



Virtual University of Pakistan
FEDERAL GOVERNMENT UNIVERSITY

COURSE HANDOUTS

Teaching of Geography

EDU515

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Lesson No.1**Defining Geography -1****Topic- 001:**

According to Greek philosophers, Geography is a subject of “the description of the Earth” “Geo” means the earth and “Graphy” means the description. Most people think that geographers are concerned with naming places, drawing maps and writing travel descriptions. Geography is a field of science dedicated to the study of the land, features, inhabitants, and the phenomena of the Earth. Geography is a spatial science with organized knowledge of the earth as the world of man. Spatial word is related to space.

Geography is the branch of science which deals with the study of earth and its physical and human environment with respect to its spatial and temporal variations. "To provide accurate, orderly, and rational description and interpretation of the variable character of the earth surface" explained by Richard Hartshorne, in 1959. The old definition of geography is “The purpose of geography is to provide "a view of the whole" earth by mapping the location of places” by Ptolemy explained in 150.

In the context of physical environment it deals with the entire physical and natural phