselberg in the Kalahari Desert of South Africa.

- When the wind blows, it lifts and transports sand from one place to another. When it stops blowing the sand falls and gets deposited in low hill – like structures. These are called sand dunes. The crescent shaped sand dunes are called Barchans.

- When the grains of sand are very fine and light, the wind can carry it over very long distances. When such sand is deposited in large areas, it is called Loess. Large deposits of loess are found in China.

Northern China loess deposits are brought from the Gobi Desert.

Coast

- A part of the land adjoining or near the sea is called the Sea coast. The boundary of a coast, where land meets water is called the Coast line. The coastal areas are subject to change due to wave erosion and wave deposition.

- The erosion and deposition of the sea waves give rise to coastal landforms. Sea Cliffs are steep rock faces formed, when the sea waves dash against them. Sea waves continuously strike at the rocks. Cracks develop. Over time they become larger and wider. Thus, hollow like caves are formed on the rocks. They are called Sea Caves.

- As the cavities of sea caves become bigger and bigger only the roof of the caves remains, thus forming Sea Arches. Further, erosion breaks

the roof and only walls are left. These walllike features are called Stacks.

- The sea waves deposit sediments of sand and gravel along the shores forming Beaches. Sand bar is an elongated deposition of sand or mud found in the sea, almost parallel to the coast.

The first longest beach in the world is the Miami beach in South Florida in U.S.A. The second longest beach in the world is the Marina beach in Chennai

- Lagoon is a shallow stretch of water partially or completely separated from the sea. E.g. Chilka lake in Odisha, Pulicat lake in Tamil Nadu and Andhra Pradesh and Vembanad lake in Kerala are the famous lagoons in India.

8th Term I

Unit – 3 Hydrologic cycle

Introduction

- Water is one of the most important elements on earth. All plants and animals need water for survival. Apart from drinking, water is required for domestic, agriculture, industrial purposes etc. Water is very essential for carrying out almost all economic activities. So, water is an indispensible element without which life form on the earth is not possible

Water on the Earth

- About 71% of the earth's surface is covered by water. The quantity of water present on the earth is about 326 million cubic miles. It is hard to visualise this massive quantity of water. Most of the water on the earth is saline and is found in seas and oceans. The salt water constitutes about 97.2% and the fresh water is only about 2.8%. Out of this 2.8%, about 2.2% is available as surface water and the remaining 0.6% as groundwater. From this 2.2% of surface water, 2.15% is available in the form of glaciers and icecaps, 0.01% in lakes and streams and the remaining 0.04% is in other forms. Only about 0.25% of the total ground water of 0.6% can be economically extracted with the present drilling technology. Water resources are useful or potentially useful to humans. Water in India is available in three sources. They are precipitation, surface water and groundwater.

Hydrologic Cycle or Water Cycle

- Hydrology is the science which deals with the various aspects of water such as its occurrence, distribution, movement and properties on the planet earth. Availability of water on the earth is not uniform. Some places are very rich in water resources while some other places are poor in water resources.

Estimated Volume of Water on the Earth's Surface

Water Source	Volume of water (Cubic Miles)	Percentage to Total Water
Oceans, Seas, & Bays	321,000,000	96.54
Ice caps, Glaciers, & Permanent Snow	5,773,000	1.74
Groundwater	5,614,000	1.69
Soil Moisture	3,959	0.001
Ground Ice & Permafrost	71,970	0.022
Lakes	42,320	0.013
Atmosphere	3,095	0.001
Swamp Water	2,752	0.0008
Rivers	509	0.0002
Biological Water	269	0.0001

- Hydrologic cycle is a global sun-driven process where water is transported from oceans to atmosphere, from atmosphere to land and from land back to oceans. The water cycle can be considered as a closed system for the earth, as the quantity of water involved in the cycle is invariable, though its distribution varies over space and time.

- Evaporation takes place from the surface water and transpiration from the plants. Water vapour gets condensed at higher altitudes by condensation nuclei and form clouds (resulting in droplet growth). The clouds melt and sometimes burst resulting in precipitation of different forms. A part of water from precipitation flows over the land is called runoff and the other part infiltrates into the soil which builds up the groundwater.

- Hydrologic cycle is a circulation of water. It is a continuous process and takes place naturally. The three important phases of the hydrologic cycle are: 1) Evapotranspiration, 2) Precipitation and 3) Runoff.

Components of Hydrologic Cycle

- There are six main components in hydrologic cycle. They are: 1) Evapotranspiration, 2) Condensation, 3) Precipitation, 4) Infiltration, 5) Percolation, and 6) Runoff.

Evapotranspiration

- It is defined as the total loss of water from the earth through evaporation from the surface water bodies and the transpiration from vegetation. In cropped area, it is difficult to determine the evaporation and transpiration separately. Therefore it is collectively called as evapotranspiration.

Evaporation

- Evaporation refers to the process in which the liquid form of water changes into gaseous form. Water boils at 100°C (212°F) temperature but, it actually begins to evaporate at 0°C (32°F); and the process takes place very slowly. Temperature is the prime element which affects the rate of evaporation. There is a positive relationship between these two variables. Areal extent of surface water, wind and the atmospheric humidity are the other variables which affect the rate of evaporation.

- Many studies reveal that the oceans, seas, lakes and rivers provide nearly 90 % of the moisture in the atmosphere through evaporation and the remaining 10 % is contributed by plants through transpiration.

- On a global scale, the amount of water gets evaporated is about the same as the amount of water delivered to earth as precipitation. This process varies geographically, as the evaporation is more prevalent over the oceans than precipitation, while over the land, precipitation routinely exceeds evaporation. The rate of evaporation is low during the periods of calm winds than during windy times. When the air is calm, evaporated water tends to stay close to the water body. During windy, the water vapour is driven away and is replaced by dry air which facilitates additional evaporation.

The rate of evaporation increases with

- Increase in wind speed

- Increase in temperature
- Decrease in humidity and
- Increase in areal extent of surface water bodies.

Transpiration

- Transpiration refers to the process by which the water content in the plants are released into the atmosphere in the form of water vapour. Much of the water taken up by plants is released through transpiration. The rate of transpiration is also affected by the temperature, wind and humidity. The soil water content and the ability of the soil to conduct water to the roots, the nature of the plant parts including barks and leaves also determine the transpiration rate. In case of agriculture, the crop characteristics, its environment and cultivation practices also affect the transpiration process.

Condensation

- It refers to the process in which the gaseous form of water changes into liquid form. Condensation generally occurs in the atmosphere when warm air rises, cools and loses its capacity to hold water vapour. As a result, excess water vapour condenses to form cloud droplets. Condensation is responsible for the formation of clouds. These clouds produce precipitation which is the primary route for water to return to the earth's surface in the water cycle. Condensation is the opposite of evaporation.

Forms of Condensation

- Dew, Fog and Clouds are the three major forms of condensation

a) **Dew:** It is a water droplet formed by the condensation of water vapour on a relatively cold surface of an object. It forms when the temperature of an object drops below the dew point temperature.

Frost: The ice crystals formed by deposition of water vapour on a relatively cold surface of an object is known as frost. It forms when the temperature of an object drops below the freezing point of temperature.

b) Fog: Fog is the suspended tiny water droplets or ice crystals in an air layer next to the earth's surface that reduces the visibility to 1,000 m or lower. For aviation purposes, the criterion for fog is 10 km or less.

Mist: Mist is the tiny droplets of water hanging in the air. These droplets form when the water vapour in the air is rapidly cooled, causing it to change from invisible gas to tiny visible water droplets. Mist is less dense than fog.

c) Clouds: Clouds consist of tiny water droplets/ice particles which are so small and light in weight. Clouds are formed by microscopic drops of water or by small ice crystals. The size of the droplets generally range from a couple of microns to 100 microns. This is the limit beyond which cloud drops become rain drops.

- Condensation occurs when the air get saturated.
- Warm air can hold more water vapour than the cool air.
- Saturation occurs when the temperature drops down.

Precipitation

- Precipitation refers to all forms of water that fall from clouds and reaches the earth's surface. For the occurrence of precipitation, cloud droplets or ice crystals must grow heavy enough to fall through the air. When the droplets grow large in size, they tend to fall. While moving down, by collecting some small droplets, they become heavy enough to fall out of the cloud as raindrops.

Forms of Precipitation

- The form of precipitation in a region depends on the kind of weather or the climate of the region. The precipitation in the warmer parts of the world is always in the form of rain or drizzle. In colder regions, precipitation may fall as snow or ice. Common types of precipitation include rain, sleet, freezing rain, hail and snow.

Rain: The most common kind of precipitation is rain. The precipitation in the form of water droplets is called rain. The precipitation in which

the size of rain drops are <0.5 mm in diameter is known as drizzle and the rain drops with >0.5 mm in diameter is known as rain. Generally drizzle takes place from stratus clouds.

Sleet: The precipitation which takes place in the form of mixture of water droplets and tiny particles of ice (5mm in diameter) is known as sleet. Sometimes raindrops fall through a layer of air below 0°C, the freezing point of water. As they fall, the raindrops freeze into solid particles of ice. So, the mixture of water droplets and ice particles would fall on the earth surface.

Freezing Rain: At other times raindrops falling through cold air near the ground do not freeze in the air. Instead, the raindrops freeze when they touch a cold surface. This is called freezing rain and the drops of water are usually greater than 0.5 mm in diameter.

Hail: The precipitation which consists of round pellets of ice which are larger than 5 mm in diameter is called hail or hailstones. Hail forms only in cumulonimbus clouds during thunderstorms. A hailstone starts as an ice pellet inside a cold region of a cloud. Strong updrafts in the cloud carry the hailstone up and down through the cold region many times.

Snow: Often water vapour in a cloud is converted directly into snow pieces due to lowering of temperature. It appears like a powdery mass of ice. The precipitation in the form of powdery mass of ice is known as snowfall. It is common in the polar and high mountainous regions.

Infiltration

- Water entering the soil at the surface of the ground is termed as infiltration. Infiltration allows the soil temporarily to store water, making it available for plants use and organisms in the soil. Infiltration is an important process where rain water soaks into the ground, through the soil and underlying rock layers. Some of this water ultimately returns to the surface through springs or low spots down hills. Some of the water remains underground and is called groundwater. The rate of infiltration is influenced by the physical characteristics of the soil, vegetative cover, moisture content of the soil,

soil temperature and rainfall intensity. The terms infiltration and percolation are often used interchangeably.

- Percolation is the downward movement of infiltrated water through soil and rock layers. Infiltration occurs near the surface of the soil and delivers water from the surface into the soil and plant root zones. Percolation moves the infiltrated water through the soil profile and rock layers which leads to the formation of ground water or become a part of sub-surface run-off process. Thus, the percolation process represents the flow of water from unsaturated zone to the saturated zone.

Runoff

- Runoff is the water that is pulled by gravity across land's surface. It replenishes groundwater and surface water as it percolates into an aquifer (it is an underground layer of water-bearing rock) or moves into

- a river, stream or watershed. It comes from unabsorbed water from rain, snowmelt, irrigation or other sources, comprising a significant element in the water cycle as well as the water supply when it drains into a watershed.

- Runoff is also a major contributor to the erosion which carves out canyons, gorges and related landforms. The amount of runoff that can happen depends on the amount of rainfall, porosity of soil, vegetation and slope. Only about 35% of precipitation ends up in the sea or ocean and the other 65% is absorbed into the soil.

Types of Runoff

- Based on the time interval between the instance of rainfall and generation of runoff, the runoff may be classified into following three types

i) Surface Runoff: It is the portion of rainfall, which enters the stream immediately after the rainfall. It occurs, when the rainfall is longer, heavier and exceeds the rate of infiltration. In this condition the excess

water makes a head over the ground surface, which tends to move from one place to another following land gradient and is known as overland flow. When the overland flow joins the streams, channels or oceans, it is termed as surface runoff or surface flow.

ii) Sub-Surface Runoff: The water that has entered the subsoil and moves laterally without joining the water-table to the streams, rivers or oceans is known as sub- surface runoff. The sub-surface runoff is usually referred as interflow.

iii) Base Flow: It is a flow of underground water from a saturated ground water zone to a water channel. It usually appears at a downstream location where the channel elevation is lower than the groundwater table. Groundwater provides the stream flow during dry periods of small or no precipitation.

Units of the Measurement pertaining to Hydrology

- Evaporation /interception - inches (or) cm
- Infiltration - inches (or) cm / hour
- Precipitation - inches (or) mm (or) cm
- Run off - inches (or) mm (or) cm
- Run off rate - cubic feet per second
- Run off volume - acre feet (or) cubic feet
- Storage - cubic feet (or) acre feet

9th Std
Unit-1
Lithosphere – I Endogenetic Processes

Pathway

- The Earth is a unique planet of the Solar family. The Earth is composed of four spheres namely, the lithosphere, the atmosphere, the hydrosphere and the biosphere. This lesson focuses on the internal processes of the Earth. The sequence of lessons generally follows the spheres of the Earth system in a comprehensive manner.

Spheres of the Earth

- Earth's surface is a vast area of 510 million sq.km, where four spheres of the Earth interact. The abiotic spheres are the lithosphere, atmosphere and hydrosphere. The biotic sphere is the biosphere. Together, these spheres constitute the planet, Earth. This topic 'lithosphere' has been bifurcated for the sake of convenience. It is divided into Endogenetic processes (Internal processes) and Exogenetic processes (External processes). This lesson deals with the Endogentic processes in detail, the next lesson will deal with the Exogenetic processes.

Spheres of Earth

- The outer surface and inner core of the Earth are totally different in their nature and structure. The structure of the Earth's interior is divided into three layers namely the crust, the mantle and the core.

Crust

- Crust is the outer layer of the Earth, where we live. It is the skin of our Earth, which ranges between 5 to 30 km. It is the solid and rigid layer of the Earth. The thickness of the crust is greater below the continents than the ocean floor. The crust is classified as continental crust and oceanic crust. The major elements of crust are Silica (Si) and Aluminium (Al) and thus, it is termed as SIAL.

Mantle

- The interior part beneath the crust is called mantle, which is about 2,900 km thick. The major elements of the mantle are Silica (Si) and Magnesium (Mg) and hence it is also termed as SIMA. In the upper part of the mantle, the rock remains solid, whereas in the lower part of the mantle, rocks are in molten form. This molten rock inside the Earth is called 'magma'.

Core

- The core is the innermost and hottest layer of the Earth which lies below the mantle. It is composed mainly of Nickel (Ni) and Iron (Fe). Hence it is called NIFE. The core is divided into Solid inner core and Liquid outer core. The presence of large quantities of iron in the core is responsible for the Earth's gravitational force. As the Earth rotates on its axis, the liquid outer core spins over the solid inner core and generates the Earth's magnetic field. This is responsible for the functioning of the magnetic compass. Due to high pressure, the materials in the inner core are unable to move and hence remain solid.

DATA ON THE EARTH'S INTERIOR				
Layers	**Thickness (km)**	**Top**	**Bottom density (g/cm3)**	**Types of rocks found**
Crust	30	2.2	- 2.9	Silicic Rocks Andesite, Basalt at base, Aluminum
Upper mantle	720	3.4 -	4.4	Peridodite, Eclogite, Olivine, Spinel, Garnet, Pyroxene Perovskite, Oxides
Lower Mantle	2,171	4.4	-	Magnesium and silicon oxides
Outer core	2,259	9.9	- 12.2	Iron oxides, Sulphur, Nickel Alloy
Inner core	1,22,	12.8	-	Iron oxides,

				Sulphur, Nickel Alloy
Total Thickness	**6,401**			

Rocks: The crust is a storehouse of rocks. An aggregate of minerals on the Earth's crust is called 'rock'. It may be hard and compact like 'granite' or soft as 'clay' or loose as 'sand'.

Types of Rock: Based on formation, rocks are classified as: 1. Igneous, 2. Sedimentary and 3. Metamorphic.

1. **Igneous Rocks:** The word 'igneous' is derived from the Latin word Ignis meaning 'Fire'. The interior of the Earth contains very hot molten material called 'Magma'. When the magma reaches the Earth's surface, it is referred to as 'Lava'. The lava on the surface cools down and gets solidified as rocks called igneous rocks. Granite and basalt are examples of such rocks. Igneous rocks are also called Primary or Mother rocks because all other rocks are directly or indirectly formed from them.

2. **Sedimentary Rocks:** These sedimentary rocks are named after the latin word 'sediment' meaning ' settle. Rivers, glaciers and winds carry bits of rock and soil and deposit them in layers. After a few million years, these deposits harden into compact rocks and are called Sedimentary rocks. The bodies of plants and animals that fall on the deposits get embedded in the layers and form Fossils. Sandstone, limestone, chalk, gypsum, coal and onglomerate are examples of sedimentary rocks.

3. **Metamorphic Rocks:** The term 'metamorphic' is derived from the word 'metamorphosis', which means, 'change of form'. When igneous or sedimentary rocks are subjected to extreme heat and pressure, they undergo a complete change in their form and character .i.e., in course of time, granite may get transformed to gneiss, basalt to schist, limestone to marble and sandstone to quartzite.

Types of Rocks	Examples	Uses
Igneous	Granite Basalt	Construction work Laying roads
Sedimentary	Gypsum Limestone	Manufacturing of wall board, cement, plaster of Paris etc. Construction and purification of Iron in blast furnaces
Metamorphic	Diamond Marble	Jewellery making Sculpture and construction

Rock Cycle: The Rock cycle is a continuous process through which igneous, sedimentary and metamorphic rocks are transformed from one form to another.

Geomorphic Processes

- The formation and deformation of landforms on the surface of the Earth is a continuous activity of two broad processes i.e. internal and external. These processes cause stress and deformation on Earth materials and finally bring changes on the surface of the Earth. These are referred as Geomorphic Processes.

- The forces that act from the Earth's interior towards the Earth's surface are called Internal processess or Endogenetic processes. These forces build the landscape and create topographic relief.

- The forces that act on the surface of the Earth due to natural agents like running water, glacier, wind, waves etc. are called External processes or Exogenetic processes. These external processes tear the landscape down into relatively low elevated plains.

Internal Processes: The internal processes generate heat and eject materials from deep below the Earth's crust. Internal radioactivity is the principal source of power for this process.

Plate Tectonics:

- The lithosphere is divided into a number of huge slabs of rocks called 'Tectonic plates.' These tectonic plates are divided into major and minor plates. These plates float independently over the mantle. Collisions of these plates produce mountain ranges and other irregular surface features, both on land and the ocean floor. This phenomenon is called 'plate tectonics'. The movement of tectonic plates is due to thermal energy from the mantle. Now we have a better understanding about the plate movements and its relation to Earthquake and volcanic activities.

Types of Plate Boundaries

- **Convergent Boundary:** Here the plate moves toward each other and sometimes, a plate sinks under another. The location where the sinking of a plate occurs is called a sub duction zone.
- **Divergent Boundary:** Here the plates pull away from each other as magma pushes up from the mantle.
- **Transform Boundary**: Here the plates slide horizontally past each other.

Movements of Continental Plates

- Due to lateral compressional forces, the plates are forced to move upwards and downwards. This is called 'Folding'. Mountains formed by folding are called fold mountains. the Process of folding creates lofty mountain ranges such as the Himalayas and the Alps The movement of plates also create stress and tension in the rocks, causing them to stretch and crack. This is called 'Faulting'. The great rift valley of East Africa is a notable example for the process of faulting. The process of folding and faulting together with volcanoes and Earthquakes continually reshape the continents and seafloor.

- According to plate tectonics, the plates are in constant motion with an average rate of few centimetres per year. The movement might seem slow, but over millions of years, the plates and the continents riding on them move a long way. For example, about 250 million years

ago, the Indian Plate was a part of the Gondwana land, which comprised of modern Africa, Australia, Antarctica, and South America.

- Approximately 140 million years ago, the Indian plate broke away from the ancient super continent 'Gondwana' and began moving north and collided with Asia. The collision with the Eurasian Plate along the boundary between India and Nepal formed the Orogenic belt that created the Tibetan Plateau and the mighty Himalayan Mountains.

Earthquake

- Earthquakes are generally caused by the sudden vibrations in the Earth's crust, which spreads outward in all directions as waves from the source of disturbance. The point of origin of an Earthquake is called 'Focus' (Hypocenter) which generates a series of elastic waves. 'Epicentre' is a point on the Earth's surface that lies directly above the focus. The impact of the Earthquake is felt the most at the epicentre.

Seismic Waves

- **Earthquakes generate seismic waves:** The nature, force and speed of these seismic waves depend on the nature of the medium through which it passes. Accordingly, there are three major types of waves.

- **Primary or P-waves** are the fastest of all the Earthquake waves and the first to reach the epicentre. These waves pass through solids, liquids and gases, either through push or pull with an average velocity of 5.3km per second to 10.6 km per second.

- **Secondary or S-waves** travel only through solids. These transverse waves shake the ground perpendicular to the direction in which they propagate. The average velocity of these waves is 1Km per second to 8 km per second.

- **Surface Waves (or) L-waves** are similar to P-waves but they travel primarily along the ground surface. These waves travel comparatively slower and are the most destructive waves. The average velocity of these waves are 1 km per second to 5 km per second.

Tsunami

- The word 'Tsunami' is a Japanese term, meaning harbour waves. It is adopted to describe large seismically generated sea waves caused by Earthquakes, submarine explosions and landslides. These waves travel at a great speed (more than 500 km per hour) and the length of the waves exceeds 600 km. These waves reach to a height of more than 15 m near the sea shore and are capable of causing destruction along the coastal area. The 2004 Indian Ocean Earthquake that caused tsunami is the sixth-deadliest natural disaster which travelled at a speed of 600 km per hour with an estimated death toll of 2,80,000. The Earthquake which occurred near Indonesia at 00.58 hours took nearly 7 hours to reach Chennai.

Volcanoes

- A volcano is a vent or an opening on the surface of the Earth crust, through which hot solid, liquid and gaseous materials (Magma) erupt out to the surface from the Earth's interior. Magma rises up and ejects on the surface as Lava. Volcanoes are also formed when plates move apart. Volcanoes generally have the following major components. They are:

i. **Magma chamber**: a large pool of liquid rock found beneath the surface of the Earth

ii. **Vents**: an opening serving as an outlet for air, smoke, fumes, magma etc

iii. **Volcanic cone:** a landform built by the magma ejected from the vent in the shape of a cone.

iv. **Crater:** a bowl shaped depression found at the top of the volcano through which the magma flows out.

Based on the periodicity of eruptions, volcanoes are classified into i. Active volcano, ii. Dormant volcano, iii. Extinct volcano.

i. **Active Volcano:** Active volcanoes are those which constantly eject volcanic lava, gases and fragmented materials. (eg.) Mount St. Helens in the United States.

ii. **Dormant Volcano:** Volcanoes that do not show any sign of volcanic activity for a long period of time are known as dormant volcanoes. Sometimes there may be a sudden explosion which may cause unimaginable loss to life and property (e.g.) Mt. Fuji , Japan

iii. **Extinct or Dead Volcano:** When a volcano permanently stops its volcanic activity, then it is called as extinct or dead volcano (e.g.) Mt. Kilimanjaro, Tanzania

Volcanoes can also be classified based on their structure and composition as composite volcano, shield volcano and dome volcano

- **Composite Volcano:** Composite volcano, also known as strata volcano, is a conical volcano built by many layers of hardened lava, pumice and volcanic ash. These are commonly found in the Pacific Ocean Eg. Mt. Fuji, Japan
- **Volcanic Dome:** A lava dome or volcanic dome is roughly a circular mound formed due to the slow ejection of viscous lava from a volcano. As the lava is rich in silica with intense viscosity, it is prevented from flowing far from its vent. e.g. Paricutin, Mexico
- **Shield Volcano:** Shield volcanoes are formed by intense viscous lava. These are shallow depositions with gently sloping sides. Hence the lava flows out in all directions to create a shield. E.g., Mauna Loa, Hawaii

Distribution of Earthquakes and Volcanoes

- Most Earthquakes and volcanic eruptions do not strike randomly, but occur along the plate boundaries. One such area is the circum-Pacific Ring of Fire, where the Pacific Plate meets many surrounding plates. The Ring of Fire is the most seismically and volcanically active zone in the world. The other distinctive major belts are Mid-Oceanic Ridges and Mid- Continental Belts.

Effect of Volcanoes

Constructive Effects

- Volcanic materials enrich the soil fertility that promotes agricultural activities. The hot volcanic region helps in generating geothermal energy. Many dormant and active volcanoes are the most

attractive tourist spots of the world. Most of the volcanic materials are used as building materials.

Destructive Effects

- Volcanic eruption causes Earthquakes, fast floods, mud slide and rock fall. Lava can travel very far and burn, bury, or damage anything in its path. The large amount of dust and ash makes breathing hard and irritable. Volcanic eruptions can alter the weather conditions and disrupt transport (Iceland volcanic eruption) in and around the volcanic region.

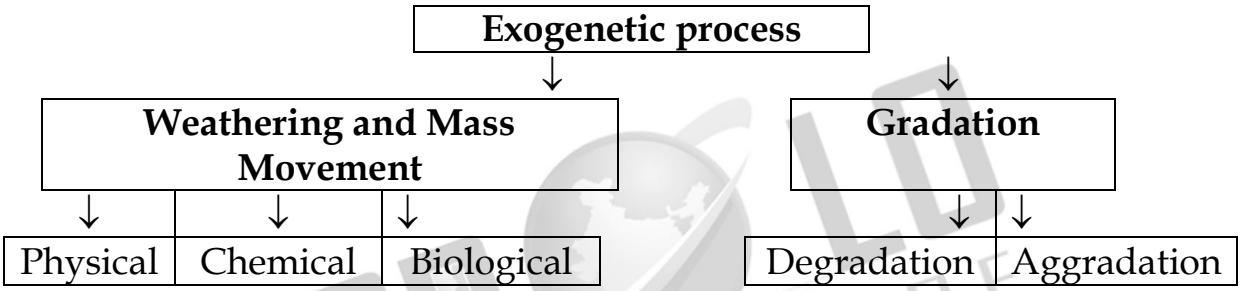
- "The Earth can physically be described as a ball of rock (the lithosphere), partly covered by water (the hydrosphere) and wrapped in an envelope of air (the atmosphere). To these three physical zones it is convenient to add a biological zone which includes all the living organisms (the biosphere)."- Arthur Holmes
- The 'Pedosphere' is a part of the lithosphere made up of soil and dirt. It exists at the interface of lithosphere, atmosphere, hydrosphere and biosphere.
- The lithosphere is the solid outer part of the Earth.
- The atmosphere is a thin layer of gases that surrounds the Earth.
- The hydrosphere is the watery part of the Earth's surface including oceans, rivers, lakes and water vapour
- The biosphere is the layer of Earth where life exists.
- The terms 'lithosphere' and 'crust' are not the same. The lithosphere includes the crust and the uppermost part of the mantle.
- All terrestrial planets have lithosphere. The lithospheres of Mercury, Venus, and Mars are much thicker and more rigid than that of the Earth.
- The Deepest Place ever reached by human technology vary from time to time. Till 2011 Kola Super Hole (12,262m) in Murmansk, Russia was the deepest place. But in 2012, Z-44 Chavyo Well (12,376m) broke the record, and is supposed to be 15 times the height of Burj Khalifa in Dubai. The exploration of Earth's interior continues.
- The ancient city of Petra in Jordan is an example of an entire city carved out of rocks. There are many specimens of magnificent rock-cut architecture in India, like the Ajanta and Ellora caves in Maharashtra, the Aihole and Badami temples in Karnataka, the

Konark temple in Odisha and Mamallapuram in Tamil Nadu.

- C.F. Richter devised a scale to measure the magnitude of Earthquakes. This scale relates to the energy released at the epicentre and provides an estimation of the severity of an Earthquake. It is an open ended scale. The highest magnitude ever recorded is 9.5 on Richter scale (Bio-Bio, Chile in 1960).
- The instrument which records the Earthquake waves is called 'seismograph' or 'seismometer'. The science that deals with Earthquakes is called 'seismology'.
- On 26 December 2004 a tsunami occurred in the Indian Ocean. It was the result of the Indio- Australian Plate subducting below the Eurasian Plate. It was caused by an Earthquake measuring a magnitude of above 9 in the Richter scale. The Earthquake caused the seafloor to uplift, displacing the seawater above.
- The term 'volcano' is derived from the Latin term VULCAN, which is the name of Roman "God of Fire".

Unit – 2
Lithosphere – II Exogenetic Processes

- The Earth is a dynamic system that undergoes various changes due to internal and external processes. The continuous interaction of these two processes controls the structure of the earth's surface. The external processes are the consequence of solar energy and gravitational forces, whereas the internal processes are an outcome of the earth's internal heat.



Weathering and Mass Movement

- Weathering is the disintegration and decomposition of materials of the earth's crust by their exposure to atmosphere. Movement of huge volumes of weathered rock material down the slope due to gravity is called mass movement or mass wastage. Example: rock slide, land slide, debris fall, mud flow. The nature and magnitude of weathering differs from place to place and region to region. Weathering is affected and controlled by factors such as temperature, rock structure, land slope and vegetation. There are three types of weathering 1. Physical weathering, 2. Chemical weathering and 3. Biological weathering

Physical weathering

- It is the breakdown of rocks without changing their chemical composition, through the action of physical forces. The constant freezing and thawing of rocks during the night and day leads to the expansion and contraction of rocks. Cracks are formed and disintegration occurs eventually. Exfoliation, block disintegration, granular disintegration etc., are the different types of weathering.

- ✓ **Exfoliation:** The alternate heating and cooling on rounded rock surfaces leads to the peeling of rocks, layer by layer like an onion. This is called exfoliation. Sheeting and shattering are the other forms of exfoliation.

- ✓ **Granular Disintegration:** Granular disintegration takes place in crystalline rocks where the grains of the rocks become loose and fall out. This is due to the action of temperature and frost.

- ✓ **Block Disintegration:** Repeated expansion and contraction of rocks during day and night respectively causes stress on the joints of the rocks which results in block disintegration.

Chemical Weathering

- Disintegration and decomposition of rocks due to chemical reactions is called Chemical Weathering. This is predominantly high in the hot and humid regions such as the equatorial, tropical and sub tropical zones. Chemical weathering takes place through the processes of oxidation, carbonation, solution, and hydration. The agents of Chemical weathering are Oxygen, Carbon-dioxide and Hydrogen.

- ✓ **Oxidation:** Oxygen in the atmosphere reacts with the iron found in rocks, thus leads to the formation of iron oxide. This process is known as oxidation, which results in the weakening of rocks.

- ✓ **Carbonation:** Carbonation is the mixing of water with the atmospheric carbon-dioxide, forming carbonic acid. Carbonation is important in the formation of caves, in limestone region. When the carbonic acid reacts with the carbonate rocks, the rocks get disintegrated.

- ✓ **Solution:** The process of dissolution of rock substances in water result in the loosening of the rock particles. This inturn breaks down the rocks.

- ✓ **Hydration**: Certain chemicals in the rock enlarge in size in humid conditions. These minerals found in the rock swell and this results in the development of cracks and the rock wears down. This type of weathering is called hydration.

Biological Weathering

- Biological weathering occurs due to the penetration and expansion of plant roots, earthworms, burrowing animals (rabbits, rats) and some human activities.

Gradation: Gradation is the process of levelling of the land by means of natural agents like rivers, ground water, winds, glaciers, and sea waves. These agents produce various gradational relief features in due course of time. Gradation takes place in two ways: degradation and aggradation

- **Degradation or denudation** is the wearing down of the land surface by various natural agents
  .
- **Aggradation** is building up of landforms due to natural agents.
- **Gradation** = Erosion + Transportation + Deposition

Agents of Gradation

Running water (River)

- The work of running water (rivers) is the most extensive among all the other agents of gradation. Rivers originate on higher landforms like, mountains, hills and plateaus that receive water from various sources like the rain, glaciers, springs, lakes, etc. The place where the river originates is called its source and where it joins the sea is known as its mouth. The primary functions of a river are (i) erosion (ii) transportation and (iii) deposition. The work of a river depends on various factors such as volume of water, velocity of the river, slope of land, load of sediment and structure of rock, and load of sediment.

Courses of River:

- Rivers generally originate from mountains and end in a sea or lake. The whole path that a river flows through is called its course. The course of a river is divided into: i. The upper course, ii. The middle course and, iii. The lower course

i. **The Upper Course:** Erosion is the most dominant action of river in the upper course. In this course, a river usually tumbles down the steep mountain slopes. The steep gradient increases the velocity and the river channel performs erosion with great force to widen and deepen its valley. The land features carved by a river in its upper course are V- shaped valleys, gorges, canyons, rapids, pot holes, spurs, and waterfalls.

ii. **The Middle Course:** The River enters the plain in its middle course. The volume of water increases with the confluence of many tributaries and thus increases the load of the river. Thus, the predominant action of a river is transportation. Deposition also occurs due to the sudden decrease in velocity. The river in the middle course develops some typical landforms like alluvial fans, flood plains, meanders, ox-bow lakes etc.,

iii. **The Lower course:** The River, moving downstream across a broad, level plain is loaded with debris, brought down from its upper and middle courses. Large deposits of sediments are found at the level bed and the river, splits into a number of channels called distributaries. The main work of the river here is deposition and it develops typical landforms like delta and estuary.

Erosional Landforms of River

- ✓ **Gorges and Canyons:** When the river flows through a mountainous region made up of hard rocks, it forms a valley with almost vertical sides called gorge. In India, deep gorges have been formed by Brahmaputra and Indus in the Himalayas. A deep gorge with steep sides that runs for hundreds of kilometres is referred to as canyon e.g. Grand Canyon of the river Colorado in the U.S.A.

- ✓ **Waterfall:** When a river flows in a region where hard rocks lie over soft rocks horizontally, the soft rocks get eroded quickly and the hard rocks projects outwards. Thus, the river falls vertically from a steep slope to form a waterfall. When the water falls with great force, it erodes the rock material beneath and creates a depression called a plunge pool. Shallow fast flowing water in a stream is called a rapid.

- ✓ **V-shaped valley:** A 'V'- shaped valley is formed by the vertical erosion of the river where the valley is deepened and widened.
- ✓ **Pot hole:** Due to the river action, cylindrical holes are drilled vertically in the river bed, with varying depth and diametre. These are called pot holes.
- ✓ **Meander**: As the river loaded with debris flows slowly, it forms sweeping loops and bends. It is referred to as meanders.
- ✓ **Ox bow lake**: Meanders in due course of time become almost a complete circle with narrow necks. This in turn gets abandoned and forms a lake. This is called an Ox-bow lake.

Depositional Landforms of River

- ✓ **Alluvial Fan:** A fan shaped deposition made by the river at the foothills is called an alluvial plain
- ✓ **Flood Plain:** Fine sediments are deposited on river banks when a river floods. These sediments make the region rich and fertile. This is called a flood plain. As the height of the river banks gets increases due to continuous deposition of a flooded river, levees are formed.
- ✓ **Estuary**: Estuary is formed where the rives meets the sea. Deposition of silt by the river is not possible here in the estuaries like delta as if the waves keep on eroding the deposits. Ex. River Narmada and Tapti.
- ✓ **Delta:** A triangular shaped low lying area formed by the river at its mouth is called delta. Deltas have fine deposits of sediments enriched with minerals. Eg. Cauvery Delta, Tamil Nadu.

Groundwater

- Water that percolates through the pores and fissures of rocks gets collected beneath the earth's surface. This is normally referred to as groundwater or sub-surface water. The rate of percolation depends on the nature of the rocks. The rocks that allow water to percolate are called porous rocks or permeable rocks. The rocks that do not allow water to seep through them are called non-porous rocks or impermeable rocks. The percolated water in course of time returns

back to the surface in the form of springs, geysers, hot springs, wells, tanks, artesian wells etc. that are useful for human activities. As an agent of gradation, underground water creates distinct landforms in limestone regions called Karst Topography.

Karst Topography

- Ground water is an active agent in limestone regions. Karst topography is formed due to the dissolution of soluble rocks such as limestone, dolomite and gypsum. Limestone topography of Western Slovenia extends for a distance of 480 km in length and 80 km in width which is termed as Karst in the Slavic language. The world's largest karst area is the Nullarbar located on the Great Australian Coast. Karst regions are also found in Southern France, Spain, Mexico, Jamaica, Western Cuba, Central New Guinea, Sri Lanka and Myanmar. Karst topography also exhibits both erosional and depositional features.

Erosional Landforms of Underground Water

- Most of erosion takes place due to the process of solution. When rain water mixes with carbon-di- oxide and enters into a limestone region, it dissolves and destroys much of the limestone. As a result, landforms such as Terra rossa, Lappies, sinkholes, swallow holes, dolines, uvalas, poljes, caves and caverns are formed.

✓ **Terra Rossa (Italian term for Red soil):** Deposition of red clay soil on the surface of the Earth is due to the dissolution of limestone content in rocks. The redness of the soil is due to the presence of iron oxide.

✓ **Lappies:** When the joints of limestone rocks are corrugated by groundwater, long furrows are formed and these are called LAPPIES.

✓ **Sinkhole:** A funnel shaped depressions formed due to dissolution of limestone rock is called sinkholes. Their average depth ranges between three and nine meters.

Caves and Caverns:

- Caves and caverns are subterranean features of karst topography. Caves are hollows that are formed by the dissolution of limestone

rocks when carbon di oxide in air turns into carbonic acid after its reaction with water. They vary in size and shape. Caverns are the caves with irregular floors. Eg. Guptadham caves in Western Bihar.

- All types of deposits in the caves and caverns are collectively called speleothems which includes travertines, tufa, dripstones. Swallow Holes, Uvalas, Dolines, Poljis are other erossional Features of karst regions predominant in other parts of the world.

Depositional Landforms Underground Water

- It is interesting to know that a variety of depositional features are formed on the floor, ceiling and walls of the caves and caverns of the Karst Topography.

Stalactite, Stalagmite and Column

- When the water containing dissolved calcite gradually drips from the ceiling of the caves, water evaporates and the remaining calcite hangs from the ceiling. Thus Stalactites are formed. When the calcite deposits rises upward like a pillar Stalagmites are formed. Sometimes, Stalactites and Stalagmites meet together to form Columns and Pillars.

Glaciers:

- A Glacier is a large mass of ice that moves slowly over the land, from its place of accumulation. It is also known as 'River of ice'. The place of accumulation is called snowfield. The height above which there is a permanent snow cover in the higher altitude or latitude is called snowline. Higher the latitude, lower the snowline from sea level. The gradual transformation of snow into granular ice is called 'firn' or ' neve' and finally it becomes solid glacial ice.

Movement of Glacier

- The large mass of ice creates pressure at its bottom and generates heat. Due to this, the glacier melts a little and starts to move .The rate of movement of a glacier varies from a few centimetres to several hundred meters a day. The movement of glaciers depends on slope, volume of the glacier, thickness, roughness at the bottom (friction) etc., and Temperature. Like the rivers, glaciers also carry out erosion, transportation and deposition.

Types of Glacier

- Glaciers are broadly divided into two types based on the place of occurrence, such as Continental glacier and valley glacier.

Erosional Landforms of glacier

- Glaciers are powerful erosive agents. Some of the important erosional landforms are Cirque, Aretes, Matterhorn, U-shaped valley, Hanging valley, Fiords etc., Most of these glacial features are predominantly seen in countries like Switzerland, Norway etc.,

- ✓ **Cirque:** The glacier erodes the steep side walls of the mountain and forms a bowl-shaped armchair like depression, it is termed as Cirque
- ✓ **Arete:** Aretes are narrow ridges formed when two cirque walls joined together back to back, and forms narrow knife like ridges.
- ✓ **Matterhorn:** The pyramidal peaks formed when three or more cirques meet together, are referred as Matterhorns.
- ✓ **U-Shaped Valley:** When the glacier moves down along a river valley, the valley further gets eroded deep and wide to form a 'U' shaped valley.
- ✓ **Hanging Valley:** These are valleys eroded by tributary glacier and that hangs over the main valley.
- ✓ **Fjord:** Fjords are glacial valleys that are partly submerged in the sea.

Depositional Landforms of glacier

- After getting eroded, fragments of rocks and boulders along with dirt form glacial debris. Glacial debris gets deposited in the low lying areas and form depositional features like moraines, drumlins, eskers, kames and outwash plains.

- ✓ **Moraine:** Landforms formed by the glacial deposits of valley or continental glaciers are termed as moraines. They are of various shapes and sizes, like ground, terminal and lateral moraines etc.
- ✓ **Drumlin**: Drumlins are deposits of glacial moraines that resemble giant inverted teaspoons or half cut eggs.

- ✓ **Esker:** Long narrow ridges composed of boulders gravel and sand deposited by streams of melting water which run parallel to a glacier are called eskers.

- ✓ **Outwash Plain:** An outwash plain consists of glacial sediments deposited by the melting ice at the terminus of a glacier. It appears as an extensive accumulation of sand, gravel and silt.

- ✓ **Wind:** When air blows horizontally at or near the earth's surface is called wind. The erosional, transportational and depositional action of wind is predominant in arid regions. This is called as Aeolian Process.

Erosional Landforms of wind

- Some of the erosional landforms of wind are mushroom rocks, Inselbergs and yardangs.

- ✓ **Mushroom Rock:** Rocks are made up of hard and soft layers. When a rock's bottom is soft, the sand-laden winds blow against it and wear it down. By the constant wearing down action of the wind, the bottom gets eroded away to form a mushroom like structure. This is called a mushroom or pedestal rock. Such rocks are found near Jodhpur in Rajasthan.

- ✓ **Inselberg:** Inselberg is a German term which means an island mountain. Certain hard rocks like igneous rocks are more resistant to wind action. Such isolated residual hills rising abruptly from their surroundings are termed as inselbergs. Eg. Uluru or Ayers Rock, Australia.

- ✓ **Yardang:** In arid regions, certain rocks have hard and soft layers arranged vertically. When winds blow over these rocks, the soft layers get eroded leaving irregular crests. These are called yardangs.

Depositional Landforms of wind

- Deposition occurs when the speed of wind is reduced by the presence of obstacles like bushes, forests and rock structures. The sediments carried by wind get deposited on both the wind ward and leeward sides of these obstacles. Some of the depositional landforms are sand dunes, barchans and loess.

- ✓ **Sand Dune:** In deserts, during sandstorms, wind carries loads of sand. When the speed of wind decreases, huge amount of sand gets deposited. These mounds or hills of sand are called sand dunes. There are different types of sand dunes.
- ✓ **Barchan:** Barchans are isolated, crescent shaped sand dunes. They have gentle slopes on the windward side and steep slopes on the leeward side.
- ✓ **Transverse Dunes:** Transverse dunes are asymmetrical in shape. They are formed by alternate slow and fast winds that blow from the same direction.
- ✓ **Longitudinal Dunes:** Longitudinal dunes are long narrow ridges of sand, which extend in a direction parallel to the prevailing winds. These dunes are called Seifs in Sahara
- ✓ **Loess:** The term loess refers to the deposits of fine silt and porous sand over a vast region. Extensive loess deposits are found in Northern and Western China, the Pampas of Argentina, in Ukraine and in the Mississippi Valley of the United States.
- ✓ **Wave:** A steady up (crest) and down (trough) movement of surface water are called waves. Sea waves are the most powerful agents of gradation and their erosional, transportational and depositional processes are confined to a very narrow belt along coastal areas.

Erosional Land Forms of Waves

Some of the erosional landforms of sea waves are sea cliff, sea cave, arch, stack, beach, bar and spit and wave cut platform.

- ✓ **Sea Cave**: Prolonged wave attack on the base of a cliff erodes rock materials, which result in the formation of caves.
- ✓ **Sea Arch:** When two caves approach one another from either side of a headland and unite, they form an arch. (Eg.) Neil Island, Andaman and Nicobar
- ✓ **Sea Stack**: Further erosion by waves ultimately leads to the total collapse of the arch. The seaward portion of the headland will

remain as a pillar of rock known as stack. Eg the Old man of Hoy in Scotland.

- ✓ **Sea Cliffs:** Sea cliffs are steep rock faces formed when sea waves dash against them. The rocks get eroded to form steep vertical walls.
- ✓ **Wave Cut Platforms:** Flat surface found at the foot of sea cliffs are called as wave cut platforms. Wave cut platform is also referred as beach, shelf, terrace and plain.

Depositional Landforms of Waves

- ✓ **Beach:** Sand and gravel are moved and deposited by waves along the shore to form beaches. This is the most dominant and constructive work of the sea. (Eg.) Juhu beach along Mumbai coast, Puri beach in Odisha and Marina beach in Chennai.
- ✓ **Bar:** A bar is an elongated deposit of sand, shingle or mud found in the sea, almost parallel to the shoreline.
- ✓ **Spit:** A spit is a ridge or embankment of sediment, attached to the land on one end and terminating in open water on the other end. Spits are common at the mouth of estuaries. Eg. Kakinada spit.

NOTE

- ❖ The disintegrated rock materials, in due course of time, are weathered further, to form soil. Soil is a mixture of disintegrated rock material and decayed organic matter called humus.
- ❖ **Tributary** – Small streams that join the main river. Eg. River Bhavani
- ❖ **Distributary** – River channels that get separated from the main river. E.g., River Kollidam.
- ❖ The highest waterfalls in the world is Angel falls (979 m) in Venezuela.
- ❖ The world's largest oxbow lake is Lake Chicot is Arkansas of USA. Lake Kanwar in Bihar (India) is Asia's largest fresh water ox bow lake.
- ❖ The Greek letter Δ) pronounced delta closely resembles the triangular delta of the river Nile. The Ganga-Brahmaputra Delta is the largest delta in the world.

- The world's best known geyser is the Old Faithful geyser in the Yellowstone National Park in Wyoming, U.S.A
- **Karst Areas in India**
  - Guptadham caves - Western Bihar,
  - Robert cave and Tapkeshwar temple - Uttarakhand.
  - Pandav caves Pachmari - Madhya Pradesh,
  - Kutumsar - Bastar district in Chattisgarh,
  - Borra caves of Visakhapatnam - Andhra Pradesh.
- The World's deepest sinkhole is China's xianozhai Tienkang at 2172 feet. There are as many as 15000 Sinkholes in Illinois
- **Geo Connect:** Cave insects lose their senses of sight and develop extraordinary long antenna to compensate the loss of sight
- The thickest known deposit of loess is, 335 metre found in the loess plateau in China.
- **Major land forms**: First order land form - continents and oceans. • Second order land form – Mountains, plateaus and plains in both continents and oceans.
- **Minor Land Forms**: Third order land forms – deltas, fjords coasts, sand dunes, beaches valleys, cirques, Mushroom rocks, limestone caves.

Unit- 3
Atmosphere

- Earth is a unique planet where life is found. Can you imagine life on the earth without air? No. The air is essential for the survival of all forms of life. The blanket of air that surrounds the Earth is called the atmosphere. It is held close to the earth by gravitational attraction.

1. Composition of the Atmosphere

- Atmosphere is a mixture of gases, water vapour and dust particles in different proportions. Nitrogen (78%) and Oxygen (21%) are permanent gases of the atmosphere. They constitute 99% of the total composition and their percentages always remain the same without any change. The remaining one percentage is occupied by Argon (0.93%), Carbon-dioxide, (0.03%), Neon (0.0018%), Helium (0.0005%), Ozone (0.00006%) and Hydrogen (0.00005%). Krypton, Xenon and Methane are also present in trace. Water vapour (0 - 0.4%) is also found in the atmosphere, which plays an important role in predicting weather phenomenon. The other solid particles present in the atmosphere includes dust particles, salt particles, pollen grains, smoke, soot, volcanic ashes etc.,.

- Oxygen is most important for living organisms. CO_2 absorbs heat and keeps the atmosphere warm by insulation and radiation. Nitrogen acts as a diluent and is chemically inactive. Ozone helps in protecting the earth from radiation. The solid particles in the atmosphere acts as nuclei on which water vapour condense to form precipitation.

2. Structure of the Atmosphere

- The atmosphere is thick near the earth surface and thins out until it eventually merges with space. The five atmospheric layers are: Troposphere, stratosphere, Mesosphere, Thermosphere and Exosphere.

Troposphere:

- The lowest layer of the atmosphere is the troposphere. The Greek word 'tropos' means 'turn' or change. The layer extends up to

8 kms at the poles and up to 18 kms at the Equator. The temperature decreases with increasing height. Almost all weather phenomenons take place in this layer. Hence it is called weather making layer. The upper limit of the troposphere is called as tropopause.

Stratosphere

- Stratosphere lies above the troposphere. It extends to a height of about 50km above earth surface. Since this layer is a concentration of ozone molecules, it is also referred as ozonosphere. The temperature increases with increase in height in this layer. Large jet planes normally fly here. The upper limit of the stratosphere is called as stratopause.

Mesosphere

- Mesosphere extends between 50km and 80km. The temperature increases with increasing height. Radio waves transmitted from earth are reflected back to earth from this layer. Most of the meteors nearing the earth get burned here. The upper most limit of the mesosphere is the mesopause.

Thermosphere

- Thermosphere exists above the mesosphere. It extends to about 600 km. The composition of gases in the lower thermosphere is more or less uniform, hence it is called "Homosphere". T e upper portion of the thermosphere has uneven composition of gases and hence it is referred as "Heterosphere". Here the temperature increases with increasing height. Ionosphere is a layer of the thermosphere that contains Ions and free electrons.

Exosphere

- The uppermost layer of the atmosphere is called exosphere. T is layer is extremely referred with gases and gradually merges with the outer space. T is zone is characterized by aurora Australis and aurora borealis.

Weather and Climate

- Weather and climate are the terms that are related to the atmospheric conditions. Weather denotes the way the atmosphere

behaves every day and climate reveals the average of weather conditions over relatively long periods of time. The difference between the two may be clearly understood with the following table.

Weather		Climate	
Partly sunny	Weather is the study of atmospheric conditions for short duration over small	Climate is the study of the average weather condition observed over a long period of time for a larger area.	Warm Climate
Windy	The weather changes very often; hour to hour and day to day	Climate is more or less permanent and remains the same always.	Monsoon
Rainy	A place can experience different types of weather conditions in a day. Eg. A day with hot morning can have a rainy moon.	A place can experience almost the same type of climate	Wet climate
Chilly	Weather data is collected every day in the observatories	Climate is average of the weather data.	Extreme Climate
Stormy	Study of weather is called Meteorology	Study of climate is called Climatology	Cyclone

2. There are many factors that influence weather and climate.

- ✓ Distance from the equator
- ✓ Altitude
- ✓ Nearness to the sea
- ✓ Nature of the prevailing winds
- ✓ Mountain barrier
- ✓ Cloud cover
- ✓ Ocean currents Natural vegetation

✓ **Distance from the Equator:** The sun's rays fall vertically on the equator. The rays are inclined on the regions away from the equator and near the poles due to the spherical shape of the earth. The vertical rays heat up the earth more than the inclined rays. Thus, the places near the equator are warmer than the places which are far away from the equator.

- ✓ **Altitude:** Altitude refers to the height above sea level. The temperature decreases at the rate of 1° C for every 165 mt of height. This is called Normal lapse rate. So, places at the higher altitude have a lower temperature.

- ✓ **Nearness to the sea:** The climate of a place varies according to its nearness to the sea. Places near the coast experience equable climate due to the influence of the winds from the sea. Places located in the land, far from the sea, does not experience the moderating influence of the sea, such places experience a continental type of climate.

- ✓ **Nature of the Prevailing Winds:** The winds change the climate of a place based on, from where they blow. When wind blows from a warm region, it makes the place warm and cold, when blows from a colder region. The on-shore winds cause rainfall making the place cool whereas the off-shore winds bring dry weather.

- ✓ **Mountains barriers:** The location of the mountains influence the climate of a place. The mountain chains act as natural barrier for the wind. Sometimes they prevent the entry of cold winds into the country or the escape of monsoon winds, thus having a great influence over the climate.

- ✓ **Cloud Cover:** Clouds reflect a large amount of radiation from the sun. This prevents the entry of heat to the earth's surface. So, in areas generally of cloudless sky like the deserts, temperature is very high. On the other hand under cloudy sky, the temperature is low.

- ✓ **Ocean currents:** The warm ocean currents raise the temperature of the nearby coastal areas, while the cold current lower the temperature of aw place.

- ✓ **Natural vegetation:** The trees release water vapour into the air and makes it cool. Thus forest areas have lower range of temperature throughout the year in contrast to non-forested areas.

3. Elements of Weather and Climate

- ✓ Temperature
- ✓ Pressure

- ✓ Wind
- ✓ Cloud
- ✓ Precipitation
- ✓ Humidity

Temperature:

- Temperature is a measure of the warmth of an object expressed in terms of Celsius or Fahrenheit, measured with thermometer. Sun is the chief source of energy for the Earth. The atmosphere acts as an insulator and maintains the temperature of the earth. Without atmosphere, the earth would experience great extremes of temperatures during day and night. Some of the processes that are responsible for atmospheric heat are radiation, Conduction, Convection and Advection.

- **Heat Zones:** Based on the amount of insolation received from the sun and the heat, Earth is classified into three heat zones namely torrid zone, temperate zone and frigid zone.

- **Torrid Zone:** This largest thermal zone covers almost 50% of the earth's surface. It is located between the Tropic of Cancer (23½°N) and Tropic of Capricorn (23½°S). Torrid Zone experiences vertical sun rays almost throughout the year and is hot.

- **Temperate Zones:** The Temperate Zone stretches out between Tropic of Cancer (23½°N) and Arctic Circle (66½°N) in the northern hemisphere and between Tropic of Capricorn (23½° S) and Antarctic Circle (66½° S) in the southern hemisphere. The sun's rays never fall vertical in this region. The Frigid Zone is found between Arctic Circle (66½°N) and North Pole (90° N)in the northern hemisphere and stretches out between Antarctic Circle (66½° S) and South Pole (90°S) in the southern hemisphere. The sun's rays fall slanting in this zone. These are the coldest regions of the world. The surface remains permanently frozen under thick snow.

Pressure

- The atmospheric pressure is the weight exerted by air on a particular area of the earth surface. It is measured with a mercury barometer and the unit of measurement is millibar (mb). The

distribution of atmospheric pressure on the surface of the earth is not uniform. It varies both vertically and horizontally.

Vertical distribution of atmospheric pressure:

- Air pressure decreases with altitude. The air molecules become scattered and more widely spaced at higher altitudes. The air pressure decreases by 34 millibars per 300 metres increase in height.

Horizontal distribution of atmospheric pressure:

- The horizontal distribution of atmospheric pressure in the world is not uniform. It varies from time to time and place to place due to (i) air temperature (ii) the earth's rotation (iii) presence of water vapour etc., The pressure belts along the latitudes are characterized by alternate high or low pressure belts. The pressure belts of the world are:
    - Equatorial low
    - Sub-tropical highs
    - Sub-polar lows
    - Polar highs

The Equatorial Low Pressure Belt: This belt extends from equator to 5° N and 5° S latitudes. At the equator, the earth gets heated by the vertical sun rays and in turn heats the air in contact with it. The heated air expands and raises upwards resulting in a low pressure belt. This belt is called doldrums due to virtual absence of surface winds.

The Subtropical High Pressure Belts: The sub-tropical high pressure belts extend from the tropics to about 35° latitudes in both the hemispheres. The air that raises in the equatorial region, becomes cold and heavy, and starts to descend in the Sub Tropical regions. This result in sub-tropical high pressure belts referred as the Horse latitude.

The Sub-polar Low Pressure Belts: The sub-polar low pressure belts extend between 45°N and the Arctic Circle in the northern hemisphere and between 45°S and the Antarctic Circle in the southern hemisphere. The air present in this layer moves to the sub-tropical high pressure belt and polar high pressure belt making it free from air

pressure forming the sub polar low pressure belt. This is made possible by the rotation of the earth.

The Polar High Pressure Belts: Sun rays are always slanting at poles resulting in low temperatures. Because of low temperature, air compresses and its density increases. Hence, high pressure is found here. Winds from these belts blow towards sub-polar low pressure belts.

Winds

- The horizontal movement of air along the surface of the earth is called the "Wind' while the vertical movement of air is a called an "Air Current". The winds always blow from a high pressure area to a low pressure area. Wind is mostly named after the direction from which it blows. For example, the wind blowing from the east is known as the easterly wind. An "anemometer" records wind speed while a "wind vane" measures the direction of the wind. The unit of measurement is kilometre per hour or knots

Types of Winds

Winds are generally classified into the following four major types:

- ❖ Planetary wind
- ❖ Periodic winds
- ❖ Variable wind
- ❖ Local wind

Planetary winds

- The winds which constantly blow in the same direction throughout the year are called the planetary winds. They are also called as permanent winds or the prevailing winds. These winds include Trade winds, Westerlies and Polar Easterlies

  - ✓ **Trade Winds:** Trade winds blow from the subtropical high pressure belt to the Equatorial low pressure belt in both the hemispheres. They blow with great regularity, force and in a constant direction throughout the year. These winds were

very helpful to traders who depended on the winds while sailing in the seas. And so, they are named as Trade winds. As they travel over vast oceans, they collect more moisture and bring heavy rainfall to the East Coast of the continents of the tropics. As they move westwards, they become dry and do not give rainfall.

- ✓ **Westerlies:** Westerlies are the permanent winds that blow from the tropical high pressure belt to the sub polar low pressure belt in both the hemispheres. They blow from South West to North East in the northern hemisphere and North West to South East in the southern hemisphere. The velocity of westerlies become so vigorous and fast to be called Roaring Forties at 400, Furious Fifties at 500 and Screaming Sixties at 600 latitudes.

- ✓ **Polar Easterlies:** Polar easterlies are cold and dry polar winds that blow from the polar high pressure belt to the sub polar low pressure belt. These are weak winds blowing from North East direction in the Northern Hemisphere and South East direction in the Southern Hemisphere.

Periodic winds:

- The periodic winds are the seasonal winds that change their direction periodically. These winds are caused by the differential heating of land and ocean. Winds which reverse their direction with the change of seasons are called monsoons. A tropical Monsoon wind of Indian subcontinent is a best example.

Variable winds:

- The disturbance and the changes in the local weather cause variations in the prevailing winds. These winds are known as the variable winds. Variable winds usually end up with the development of cyclones, anticyclones and storms.

- ✓ **Cyclones:** The term cyclone is a Greek word meaning "coil of a snake". Cyclones are centres of low pressure where, winds from the surrounding high pressure area converge towards the centre in a spiral form. Due to the rotation of the earth, the cyclonic winds in the northern hemisphere move in anti-clock

wise direction, where as they move in clockwise direction in the southern hemisphere. Cyclones can be classified into: 1. Tropical cyclones, 2. Temperate cyclones, 3. Extra tropical cyclones

- **Tropical cyclones:** Tropical cyclones develop in the Inter tropical convergence zone [ITCZ]. They are formed due to the differential heating of land and sea. Tropical cyclones are known as 'cyclones' in Indian ocean, 'typhoons' in the western pacific ocean, 'hurricanes' in the Atlantic and eastern Pacific ocean, 'Baguio's' in Philippines and 'willy willy' in Australia. Tropical cyclones often cause heavy loss of life and property on the coasts and become weak after reaching the landmasses.

- **Temperate cyclones:** Temperate cyclones are formed along a front where hot and cold air masses meet in mid-latitudes between 35° and 65°N and S. Temperate cyclones do not become weak like the tropical cyclones on reaching the land. Temperate cyclone commonly occurs over the North Atlantic Ocean, North West Europe, Mediterranean basin. Mediterranean basin's temperate cyclones extend up to Russia and India in winter. In India it is as called western disturbances.

- **Extra tropical cyclones:** Extra tropical cyclones occur in the latitudes between 30° and 60° in both the hemispheres. They are also called as mid-latitude cyclones. They collect energy from temperature differences which are found in higher latitudes. Extra tropical cyclones produce mild showers to heavy gales, thunderstorms, blizzards, and tornadoes.

✓ **Anticyclones:** Anticyclones are the opposite of cyclones. Here an area of high pressure region is found in the centre surrounded by low pressure on all sides. The wind from the high pressure region move outwards to the low pressure regions in a spiral form. Anticyclones are often accompanied by cold and heat waves.

Cyclonic occurrences in Tamil Nadu						
Year	**Cyclone Name**	**District**	**Atmospheric Pressure** (in millibars)	**Wind Speed** (km/h)	**Fatalities** (in numbers)	**Property loss** (M-Million G-Billion)
2010	**JAL**	Chennai	988	100	78	1.73M
2011	**THANE**	Cuddalore	972	140	48	235M
2012	**NILAM**	Mahapalipuram & Chennai	992	85	75	56.7M
2013	**MADI**	Chennai	986	120	323	1.5G
2016	**ROANU**	Nagapattinam & Chennai	983	85	22	2.0G
2016	**KYANI**	Chennai	997	85	-	-
2016	**NADA**	Chennai	1000	75	-	-
2016	**VARDAH**	Chennai	982	130	38	5.1G
2017	**OCKHI**	Kanyakumari	975	155	245	5.07G

Local Winds:

- Local winds are the winds that blow only in a particular locality for a short period of time, the effect of these local winds are experienced only in that particular area. They are mostly seasonal and have local names like....

  - ✓ Foehn (Alps-Europe)
  - ✓ Sirocco (North coast of Africa)
  - ✓ Chinook (Rockies-North America)
  - ✓ Loo (Thar Desert- India)
  - ✓ Mistral (Mediterranean sea in France)
  - ✓ Bora (Mediterranean sea in Italy)

5. Clouds

- Large amount of water evaporates each day from the surface of the sea. This is the principal source of atmospheric moisture. Cool moisture laden air, gets collected around particles like dust, salt content from the sea, smoke etc., and forms clouds. Sometimes, mixing of warmer and cooler air also produces clouds. A visible mass of condensed water vapour floating in the air above the ground level is called a cloud. The three layers of atmosphere such as troposphere, stratosphere and mesosphere are specific locations of clouds. According to their height, clouds are classified into the following types 1. High clouds (6-20km Height), 2. Middle clouds (2.5km-6km Height), 3. Low clouds (ground surface to 25 km height. These major types of clouds are further divided into different types on the basis of shape and structure.

High clouds

- **Cirrus:** Detached clouds in the form of white delicate fibrous silky filaments formed at the high sky (8000 meters to 12000 meters) are called Cirrus clouds. These clouds are dry and do not give rainfall.
- **Cirro-cumulus**: White patched, sheet or layer like clouds composed of ice crystals.
- **Cirro-stratus:** Smooth milky transparent whitish clouds composed of tiny ice crystals.

Middle clouds

- **Alto-stratus:** Thin sheets of grey or blue coloured clouds in uniform appearance. consisting of frozen water droplets
- **Alto-cumulus:** Clouds fitted closely together in parallel bands, called as 'Sheep clouds' or wool pack clouds.
- **Nimbo stratus:** These are clouds of dark colour very close to the ground surface associated with rain, snow or sleet.

Low clouds

- **Strato-cumulus**: Grey or whitish layer of non-fibrous low clouds found in rounded patches at an height of 2500 to 3000 metres, associated with fair or clear weather

- **Stratus**: Dense, low lying fog-like clouds associated with rain or snow
- **Cumulus**:- Dome-shaped with a flat base often resembling a cauliflower, associated with fair weather
- **Cumulo-nimbus**:- Fluffy thick towering thunderstorm cloud capable of producing heavy rain, snow, hailstorm or tornadoes

Precipitation

- Falling down of condensed water vapour in different forms is called Precipitation. When the dew point is reached in the cloud water droplets become saturated and start to fall. Hence, they fall on the earth as Precipitation. The climatic conditions/ factors influencing the forms of precipitation mainly are:

    - Temperature.
    - Altitude
    - Cloud type.
    - Atmospheric conditions.
    - Precipitation process.

  The main forms of precipitation include drizzle, rain, sleet, snow, hail etc.

- **Drizzle:** Falling of numerous uniform minute droplets of water with diameter of less than 0.5 is called a drizzle.mm from low clouds. Sometimes drizzles are combined with fog and hence reduce visibility.

- **Rain:** Rain is the most widespread and important form of precipitation in places having temperature above the freezing point. It occurs only when there is abundant moisture in the air. The diameter of a rain drop is more than 5mm.

- **Sleet:** Sleet refers to a precipitation, in the form of pellets made up of transparent and translucent ice. This precipitation is a mixture of snow and rain
- **Snow:** Snow is formed when condensation occurs below freezing point. It is the precipitation of opaque and semi opaque ice crystals. When these ice crystals collide and stick together, it becomes snowflakes.

- **Hails:** Hails are chunks of ice (greater than 2cm in diameter) falling from the sky, during a rainstorm or thunderstorm. Hailstones are a form of solid precipitation where small pieces of ice fall downwards. These are destructive and dreaded forms of solid precipitation because they destroy agricultural crops and human lives.

Rainfall

Rainfall is the most predominant type of Precipitation. Moisture laden air masses raise upwards, forms clouds and bring rainfall. Based on the mechanisms of raising the air, there are three types of rainfall.

- Convectional rainfall
- Frontal or cyclonic rainfall
- Orographic rainfall.

- **Convectional rainfall:** Earth surface is intensely heated through solar radiation during the day time. When the air near the earth surface is heated, it rises and expands. This heating results is the formation of convectional air currents. Thus the ascending moist air cools, condenses and results in convectional rainfall. Convectional rainfall occurs regularly in the equatorial region in the evenings. It is also experienced in tropical, sub-tropical and temperate regions in the summer months and on warmer days.

- **Cyclonic rainfall:** Cyclonic precipitation occurs during cyclones when air masses are made to converge and move upward so that adiabatic cooling occurs. Cyclonic rainfall occurs in tropical as well as temperate regions. When warm and cold air masses converge, condensation and precipitation takes place on the boundary between warm and cold air masses called as Frontal rainfall.

- **Orographic rainfall** Orographic rainfall, also called relief rainfall, is caused when air is forced to rise against a high mountain. The mountain barriers lying across the direction of air flow, force the moisture laden air rise along the mountain slope. This results in the cooling of the air, which leads to the formation of clouds and rain. This rainfall is called Orographic rainfall. The side of the mountain facing the wind is called the windward side and receives heavy rainfall. It is called the rain fed region. The other side of the

mountain that does not face the wind is called the leeward side and receives less rainfall becomes rain shadow region.

Humidity:

- Humidity is an important aspect of the atmosphere because it affects both weather and climate. The amount of water vapour present in the atmosphere is referred to as humidity. Humidity of the atmosphere is high when it has large quantities of water vapour. The amount of water vapour in the atmosphere is called absolute humidity. The ratio between the amount of water vapour in the atmosphere and the amount of water vapour it can hold is relative humidity Hot air can hold more water vapour then cold air. Relative humidity increases when air gets cold and decreases when air gets heated up.

NOTE

- In 1772 CE Daniel Rutherford discovered Nitrogen in atmosphere. In 1774 Joseph priestly discovered oxygen in atmosphere
- Magnetosphere lies beyond the exosphere. It is the earth's magnetic belt, where proton and electrons, coming out from the sun are trapped by the earth. The magnetic field extends to around 64,000 km above the Earth.
- Auroras are cosmic glowing lights produced by a stream of electrons discharged from the Sun's surface due to magnetic storms that are seen as unique multi-coloured fireworks hanging in the polar sky during midnight
- During the day, the land masses get heated more rapidly than the oceans. Heated air ascends and this causes low pressure on the adjoining ocean. Therefore, the wind blows from ocean to land in the afternoon. This is called sea breeze. **Sea breeze** helps in reducing the temperature of the coastal region especially during the summer season. During the night, the land cools more rapidly than the ocean. Cool air sinks and forms high pressure. The wind blows from land to sea during the night, this is called **land breeze**.
- The windward is the side of a mountain which faces the prevailing wind. It receives heavy rainfall. The leeward side of the mountain is the side sheltered from the wind. It receives very less rainfall.
- Heat is the energy which makes objects hot, while temperature measures the intensity of heat.

- The amount of heat received from the sun in the form of short waves is called Insolation or Incoming Solar Radiation.
- The outgoing heat from the earth to space in the form of long waves is called terrestrial radiation. This is also called as re-radiation
- Albedo is the fraction of solar energy reflected from the earth back into space without reaching or heating the earth surface.
- There is a balance between insolation and radiation. This balance is termed as a heat budget of the earth.
- Isotherms are imaginary lines drawn on maps, connecting points that have equal temperatures. Temperature varies from place to place, season to season and continent to continent. The average global surface temperature is about 13 °C.
- **Conduction** is the transfer of heat from hot body to a cold body through contact.
- **Convection** is transfer of heat by movement or circulation of air in a mass.
- **Advection** is the transfer of heat through the horizontal movement of air.
- An isobar is an imaginary line drawn through places having equal atmospheric pressure reduced to sea level.
- At the top of Mount Everest (elevation 8848m), the air pressure is only about one third the pressure at sea level. When we fly in aircraft or travel fast on road to hill stations, our ears pop as they adjust to a rapid change in pressure when ascending or descending.
- **ITCZ and Doldrums:** The Inter Tropical Convergence Zone (ITCZ) is the belt of converging winds and rising air encircling Earth near the Equator. Doldrums (the zone of calm) lies in the equatorial region with calms, light unpredictable winds and sudden cyclones
- **HORSE LATITUDE:** In olden days vessels with cargo of horses passing through sub-tropical high pressure belts found difficulty in sailing under calm conditions. With little water and food left for the humans, sailors used to throw the horses in to the sea in order to make the vessels lighter. Henceforth these belts or latitudes are also called 'horse latitudes'.
- The rotation of the Earth causes deflection of winds from their original path, called the “Coriolis effect”. Winds are deflected to

the right in the northen hemisphere and to the left in the southern hemisphere which is known as "Ferrel's law". This was profounded by William Ferrel. He used "Coriolis force" named after G.G Coriolis (1792-1843) for proving Ferrel's Law

- **Super Cyclone**: A violent cyclone that hit Odisha, on Friday, 29 October 1999, was one of the most devastating and strongest storm to hit the Indian coast. Winds of up to 260 kph raged for over 36 hours. The winds caused a seven-metre tidal wave that swept more than 20 km inland and brought massive destruction and death to a number of coastal districts in the state of Odisha. It is estimated that more than 10 million people in 12 coastal belt districts were affected by the cyclone. More than 10,000 people lost their lives.
- A front is the boundary separating warm and cold air masses. One type of airmass is usually denser than the other, with different temperatures and humidity. This meeting of airmass causes rain, snow, cold days, hot days, and windy days.
- Deliberations for naming cyclones in the Indian ocean region began in 2000 and a formula was agreed upon in 2004. Eight countries in the region Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Srilanka, and Thailand contributed a set of names which our assigned sequentially whenever a cyclonic storm develops.
- During sunset cirrus clouds look colourful hence they are called as "Mare's Tails".
- The only sphere which contains all clouds in the atmosphere is troposphere
- Any thunderstorm which is associated with fall of hail stones is known as hailstorm. Hailstorm is one of the most feared weather phenomenon because it has the potential to destroy plant, trees, crops, animals and human life.
- Mawsynram is the wettest place of India as it is located in the windward side of the Purvachal hills, whereas Shillong lies on the leeward side and thus receives less rainfall. This is the same, in the case of Mumbai and Pune.
- Absolute humidity is expressed in terms of grams of water vapour present per cubic metre of air. Relative humidity is expressed in percentage.
- When the relative humidity of the air is 100%, the air is said to be saturated. Saturated air will not absorb any more water vapour.

The temperature at which air gets saturated is called dew point. Humidity of the atmosphere is measured by the wet and dry bulb thermometer also called the Hygrometer

Unit - 4. Hydrosphere

- One of the most indispensable natural resources on earth is water. The Earth is also called the Blue planet, as it holds water in abundance and thus stands unique among all other planets. Hydrosphere consists of water in various forms found on the earth. Over 97% of the water on the Earth's surface is confined to oceans. Less than 3% of water is held on land as glaciers, ice caps, groundwater, rivers, lakes, and also as the water vapour in air.

Hydrological Cycle

- The Earth's water is not static. It is always in motion. This continuous movement of water on, above and below the earth's surface is called the Hydrological Cycle. The three major processes involved in the water cycle are evaporation, condensation and precipitation. Water changes its form constantly i.e. Ice, water and water vapour. This process happens in the blink of an eye or even over millions of years. Water resources of the Earth can be broadly divided into fresh water and salt water.

Fresh Water

- Rain water is considered to be the purest form of water, as it contains very less proportion of salts when compared to the oceans and seas. Hence it is called fresh water. A major part of fresh water is found in the frozen state in the form of ice caps and glaciers. Around 1% of it is found in the liquid state as rivers, streams, lakes, ponds etc. Surface water may also penetrate through porous rocks and gets collected beneath the Earth's surface. This is called groundwater.

Oceans

- The ocean is a continuous body of salt water that forms the major part of hydrosphere. Geoscientists believe that the oceans were formed on Earth nearly three billion years ago. It is difficult to believe that in the beginning there was no water on our planet. In due course of time, when the Earth started cooling, steam escaped from the interior and entered the atmosphere to form clouds. At first, the clouds brought

incessant rains. The rain water filled the depressions for tens of thousands of years and eventually a super ocean was formed.

- The continents and oceans are however, not evenly distributed in the northern and the southern hemispheres. The northern hemisphere holds 61% of land whereas the southern hemisphere holds 81% of water. It is because of this pattern of land and water distribution, the northern hemisphere is called as the land hemisphere and the southern hemisphere is called as the water hemisphere. Oceans and seas are considered as resource bowl of the earth because of the immense availability of food, minerals etc., Present distribution of the world's oceans and major seas are illustrated in the map.

Relief of the Ocean Floor

- The ocean floor is not flat as it was believed to be in the earlier days. It comprises of many complex and varied relief as observed on the earth's surface. The ocean floor also has high mountains, deep trenches and large flat plains. These features are formed due to the tectonic, volcanic and depositional activities.

Comparative study of major oceans of the world

Ocean	Location	Average Depth (m)	Deepest Point (Below mean sea level)	Important Seas	Important Islands
Pacific Ocean	Bounded by North and South America on the east, Asia and Australia on the west and Antarctica on the South.	4,028	Challenger Deep in Mariana Trench (10,924 m)	Bering Sea, Sea of Japan , Okhotsk sea, yellow Sea, South china Sea, Coral sea	Hawali, Vancouver, Shakalin, Fiji
Atlantic Ocean	Extends from Greenland in the North to Antarctica in the South and located between North and South America in the west and Europe and	3,926	Puerto Rico Trench (8,605 m)	Baltic sea, Black sea, Caribbean sea, North sea, Mediterranean sea, Norwegian sea	Canary island , New Found land, Azores, Greenland, Iceland,

	Africa in the East.				
Indian Ocean	Bounded by Asia in the north, Africa in the west, Australia in the east and Antarctica in the south.	3,963	Java Trench in Sunda Deep (7,258 m)	Red sea, Persian Gulf, Arabian sea, Andaman sea, bay of Bengal	Andaman and Nicobar, Islands, Lakshadweep Island, Sri Lanka, Pamban Islands
Southern Ocean	Found to the south of 60° South latitude and encircle Antarctica.	4,000 to 5,000	South Sandwich Trench (7,235 m)	Weddell sea, Amundsen sea, Davis sea, Ross sea	Trinity Islands Barry Islands, Wednesday Islands, Saddle Islands, Tasmania
Arctic Ocean	Surrounded by Europe, Asia, North America, Greenland, and by several islands.	1,205	Fram Basin (4,665 m)	Beaufort sea, Hudson Bay, White sea,	Amsterdam Island, Monumental Islands, Hyde Parker Islands, Shoe Islands

- The ocean basins are characterised by the following major relief features:

A. Continental shelf
B. Continental slope
C. Continental rise
D. Deep sea plain or Abyssal plain
E. Oceanic deep
F. Oceanic ridge

A. Continental Shelf: A shallow and gently sloping platform extending out from the adjoining continental land mass into the sea is called Continental Shelf. It is almost a uniform zone of sea bed with a gentle gradient. The continental shelf is of great significance for the following reasons:

- ✓ They are shallower, thus enables sunlight to penetrate through the water. This encourages abundant growth of grass, sea weeds and plankton. Hence these zones become the richest fishing grounds in the world. Eg. The Grand Banks of Newfoundland.

- ✓ The continental shelves have extensive deposits of minerals and mineral fuels. Hence, this zone becomes accessible for oil drilling and mining activities. E.g. Mumbai High in Arabian Sea.

B. Continental Slope: A steep slope which descends from the edge of the continental shelf to the deep ocean-bed is called continental slope. It forms a boundary between the Continental Crust and the oceanic crust. This zone is free from deposits as they are steep. The most important characteristic of continental slope is the presence of deep canyons and trenches. Due to the low penetration of sunlight, the slope has nearly freezing temperature. Hence aquatic life has very slow rate of metabolism.

C. Continental Rise: At the base of the continental slope is a gently sloping layer of sediments which merge into the deep-sea floor. This underwater feature found between continental slope and abyssal plains is called the continental rise. It consists of submarine fans which are similar to the alluvial fans found on land.

D. Deep Sea Plains or Abyssal Plains: The deep sea plains or abyssal plains are underwater plains found on the deep ocean floor. These plains extend from continental rise to the mid oceanic ridges. The gradient of the slope is very gentle and it appears as a uniform flat and featureless plain. These plains are usually covered by the thick layer of sediments composed of clay, silt and sand, brought by the rivers. These are often characterized by features like abyssal hills, sea mounts, guyots, coral, atoll etc.

E. Oceanic Deeps: Trenches are the deepest part of the oceans and occupy about 7% of the total relief of the ocean floor. The ocean temperature in the trench is slightly cooler than the freezing temperature. As they are sediment free, most trenches are V-shaped with steep sides. Epicentre of the great earthquakes are all found in the trenches.

F. Oceanic Ridge: Oceanic ridge is a continuous submarine mountain chain. They are made of young basaltic rock formed when two tectonic plates moves apart. The mid-ocean ridge is probably the most extensive single feature of the earth's topography. Two of the most well known mid- ocean ridges are the

Mid-Atlantic Ridge and the East Pacific Ridge. The Mid-Atlantic Ridge is the largest unbroken oceanic ridge.

Ocean Temperature and Salinity

- Like land masses, ocean waters also vary in temperature from place to place, both at the surface and at its depths. As the warming and cooling of water is slower than the land, the annual range of temperature in any part of the ocean is very much lower. The mean annual temperature of the ocean water in equatorial regions is about 21^{o} C and almost drops down to freezing point at the polar region.

- The degree of concentration of salts in the sea water is called salinity. It is usually expressed in terms of parts per thousand (ppt or ‰). Salinity varies both horizontally and vertically. The influence of temperature on ocean salinity depends upon the heating up of the surface water, which varies from tropics to polar regions. When the sun heats up the surface layer of water in the tropics, the salt content is left out in the oceans after evaporation. Thus salinity is maximum at the tropics and lower at the equator and the poles.

Movement of the Ocean Water

- The ocean water is dynamic. Temperature, salinity, density, external forces of the sun, moon and the winds keep the ocean waters in movement, both horizontally and vertically. Waves and currents are in horizontal motion while tides have vertical motion.

Waves:

- Of all the movements of the oceans, sea waves are considered to be the strongest. Sea waves are ripples on water caused when winds blow over the sea. The height of these waves depends on the speed of wind, its duration and the direction from which they blow. Sometimes waves are also caused by tremors felt on the ocean floor. Such waves are quite destructive and called Tsunami.

Tides

- ✓ The periodic rise and fall of sea water due to the gravitational pull of the sun and moon on earth are called tides. They are classified broadly into Spring tides and Neap tides.

- ✓ When the Sun, Moon and Earth are aligned in the same line, the collective gravitation pull of the sun and moon on earth's water strengthens to form a high tide known as spring tide. Such tides always occur on full moon and new moon days.
- ✓ When the sun and the moon are at right angles, their gravitational forces work against each other, causing a low tide called neap tide. A neap tide occurs between two spring tides i.e., twice a month, when the first and last quarter moon appears.

Oceans Currents

- The movement of oceanic water on the surface and at the depths in a definite direction is called ocean current. Ocean currents are in clockwise motion in the northern hemisphere and in the anti-clockwise motion in the southern hemisphere. The factors that generate ocean currents are: 1. Earth's rotation, 2. Prevailing winds and, 3. Differences in temperature and salinity of ocean water. On the basis of temperature, ocean currents are classified as warm currents and cold currents. The movement of ocean currents from the low latitudes (tropical zones) towards high latitudes (temperate and polar zones) is called warm current. Eg. Gulf Stream in Atlantic Ocean, North Equatorial Current in Pacific Ocean.

CASE STUDY Tides and Border Security Force (BSF).

The strategic role played by the Border Security Force (BSF) to guard the creek of Rann of Kutch is an enormous one. Firstly, most of the creek area gets submerged due to high tide and at times of low tide, the creek emerges out along with poisonous creatures like snakes, scorpions, etc. Even the landscape view differs in the morning and in the evening due to tidal effects twice a day. Secondly, the turbulence here in the creek area is more violent than the open sea. Thirdly, the salt marshy terrain and the humid weather conditions affect the health of the soldiers. Strong winds, scorching heat waves, high salinity of the coastal waters and mirages also affect the eyes of the soldiers. Natural factors like currents, tides, shifting sand bars and lack of permanent landmarks on the boundary, lead to great difficulty in safeguarding this sensitive area under military domain.

Distribution of Major Ocean Currents and Effects		
Ocean	**Name of the Current**	**Effects**
South Atlantic Ocean	Benguela Current (Cold)	Leads to foggy conditions along the coast of Namibia. Helped in the development of Namibian & Kalahari deserts
North Atlantic Ocean	Canaries (Cold)	Influences the extension of Sahara Desert
	Gulf Stream (Warm)	Its confluence with the Labrador current produces heavy fog along the coast of Newfoundland, obstacles the navigation. Hence, Newfoundland is one of the major fishing grounds of the world.
	North Atlantic Drift (warm)	It keeps the ports at higher latitudes ice-free throughout the year. Eg. Port of Rorvik (Norway), Murmansk and Severodvinsk (Russia)
	Labrador (Cold)	Its confluence with Gulf Stream creates fog and hinders navigation.
South Pacific Ocean	Peruvian / Humboldt Current (Cold)	Helped in the desertification of the Atacama desert. EL-Nino effects the weather in western & S. America. It also affects timely arrival of Indian monsoon
North Pacific Ocean	Kuroshio Current (Warm)	It plays a vital role in carrying large amount of heat to the adjacent land areas and forms cloud cover that a use rainfall.
	Oyashio /Kurile Current (Cold)	Its confluence with the Kuroshio current produces heavy fogs around Hokkaido, which become potential hazards for navigation. Hence, Hokkaido acts as the major fishing ground of the world.
	Alaska Current	Keeps the seaports of Alaska open

	(Warm)	throughout the year.
	California Current (Cold)	Leads to foggy Conditions along the coast of California. It helped in the development of Arizona & Sonata deserts.
India Ocean	West Australian Current (Cold)	Leads to foggy conditions along the western coast of Australia. It helped in the genesis of west Australian desert.

Marine Resources

- The biotic and abiotic resources found in the oceanic water and at the bottoms are called marine resources. The ocean's resources play a vital role in sustaining the needs of society. A diverse array of marine organisms is used for food, medicine, cosmetics, and a wealth of industrial applications. The world's demand for energy, minerals and water have become increasingly dependent on non-living marine resources.

Marine Resources	Biological Resources: Eg. Fishes, Plankton, sea grass, Coral etc.
	Mineral Resources: Petroleum, Natural gas, Metallic minerals, Sand, Gravel etc.
	Energy resources: Eg. Energy fuels, Tidal energy, wave Energy etc.

Conservation of Marine Resources

- Oceans are the life blood of planet earth and mankind. The humankind depends on the marine resources for its survival. They are also essential for the economic prosperity, social well-being and quality of life. Oceans have extensive deposits of oil reserves. Besides a major fishing ground, it helps in generating non-conventional energy, development of many ports and harbours for trade activities. Coastal tourism also attracts people around the world, thereby contributing to the economy of many countries.

- The marine environment is faced with a number of increasingly severe threats. These include loss of biodiversity, loss of habitats, contamination through dangerous substances, and the impacts of climate change. Yet the marine resources are not deteriorating, it is necessary to find better ways of managing it.

NOTE

- ❖ Finland is known as the land of thousand lakes. There are 1,87,888 lakes in Finland.
- ❖ Water table is a level below the ground, where water is found collected beneath the Earth's surface. Aquifers are porous rock strata filled with water, found below the earth's surface.
- ❖ Sylvia Earle is a famous American oceanographer . She was named as the first, 'Hero for the Planet' by Time magazine for her efforts towards marine life protections.
- ❖ Jacques-Yves Cousteau (1910-1997) was a famous French Ocean explorer, who conducted extensive under-sea investigations.
- ❖ He belonged to the information service of the French Navy, and was sent on missions to Shanghai and Japan (1935– 1938) and in the USSR (1939).
- ❖ Honours: Cross of War 1939–1945 (1945), U.S. Presidential Medal of Freedom (1985)
- ❖ A Hypsometric Curve is a graphic representation which shows the height of a certain place found on land and the height of ocean features at sea. 'Hypso' means height in Greek.
- ❖ ONGC: Oil and Natural Gas Corporation is India's largest oil and gas exploration and production company. Its latest estimate is that about 20 million tons of oil reserves are found west of Mumbai High off shore.
- ❖ Abyssal plains in the Atlantic and Indian Oceans tend to be extensive than the Pacific Ocean because, majority of the world's largest rivers empty their sediments into either Atlantic or Indian Ocean. E.g. Amazon, Ganga and Brahmaputra rivers.
- ❖ Dragon Hole is the deepest known underwater sink hole in the world. The local fishermen call it the 'eye' of the South China Sea.
- ❖ **Fathoms:** A nautical measurement of the depth of water in the ocean.
- ❖ **Isobath:** An imaginary line on a map joining the points of equal depths.
- ❖ **Isohaline:** An imaginary line on a map joining the points of equal salinity in oceans.

- The Bermuda Triangle, also called the Devil's Triangle, is a loosely defined region in the Western part of the North Atlantic Ocean, where a number of aircraft and ships are said to have disappeared. Collect recent news about this triangle and have a discussion about the same in your class room.
- The sea / ocean water does not contain calcium in great quantities. Many of the aquatic animals with shells use the dissolved calcium in the sea water to build their protective shells.
- The energy of the falling wave water is used to turn hydro turbines to generate power. Wave energy power plants have been installed at Vizhinjam in Kerala coast and Andaman and Nicobar islands of India.
- Potential tidal energy zones of India are the Gulf of Khambhat, Gulf of Kutch and Sundarbans.
- Maritime boundary of most the Countries is fixed to be 12 nautical miles from the baseline. This was fixed by the U.N. Convention on the Law of the sea 2013 where -as Jordan and Palau have 3 nautical miles as their maritime boundary and Benin, Republic of Congo, EI Salvador, Peru and Somalia have 200 nautical miles.
- NIO (National Institute of Oceanography) was established in 1st January 1966. The headquarters of NIO is located at Dona Paula, Goa. It Conducts research and observations to understand oceanic features, Ocean engineering, marine Archaeology etc.
- The Gangetic Dolphin was declared the National Aquatic Animal in 2010. This has become an endangered species. Are the Dolphins really at risk? If so, list out the reasons.
- **The Great Barrier Reef**: The Great Barrier reef is the world's largest coral reef system composed of 2,900 individual reefs and 900 islands stretching for about 2,000 kilometres. It covers an area of about 3,50,000 km. The reef is located in the Coral sea, off the coast of Queensland, Australia. The Great Barrier Reef can be seen from the outer space. This sprawling coral reef system is one of the most biologically diverse places on the planet. Coral reefs are built by billions of tiny organisms, known as Coral polyps. CNN labelled it as one of the seven natural wonders of the world.

Unit – 5
BIOSPHERE

- Biosphere, the fourth sphere of the Earth, is a life supporting layer that exists on the earth's surface. This layer on earth encompasses the Lithosphere, Hydrosphere and Atmosphere. It includes flora and fauna that thrive on or near the earth's surface. The vertical range of the biosphere is approximately 20 km, which is measured from the ocean floor to the troposphere. However, most plants and animals live in a very narrow section for about 1 km above and below the Mean Sea Level (MSL). Biosphere is made up of different ecosystems and biomes. All living things, large or small, are grouped Into Species. The area in which an animal, plant or micro organism lives is called its habitat. A wide variety of plants and animals live in a particular habitat known as *biodiversity.*

Ecosystem

- An ecosystem is a community, where all living organisms live and interact with one another and also with their non-living environment such as land, soil, air, water etc. Ecosystems range in size from the smallest units (Eg: bark of a tree) that can sustain life to the global ecosystem or ecosphere. (Eg: Cropland, Pond ecosystem, Forest ecosystem, Desert ecosystem etc.). Biosphere harbours all ecosystems on the earth and sustains life forms including mankind.

Components of ecosystem

- ❖ An ecosystem consists of three basic components, namely
- ❖ Abiotic components
- ❖ Biotic components and
- ❖ Energy component

a. Abiotic Components: Abiotic components include the non-living, inorganic, physical and chemical factors in the environment. Eg. Land, Air ,Water, Calcium, Iron etc.

b. **Biotic Components:** Biotic components include plants, animals and micro-organisms. Biotic components can be classified into three categories:

- **Producers** are self-nourishing components of the ecosystem. Hence they are called Autotrophs. They are found both on land and water. Eg. Plants, Algae, Bacteria etc.
- **Consumers** are those that depend on producers, directly or indirectly. Hence they are called Heterotrophs. The common category of consumers are:
  - ✓ **Primary consumers** depend on producers for their food. They are exclusively herbivores. Eg. zebra, goat etc.
  - ✓ **Secondary consumers** are small carnivores i.e., they consume herbivores. Eg. lion, snake etc.
  - ✓ **Tertiary consumers** are top carnivores that prey on both herbivores and carnivores. Eg. owl, crocodile etc.
- **Decomposers** are some organisms that are incapable of preparing its own food. They live on dead and decaying plants and animals. Hence they are called Saprotrophs. Eg. fungus, mushrooms etc.

c. **Energy Components:** All organisms in the biosphere use energy to work and convert one form of energy into another. The Sun is the ultimate source of energy for the biosphere as a whole. The solar energy gets transformed into other forms of energy through the various components in the ecosystem. The producers, consumers and the decomposers contribute a lot to the energy flow in an ecosystem.

Functions of an ecosystem

- The living organisms form an interacting set of flora and fauna which are organized into trophic levels, food chains and food webs. The functioning of an ecosystem depends on the pattern of the energy flow, as it helps in the distribution and circulation of the organic and inorganic matter within an ecosystem. Energy flow generally takes place in a hierarchical order in an ecosystem through various levels. These levels are called trophic levels. The chain of transformation of energy from one group of organisms to another, through various trophic levels is called a food chain. A system of interlocking and interdependent food chains is called a food web.

Biodiversity

- Biodiversity or biological diversity refers to a wide variety of living organisms (plants, animals and other micro-organisms) which live in a habitat. It is highly influenced by topography, climate as well as human activities. It represents the strength of the biological resources of a place on earth. In biodiversity, each species, no matter how big or small, has an important role to play in the ecosystem. It maintains the ecological balance and facilitates social benefits such as tourism, education, research etc. over an area.

Loss of biodiversity

- The extinction of species (flora and fauna) due to human and natural influences is called loss of biodiversity. The biodiversity loss has a great impact on mankind and also affects land, water, air etc. Habitat destruction due to deforestation, population explosion, pollution and global warming are the major cause for loss of biodiversity. Sometimes, habitat loss is so severe or happens so quickly that it results in a species being eliminated from the planet. Scientists are still trying to decide what caused the mass extinction of dinosaurs. A healthy eco system provides clean water, pure water, enriched soil, food, raw materials, medicines etc. Hence stable biosphere has to be conserved.

Biomes

- A biome is a geographically extensive ecosystem where all flora and fauna are found collectively. It is the total assemblage of plant and animal life interacting within the biosphere. Biomes are defined by abiotic factors like, relief, climate, soils and vegetation. They are classified into two broad categories, terrestrial biomes and aquatic biomes.

Terrestrial Biomes

- Terrestrial biomes is a group of living organisms that live and interact with one another on land. They are mainly determined by temperature and rainfall. Some of the major terrestrial biomes of the world are A. Tropical Forest Biomes, B. Tropical Savanna Biomes, C. Desert Biomes, D. Temperate Grassland Biomes, E. Tundra Biomes

A. Tropical Forest Biomes

- The tropical forest biome is comprised of several sub-biomes, including evergreen rainforest, seasonal deciduous forest etc. This biome extends between 10° N and 10° S of the Equator. Central and South America possess half of the world's tropical forests. The climate in these biomes shows little seasonal variation with high annual rainfall and relatively constant, high temperature. This unique weather condition favours thick vegetative cover. Tropical forests have the highest biodiversity and primary productivity of any of the terrestrial biomes.

- The Amazon basin, Congo basin and Indonesian islands are the major regions of this biome. These regions have very dense forests and so have great economic importance. Human settlements are found scattered here. They sustain their livelihood through food gathering, fishing, lumbering and shifting cultivation. Due to the humid nature of this biome, the people get afflicted to tropical diseases like malaria, yellow fever etc. The chief trees found here are rubber, bamboo, ebony, etc. Bats, pheasants, jaguars, elephants, monkeys etc. are the important birds and animals found here.

B. Tropical Savanna (Grasslands) Biomes

- Tropical grasslands are generally found between tropical forests and deserts. Tropical Savanna biomes are found between 10o to 20o N and S latitudes. These grasslands are generally flat and are found in the Sahel, south of Sahara in East Africa and in Australia. This biome is generally hot and dry and experiences moderate to low rainfall. So, the grass which grow here are tall and sharp. Hence the chief occupation of the people found here is herding. The primitive people living here are nomadic. The common animals found here are the lion, leopard, tiger, deer, zebra, giraffe etc. Flora such as Rhodes grass, red oats grass, lemon grass etc. are found in this biome.

C. Desert Biomes

- Deserts are usually found on the western margins of the continents between 20° and 30° N and S latitudes. The annual rainfall is less than 25 cm in these regions. Due to the lack of rainfall and arid conditions, these regions do not possess any vegetation but have special vegetation type called Xerophytes. As the soil is sandy and saline, deserts remain

agriculturally unproductive. Drought resistant thorny scrubs and bushes, palms are found here.

- Tribal people who live here practice food gathering and hunting. They move their temporary settlements frequently in search of pastures. Transportation becomes very difficult here and is carried on by camels. Reptiles like snakes, lizards, scorpions etc., are most commonly found here.

D. Temperate Grassland Biomes

- Temperate Grasslands are usually found in the interior of the continents and are characterized by large seasonal temperature variations, with warm summer and cold winter. The type of grassland in these regions strongly depends upon precipitation. Higher precipitation leads to tall and soft grass and lower precipitation leads to short and soft grass. These regions favour wheat cultivation. Extensive mechanised agriculture is practised due to lack of farm labour. Pastoral industry becomes the main occupation, thereby facilitating slaughtering of animals, packing of raw and processed meat, dairy products etc. The common birds and animals are grass hopper, wolf, bison, prairie dog etc.

E. Tundra Biomes

- These vast lowlands are found where the ground remains frozen. Greenland, Arctic and Antarctic regions and Northern parts of Asia, Canada and Europe fall in this biome. These regions are also called Barren lands. This biome experiences long severe winter and short cool summer. Due to the prevailing of low temperature and short growing seasons, the net primary productivity is very low in tundra. People are nomadic. Hunting and fishing are their major occupations. The population here is extremely sparse and the harsh environment makes them change their settlement frequently. They live in igloos in winter and in tents during summer. Arctic moss, Arctic willow, lichens etc. grow here. Fauna like the polar bear, wolverine, reindeer, snowy owl are found here.

Aquatic Biomes

- Aquatic biome is a group of living organisms that live and interact with one another and its aquatic environment for nutrients and shelter. Like terrestrial biomes, aquatic biomes are influenced by a series of abiotic factors. It is broadly classified as fresh water biomes and marine biomes.

A. Fresh water Biomes: It comprises lakes, ponds, rivers, streams, wetlands etc. It is influenced by various abiotic components such as the volume of water, water flow, composition of oxygen, temperature, etc. Humans rely on freshwater biomes for drinking water, crop irrigation, sanitation and industry. Water lily, lotus, duck weeds etc. are the common plants found here. Trout, salmon, turtles, crocodiles etc. are the animals found here.

B. Marine Biomes: They are the largest aquatic biomes on earth. They are continuous bodies of salt water and provide a wide range of habitats for marine plants and animals. Coral reefs are a second kind of marine biomes within the ocean. Estuaries, coastal areas where salt water and fresh water mix, form a third unique marine biome. As water provides maximum mobility to marine organisms, nutrients are circulated more quickly and efficiently here than the terrestrial biomes.

- Apart from animals, plants such as kelp, algae, phytoplankton etc. also grow in water. Aquatic biomes are not only important for plants and animals, but also for humans. Humans use aquatic biomes for water, food and leisure activities. Some of the threats and issues to aquatic biomes are overfishing, pollution and rise in sea level.

Difference between Aquatic and Terrestrial ecosystem	
Aquatic Ecosystem	**Terrestrial Ecosystem**
Aquatic ecosystem exists on water covering 71% of the earth surface.	Terrestrial ecosystem exists on land covering 29% of the earth surface.
Aquatic animals use 20% of energy to obtain oxygen.	Terrestrial animals use only 1-2% of energy to obtain oxygen.
In this ecosystem there is abundant of water with limited oxygen supply.	In this ecosystem there is less availability of water, greater

	availability of gases and temperature fluctuation.
The small drifting photo synthetic organisms of the ocean called photo phytoplankton are regarded as the major primary producer.	The primary producer is the plants that produce food through photosynthetic process.
Aquatic environment is more stable with smaller fluctuation in temperature and other variable.	Terrestrial environment is quite unstable as the land surface is affected by great risks from external impacts.

Conservation

- The biosphere extends from the deep ocean trenches to lush rain forests. People play an important role in maintaining the flow of energy in the biosphere. At the same time, the primary cause of today's loss of biodiversity is habitat alteration caused by human activities. The ever increasing population results in over exploitation of biological resources. This has an adverse impact on flora and fauna on earth. There are places on earth that are both biologically rich and deeply threatened. Hence it is man's duty to conserve and care for the earth and make it a better place to live in.

Case Study-Biosphere II

Scientists have created an artificial Biosphere called Biosphere-2, to understand the Earth which is refered as Biosphere-1.

Facts and Numbers

- ✓ Biosphere-2 covers 3.15 acres and is located in Arizona, America.
- ✓ It is 91 feet at its highest point.
- ✓ It is sealed off from earth below by 500 ton welded stainless steel liner.
- ✓ A host of instruments constantly monitors the air, soil and water.
- ✓ The 25 foot ocean contains a million gallons of salt water.
- ✓ Biosphere-2 contains five biomes - a rain forest, desert, savanna, marsh and ocean.
- ✓ It has more than three thousand species of living organisms.
- ✓ The habitat is opened for public tours. (To visit biosphere-2 log on to www.biosphere2.org)

Gulf of Mannar – Marine Treasure

- ✓ **Location:** Lies between the southeastern tip of India and the west coast of Sri Lanka, in the Coromandel Coast region.
- ✓ **Marine National Park**: The gulf of Mannar Marine National Park is a protected area consisting of 21 Small Island and adjacent coral reefs in the Gulf of Mannar in the Indian Ocean.
- ✓ **History:** Gulf of Manner was declared as National park in 1986. Later deckared as a biosphere reserve in 1989.
- ✓ **Flora**: They consist of species belonging to the mangrove, Rhizophora, Avicennia, Bruguiera, Ceriops and Lumnitzera genus.
- ✓ **Fauna:** Indo – Pacific bottlenose dolphin, Common dolphin, Melon-headed whale, and critically endangered whale species.

NOTE

- ❖ The branch of science that deals about ecosystem is called *Ecology.*
- ❖ A person who studies ecology is referred to as an *Ecologist.*
- ❖ An ecological region that has lost more than 70% of its original habitat is considered a hotspot. Hotspots in India are the Himalayas, Western Ghats, Indo Burma Region and Sundaland.
- ❖ Of late, parts of the Savanna grasslands are being converted into farmlands, which pose a great threat to the wide range of fauna. For Eg. The population of the big cats like cheetah, lion etc. are dwindling drastically.
- ❖ The U.S. National Cancer Institute has identified about 70% of the plants used for treating cancer. Which are found only in rain forests. Eg. Lapacho.
- ❖ An oasis is a fertile fresh water source found in deserts and semi-arid regions. Oases are fed by springs. Crops like date palms, figs, citrus fruits, maize etc. are cultivated near these oases.
- ❖ Temperate grasslands are called differently in different parts of the world.
  - Prairies - North America
  - Steppes - Eurasia
  - Pampas - Argentina and Uruguay
  - Veld - South Africa
  - Downs - Australia and New Zealand
- ❖ A Biosphere Reserve is a special ecosystem or specialized environment

with flora and fauna that require protection and nurturing. There are 18 Bioshpere Reserves in India.

10th std
Unit -1
India – Location, Relief and Drainage

Introduction

- India is the seventh largest country in the world and second largest country in Asia. It forms a part of south Asia and is separated by the Himalayas from the rest of the continent. India accounts for about 2.4 % of the total area of the world with an area of 32,87,263 sq.km. many of the India states are larger than several countries of the world.

India's Land and Water Frontiers

- India shares its 15,200 km long land frontier with Pakistan in the west, Afghanistan in the north-west, China, Nepal and Bhutan in the north and Bangladesh and Myanmar in the east. India's longest border is with Bangladesh (4156 km) while the shortest border is with Afghanistan. (106 km) About 6,100 km long coastline of India is washed on three sides of the country by the Indian Ocean and its two arms namely the Arabian sea in the west and the Bay of Bengal in the east. The total length of the coast line of India including the islands is 7,516.6 km. India and Sri Lanka are separated by a narrow and shallow sea called Palk Strait.

India and the World

- The Indian land mass has a central location between, the East and the West Asia. India and the southward extension of the Asian continent. The trans Indian ocean routes which connect the countries of Europe in the west and the countries of East Asia provide a strategic central location to India. Thus it helping India to establish close contact with West Asia, Africa and Europe from the western coast and with South East, east Asia from the eastern coast. India: A Subcontinent India along with the countries of Myanmar, Bangladesh, Pakistan, Nepal, Bhutan and Sri Lanka is called a subcontinent. This region is separated from the rest of Asia by a chain of mountains in the northwest, north and northeast and by seas in the south. This region

also possesses a distinct continental characteristics in physiography, climate, natural vegetation, minerals, human resources etc. Hence India is known as 'subcontinent'.

Location and Extent

- India extends from 8°4 'N to 37°6 'N latitudes and 68°7 'E to 97°25 'E longitudes. Hence India is located of the north Eastern hemisphere The southernmost point of the country is Pygmalion Point or Indira Point (6°45'N latitude) located in the Andaman and Nicobar Islands. The southernmost point of main land of India is Cape Comorin (Kanyakumari). The north-south extent of India is 3,214 km and it extends from Indira Col in Jammu and Kashmir in the north to Kanyakumari in the south. The east-west extension is 2933 km and it stretches from Rann of Kutch (Gujarat) in the west to Arunachal Pradesh in the east. The Tropic of Cancer (23°30' N) passes through the middle of the country dividing it into two halves as northern temperate and southern tropical lands. India has been politically divided into 29 states and 7 union territories for administrative convenience.

Indian Standard Time (IST)

- The longitudinal difference between Gujarat in the west and Arunachal Pradesh in the east is about 30°. The Earth rotates through its axis around 360° in 24 hours. Thus, a difference of 1° longitude will make a difference of 4 minutes in time. The difference in longitude between Gujarat (68°7 'E) and Arunachal Pradesh (97°25 ' E) is 29°18'. Hence the difference in local time between these two places is 29°18' X 4' (minutes) = 1 hour 57 minutes 12 seconds (approximately 2 hours). Since Arunachal Pradesh is towards east, it will have sunrise about two hours earlier than the sunrise at Gujarat which is in the west. In order to avoid these differences, Indian standard time is calculated. The local time of the central meridian of India is the standard time of India. India's central meridian is 82°30' E longitude. It passes through Mirzapur and roughly bisects the country in terms of longitude. The IST is 5.30 hrs ahead of Greenwich Mean Time (GMT).

Major Physiographic Divisions of India

- The majestic Himalayan peaks in the north, the beautiful beaches in the south, the great Indian desert in the west and the breath taking

natural heritage in the east make India a geographically vibrant, colourful and truly incredible country. There is a varied nature of physiographic divisions in India. Though the country has many landforms based on the major differences, it is divided into the following five physiographic divisions:

1. The Himalayan Mountains
2. The Great Northern Plains
3. The Peninsular plateau
4. The Indian Desert
5. The Coastal Plains
6. The Islands

Himalayan Mountains

- The Himalayan Mountains (Northern Mountains) consist of the youngest and the loftiest mountain chains in the world because they have been formed only few millions years ago and also they were formed because of the folding of the earth crust due to tectonic activity.

- It stretches for a distance of 2,500 km from the Indus gorge in the west to Brahmaputra gorge in the east. The width of the Northern Mountains varies from 500 km in Kashmir to 200 km in Arunachal Pradesh. The Pamir Knot, popularly known as the "Roof of the World" is the connecting link between the Himalayas and the high ranges of Central Asia. From the Pamir, Himalayas extend eastward in the form of an arc shape. The term "Himalaya" is derived from Sanskrit. It means "The Abode of Snow". The Northern Mountains that function as a great wall is grouped into three divisions. 1) The Trans-Himalayas, 2) Himalayas, 3) Eastern or Purvanchal hills.

1. The Trans-Himalayas

- It is also known as western Himalaya's. It lies to the north of the great Himalayan range. It lies in Jammu and Kashmir and Tibetian plateau. As its areal extent is more in Tibet, it is also known as Tibetean Himalayas. The Trans-Himalayas are about 40 km wide in its eastern and western extremities and about 225 km wide in its central part. They contain the Tethys sediments. The rocks of this regioncontain fossils bearing marine sediments which are underlain by 'Tertiary granite'. It has partly metamorphosed sediments and constitutes the

core of the Himalayan axis. The prominent ranges of Trans Himalayas are Zaskar, Ladakh, Kailash, and Karakoram.

2. The Himalayas

Peak	Country	Height in Metres
Mt. Everest	Nepal	8848
Mt. K2 or Godwin Austen	India	8611
Kanchenjunga	India	8598
Makalu	Nepal	8481
Dhaulagiri	Nepal	8172
Nanga Parbat	India	8126
Annapurna	Nepal	8078
Nanda Devi	India	7817
Kamet	India	7756
Namcha Barwa	India	7756
Gurla Mandhata	Nepal	7728

- It constitutes the core part of northern mountains. It is an young fold mountain. It was formed by the movement of Angara land mass in the north and Gondwana land mass in the south. The Tethys sea found between these two land masses was uplifted by the compression and the resultant landform was the Himalayas. It consists of many ranges. The main divisions of the Himalayas are the (i) Greater Himalayas,(ii) the Lesser Himalayas and (iii)the Siwaliks

The Greater Himalayas or the Himadri

- The Greater Himalayas rise abruptly like a wall north of the Lesser Himalayas. The Greater Himalayas are about 25 km wide. Its average height is about 6,000 m. The Greater Himalayas receive lesser rainfall as compared to the Lesser Himalayas and the Siwaliks. Physical weathering is less effective over the Greater Himalayas as compared to the other ranges. Almost all the lofty peaks of Himalayas are located in this range. The notable ones are Mt. Everest (8,848 m) and Kanchenjunga (8,586 m). Mt. Everest is located in Nepal and Kanchenjunga is located between Nepal and Sikkim. This range is the most continuous of all ranges. It is region of permanent snow cover. So,

it has many glaciers. Gangothri, Yamunothri and Siachen are some of them.

The Lesser Himalayas or the Himachal

- It is the middle range of Himalayas. Height of this range varies from 3, 700 to 4,500 m. Its width varies upto 80 km. The major rocks of this range are slate, limestone and quartzite. This region is subjected to extensive erosion due to heavy rainfall, deforestation and urbanization. Pir Panjal, Dhauladhar and Mahabharat are the mountain ranges found in this part. Major hill stations of the Himalayas are located in this range. Shimla, Mussourie, Nainital, Almora, Ranikhet and Darjeeling are the familiar ones.

The Siwaliks or Outer Himalayas

- The Siwaliks extend from Jammu and Kashmir to Assam. It is partly made by the debris brought by the Himalayan rivers. The altitude varying between 900-1100 metres elevation of this range is 1300 m. The width of Siwaliks vary from 10 km in the east to 50 km in the west. It is the most discontinuous range. The longitudinal valleys found between the Siwaliks and the Lesser Himalayas are called Duns in the west and Duars in the east. These are the ideal sites for the development of settlements in this region.

Purvanchal Hills

- These are the eastern off-shoot of Himalayas. It extended in the north-eastern states of India. Most of these hills are located along the border of India and Myanmar while others are inside India. Dafla Hills, Abor Hills, Mishmi Hills, Patkai Bum Hills, Naga Hills, Manipur Hills, Mizo Hills, Tripura Hills, Mikir Hills, Garo Hills, Khasi Hills and Jaintia Hills are the hills which are collectively known as purvanchal Hills.

Importance of Himalayas

- ✓ Himalayas blocks southwest monsoon winds and causes heavy rainfall to north
- ✓ India.
- ✓ It forms a natural barrier to the subcontinent.
- ✓ It is the source for many perennial rivers like Indus, Ganges,

Brahmaputra etc.

- ✓ The Northern Mountains are described as the paradise of tourists due to its natural beauty.
- ✓ Many hill stations and pilgrim centres like Amarnath, Kedarnath, Badrinath and
- ✓ Vaishnavi devi temples are situated here.
- ✓ It provides raw material for many forest based industries.
- ✓ It prevents the cold winds blowing from the central Asia and protects India from severe cold.
- ✓ Himalayas are renowned for the rich biodiversity.

Longitudinal Divisions of Himalayas

1. The Kashmir Punjab Himachal Himalayas- Located between the rivers of Indus and Sutlej.
2. The Kumaun Himalayas- Located between the rivers of Sutlej and Kali.
3. The Central-Nepal Himalayas- Located between the rivers of Kali and Tista.
4. The Assam Eastern Himalayas- Located between rivers of Tista and Dihang.

The Great Northern Plains

- The fertile land extending across seven north Indian states forms the Great Northern Plains. This extensive plain lies to the south of the northern mountains. This plain is one of the most extensive stretches of the alluvium in the world and is deposited by the rivers Indus, Ganga, Brahmaputra and their tributaries. The length of the plain is about 2,400 km and the width varies from 240 to 320 km. Its width increases from east to west. It covers an area of over 7 lakh sq.km. The Great Plains of India is remarkably a homogeneous surface with an imperceptible slope. They are formed mostly by the depositional process of the Himalayan and Vindhyan rivers. These rivers deposit enormous quantity of sediments deposited along the foothills and flood plains. The important characteristics featuress of sediment deposition in the plains areas as follows.

The Bhabar Plain

- This plain is made up of gravels and unassorted sediments deposited by the Himalayan rivers. The porosity of this plain is so high that most of the small streams flow over this region disappear. It lies to the south of the Siwalik from west to east (Jammu Division to Assam). Its width varies from 8 to 15 km. It is wider in the western plains (Jammu Division) than in the east (Assam). This plain is not suitable for cultivation, only big trees with large roots thrive in this region.

The Tarai Tract

- It is a zone of excessive dampness, thick forests and rich wild life. This tract lies to the south of Bhabar plains. The width of this belt is 15-30 km. The Tarai is wider in the eastern parts of the Great Plains, especially in Brahmaputra Valley due to heavy rainfall. In many states, the Tarai forests have been cleared for cultivation.

The Bhangar Plains

- The Bhangar represent the upland alluvial tracts of the Great Plains of India, formed by the older alluviums. The Bhangar land lies above the flood limits of the rivers. This soil is dark in colour, rich in humus content, well drained and useful for agriculture.

On the basis of deposition of sediments by various rivers and topographical characteristics, the Northern Plains of India is divided into the following four major regions:

a. Rajasthan Plains: It is located to the west of Aravalli range. It covers an area of about 1,75,000 sq.km. Rajasthan plain is formed by the deposition of the river Luni and the long vanished river Saraswathi. There are several salt lakes in Rajasthan. The Sambhar salt lake (Pushkar Lake) near Jaipur is the prominent one.

b. Punjab - Haryana Plains: It lies to the north-east of the Great Indian Desert. This plain is found over an area of about 1.75 lakh sq.km. The Punjab - Haryana plains are formed by the deposition of the rivers Sutlej, Beas and Ravi. This plain acts as water - divide (doab). The two major watershed it divides are Yamuna – Sutlej and Ganga – Yamuna.

c. Ganga Plains: It extends from the Yamuna River in the west to Bangladesh in the east. The total area covered by this plain is about 3.75 sq.km. River Ganga and its tributaries such as Ghaghra, Gandak, Kosi, Yamuna, Chambal, Betwa etc. constitute this plain by their sediments and make a great plain in India. It is the largest plain of India. The general slope of the entire plain (upper, middle and lower Ganga plains) is towards east and south-east.

d. Brahmaputra Plains: It is located mainly in the state of Assam. It is a low - level plain located in the eastern part of the Great Plains of India and is formed by the deposits of river Brahmaputra. It covers an area of about 56,275 sq.km. These plains create alluvial fans and marshy tracts.

The Khadar Plains

- The new alluvium tracts along the courses of the rivers are known as the 'Khadar' or 'Bet' lands. The Khadar tracts are enriched by fresh deposits of silt every year during rainy seasons. The Khadar land consists of sand, silt, clay and mud. It is highly fertile soil.

Delta Plains

- The deltaic plain is an extension of the Khadar land. It covers about 1.9 lakh sq.km in the lower reaches of the Ganga River. It is an area of deposition as the river flows in this tract sluggishly. The deltaic plain consists mainly of old mud, new mud and marsh. In the delta region, the uplands are called 'Chars' while the marshy areas are called 'Bils'.

The Peninsular Plateaus

- The plateau region lies to the south of the Great Northern Plains. This is the largest physiographic division of our country. It covers an area of about 16 lakh sq.km (about half of the total area of the country). It is an old rocky plateau region. The topography consists of a series of plateaus and hill ranges interspersed with river valleys. Aravalli hills mark the north-western boundary of the plateau region. Its northern and north-eastern boundaries are marked by the Bundelkhand upland, Kaimur and Rajmahal hills.

- The Western Ghats and the Eastern Ghats mark the western and eastern boundaries respectively. The altitude of a large portion of the plateau is more than 600 m from mean sea level. The peak of Anaimudi is the highest point in the plateau. Its height is 2,695 m and is located in Anaimalai. The general slope of this plateau is towards east. The Great Plateau is a part of the Gondwana (very ancient one) land mass. Due to the old age, the rivers in this region attained their base level and developed broad and shallow valleys.

- The river Narmada divides the plateau region of India broadly into two parts. The region lying to the north of the Narmada is called the Central Highlands and the region lying to the south of Narmada is called the Deccan Plateau. All the major rivers (Mahanadi, Godavari, Krishna, Kaveri etc.) lying to the south of the Vindhyas flow eastwards and fall into the Bay of Bengal. Narmada and Tapti are the two rivers situated to the south of the Vindhyas flow westward. Their movement towards west is due to the presence of a rift valley in the region.

a. Central Highlands

- The Central Highlands extend between the river Narmada and the Northern Great Plains. The Aravallis form the west and north-western edge of the Central Highlands. These hills extend from Gujarat, through Rajasthan to Delhi in the north-westerly direction for a distance of about 700 km. The height of these hills is about 1,500 m in southwest while near Delhi the height is hardly 400 m. Gurushikhar with 1,722 m is the highest peak of this range. The Western part of the Central Highland is known as the Malwa Plateau. It lies to the southeast of Aravallis and to the north of Vindhyachal Range.

- The rivers Chambal, Betwa and Ken drain the Malwa Plateau before they join the river Yamuna. The part of the Central Highlands which extends to the east of Malwa Plateau is known as Bundelkhand and its further extension is known as Bagelkhand. The eastern part of the Central High lands which lies in the north-eastern part of the Indian Plateau is known as Chhota-Nagpur Plateau. It covers much of Jharkhand, adjacent parts of Odisha, West Bengal, Bihar and Chhattisgarh. This region is very rich in mineral resources particularly iron ore and coal.

b. Deccan Plateau

- This physiographic division is the largest part of the plateau region of India. The shape of this plateau is roughly triangular. One of the sides of this triangle is marked by the line joining Kanyakumari with Rajmahal Hills and this line passes through the Eastern Ghats. The second arm is marked by the Satpura Range, Mahadeo Hills, Maikal Range and the Rajmahal Hills. The third arm is marked by the Western Ghats. The area of this Plateau is about 7 lakh square km and the height ranges from 500 to 1000 m above sea level.

- The Western Ghats forms the western edge of the Peninsular Plateau. It runs parallel to the Arabian Sea coast. The northern part of this range is called as Sahyadris. The height of the Sahyadris increases from north to south. Anaimudi is a sort of tri-junction of the Anaimalai Range, the Cardamom Hills and the Palani Hills. Kodaikanal is a beautiful hill resort situated on the Palani Hills. Eastern Ghats run from southwest to northeast form the eastern edge of this Plateau. This range is also called as Poorvadri. The EasternGhats join the Western Ghats at the Nilgiri hills, bordering Karnataka and Tamil Nadu. The Eastern Ghats are not continuous like the Western Ghats. The rivers of Mahanadi, Godavari, Krishna, Pennar and Kaveri have dissected this range at many places.

The Indian Desert

- The Thar desert, also known as the Great Indian desert is a large arid region in the north western part of the Indian subcontinent that covers an area of 2,00,000 km2 and forms a natural boundary between India and Pakistan. It is the world 7th largest desert, and world 9th largest sub tropical desert located in Western part of the India. The desert lies in the western part of the aravalli range and covers 2/3 of Rajastan state. There are two major divisions in the Thar desert. They are known as the Actual desert region (Marusthali) and the semi desert region (Bhangar). Many different types of sand dunes and salt lakes (Dhands) are seen here.

The Coastal Plains

- The Peninsula Plateau of India is flanked by narrow coastal plains of varied width from north to south, known as the Western Coastal

Plains and the Eastern Coastal Plains. They were formed by the depositional action of the rivers and the erosional and depositional actions of the sea-waves. The Indian coastal plains are divided into the following two divisions: 1) The Western Coastal Plains and 2) The Eastern Coastal Plains.

1. The Western Coastal Plain

- It lies between the Western Ghats and the Arabian Sea. It extends from Rann of kutch in the north to Kanyakumari in the south and its width varies from 10 to 80 km. It is mainly characterised by sandy beaches, coastal sand dunes, mud flats, lagoons, estuary, laterite platforms and residual hills. The northern part of the West Coastal Plain is known as Konkan Plain. The middle part of this plain is known as Kanara. The southern part of the plain is known as Malabar coast which is about 550 km long and 20-100 km wide. This part of the coast is characterized by sand dunes. Along the coast, there are numerous shallow lagoons and backwaters called Kayals and Teris. Vembanad is a famous back water lake found in this region.

2. The Eastern Coastal Plain

- It lies between the Eastern Ghats and the Bay of Bengal and, stretches along the states of West Bengal, Odisha, Andhra Pradesh and Tamil Nadu. These plains are formed by the alluvial fillings of the littoral zone by the east flowing rivers of India. The coastal plain consists mainly of the recent alluvial deposits. This coastal plain has a regular shoreline with well-defined beaches. The coastal plain between Mahanadi and Krishna river is known as the Northern Circars and the southern part lies between Krishna and Kaveri rivers is called Coromandal coast. The Marina beach on this coast in Chennai and it is the second longest beach in the world. Among the back water lakes of this coast, lake Chilka (Odisha) is the largest lake in India located to the southwest of the Mahanadi delta, the Kolleru Lake which lies between the deltas of Godavari and Krishna and the Pulicat Lake lies in the border of Andhra Pradesh and Tamil Nadu are the well known lakes in the east coastal plain.

The Islands

- India has two major island groups namely Andaman and Nicobar and Lakshadweep. The former group consists of 572 islands and are located in Bay of Bengal, and the later one has 27 islands and are located in Arabian Sea. The islands of Andaman and Nicobar are largely tectonic and volcanic origin. India's only active volcano is found on Barren Island in Andaman and Nicobar group of Islands, while the islands of the Arabian Sea are mainly coral origin.

a) Andaman and Nicobar Islands

- These islands are located in an elevated portion of the submarine mountains. Since these islands lie close to the equator, the climate remains hot and wet throughout the year and has dense forests. The area of the island group is about 8,249 sq.km. The entire group of islands is divided into two. They are Andaman in the north and the Nicobar in the south. These island groups are of great strategic importance for the country. Port Blair is the administrative capital of the Andaman and Nicobar islands. The Ten Degree Channel separates Andaman from Nicobar group. The southernmost tip, the Indira Point is a part of Nicobar Island.

b) Lakshadweep Islands

- This is a small group of coral islands located off the west coast of India. It covers an area of 32 sq. km. Kavaratti is its administrative capital. Lakshadweep islands are separated from the Maldive Islands by the Eight Degree Channel. The uninhabited "Pitt Island" of this group has a bird sanctuary. Earlier, it had three divisions namely Laccadive, Minicoy and Amindivi. It was named as Lakshadweep in 1973.

c) Offshore Islands

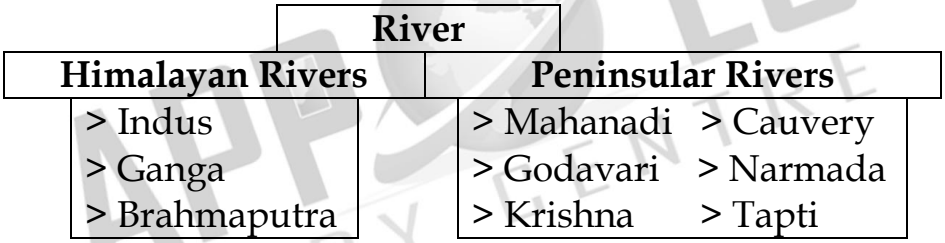
- Besides the two group of islands, India has a number of islands along the Western Coast, Eastern Coast, in the delta region of Ganga and in the Gulf of Mannar. Many of these islands are uninhabited and are administered by the adjacent states.

Drainage System of India

- A drainage system is an integrated system of tributaries and a trunk stream which collects and drains surface water into the sea, lake or some other body of water. The total area drained by a river and its tributaries is known as a drainage basin. The drainage pattern of an area is the result of the geological structure of the respective areas. The river system provides irrigation, drinking water, navigation, power as well as grant livelihoods for a large number of population. The drainage system of India is broadly divided into two major groups on the basis of their location. They are Himalayan rivers and the Peninsular rivers.

Himalayan Rivers

- These rivers are found in north India and originate from Himalayas. So, they are also called



a. The Indus River System

- The Indus River is one of the largest rivers of the world. It originates from the northern slope of the Kailash range in Tibet near Manasarovar Lake at an elevation of about 5,150 m. Its length is about 2,880 km (Only 709 km is in India). The river has a total drainage area extending 11,65,500 sq km in which 321,289 sq km areas are drained in India. The river flows through the Ladakh and Zaskar ranges and creates deep gorges. The river runs through Jammu and Kashmir, turns south near Chillar and enters Pakistan. Its major tributaries are Jhelum, Chenab (Largest tributary of Indus), Ravi, Beas and Sutlej. It enters into with the Arabian Sea.

b. The Ganga River System

- The Ganga River system is the largest drainage system of India it extend over and area of 8,61,404 sq km in India. The Ganga plain is the most densely populated place in India and many towns are developed on the banks of this river. The river Ganga originates as Bhagirathi from the Gangotri Glacier in Uttar Khasi District of Uttarkhand state, at an elevation of 7,010 m. The length of the river Ganga is about 2,525 km. Its major tributaries from the north are Gomti, Gandak, Kosi and Ghaghra and from south, Yamuna (largest tributary of Ganga), Son, Chambal etc. The river Ganga is known as the River Padma in Bangladesh. The combined river of Ganga and Brahmaputra creates the World's largest delta known as Sundarbans in Bangladesh before joining the Bay of Bengal.

c. The Brahmaputra River System

- The river Brahmaputra originates from the Chemayungdung Glacier of the Kailash range to the east of Lake Manasarovar in Tibet at an elevation of about 5,150 m. The total area is about 5,80,000 sq km but the drainage area lying in India is 1,94,413 sq km This river is known as Tsangpo (Purifier) in Tibet. The length of this river is about 2,900 km (900 km in India). It enters into India through a gorge in Arunachal Pradesh namely Dihang. It has many tributaries. Tista, Manas, Barak, Subansiri are some of them. This river is called as Jamuna in Bangladesh. After it joins with the river Ganga in Bangladesh, the river is called as Meghna. Characteristics of Himalayan Rivers

- ✓ **Originate from Himalayas**
- ✓ **Long and wide**
- ✓ **Perennial in nature**
- ✓ **Unsuitable for hydro power generation**
- ✓ **Middle and lower courses are navigable**

Peninsular Rivers

- The rivers in south India are called the Peninsular rivers. Most of these rivers originate from the Western Ghats. These are seasonal rivers (non–perennial). They have a large seasonal fluctuation in volume of water as they are solely fed by rain. These rivers flow in valleys with steep gradients. Based on the direction of flow, the peninsular rivers are divided into the West flowing and East flowing rivers.

East Flowing Rivers

a. Mahanadi

The river Mahanadi originates near Sihawa in Raipur district of Chattisgarh and flows through Odisha. Its length is 851 km. Seonath, Telen, Sandur and Ib are its major tributaries. The main stream of Mahanadi gets divided into several distributaries such as Paika, Birupa, Chitartala, Genguti and Nun. All these distributaries form the Delta of Mahanadi which is one of the largest deltas in India. The Mahanadi empties its water in Bay of Bengal.

b. Godavari

- Godavari is the longest river (1,465 km) with an area of 3.13 lakh km2 among the Peninsular rivers. It is also called Vridha Ganga. It originates in Nasik district of Maharashtra, a portion of Western Ghats. It flows through the states of Telangana and Andhra Pradesh before joining Bay of Bengal. Purna, Penganga, Pranitha, Indravati, Tal and Salami are its major tributaries. The river near Rajahmundry gets divided into two Channels called Vasistha and Gautami and forms one of the largest deltas in India. Kolleru, a fresh water lake is located in the deltaic region of the Godavari.

c. Krishna

- The river Krishna originates from a spring at a place called Mahabaleshwar in the Western Ghats of Maharashtra. Its length is 1,400 km and an area of 2.58 lakh sq km. It is the second longest Peninsular river Bhima, Peddavagu, Musi, Koyna and Thungabhadra are the major tributaries of this river. It also flows through Andhra Pradesh and joins in Bay of Bengal, at Hamasaladeevi.

d. Kaveri

- The river Kaveri originates at Talakaveri, Kudagu hills of Karnataka. Its length is 800 km. The river kaveri is called Dhakshin Ganga or Ganga of south Harangi, Hemavati, Kabini, Bhavani, Arkavathy, Noyyal, Amaravathi etc are the main tributaries of the river Kaveri. In Karnataka the river bifurcates twice, forming the sacred islands of Srirangapatnam and Sivasamudram. While entering Tamil Nadu, the Kaveri continues through a series of twisted wild gorges until it reaches Hogenakkal Falls and flows through a straight, narrow gorge near Salem. The Kaveri breaks at Srirangam Island with two channels, river Coleroon and Kaveri. At last, it empties into the Bay of Bengal at Poompuhar.

West Flowing Rivers

a. Narmada: This river rises in Amarkantak Plateau in Madhya Pradesh at an elevation of about 1057 m and flows for a distance of about 1,312 km it covers and area of 98,796 sq km and forms 27 km long estuary before out falling into the Arabian Sea through the Gulf of Cambay. It is the largest among the west flowing rivers of Peninsular India. Its principal tributaries are Burhner, Halon, Heran, Banjar, Dudhi, Shakkar, Tawa, Barna and Kolar.

b. Tapti: The Tapti is one of the major rivers of Peninsular India with the length of about 724 km. It covers an area of 65,145 sq km. Tapti river rises near Multai in the Betul district of Madhya Pradesh at an elevation of about 752 m. It is one of only the three rivers in Peninsular India that run from east to west - the others being the Narmada and the Mahi. The major tributaries are Vaki, Gomai, Arunavati, Aner, Nesu, Buray, Panjhra and Bori. It outfalls into the Arabian Sea through the Gulf of Cambay.

Characteristics of South Indian

Rivers

- ❖ Originate from Western Ghats
- ❖ Short and narrow
- ❖ Non perennial in nature

- Suitable for hydro power generation
- Not useful for navigation

NOTE

- Amaravati is the new capital of Andhra Pradesh But according to Andhra Pradesh
- Reorganization Act, Hyderabad will be the capital for both the states of Andhra Pradesh and Telungana till 2024 (For 10 years from the act passed).
- Aravalli range is the oldest fold mountain range in India.
- The major passes in the Himalayan are Karakoram pass (Jammu and Kashmir), Zojila pass, Shipkila pass (Himachal Pradesh), Bomdila pass (Arunachal Pradesh), Nathala pass (Sikkim) and Jhelepla pass (Sikkim). The Khyber pass which connects Pakistan and Afanisthan, and Bolan pass in Pakistan are important passes of the Indian subcontinent.
- Himalaya is the home of several high peaks. However, it holds the record of having the maximum number of highest peaks among any mountain range in world. Out of 14 heights peaks in this world, Himalayas holds 9.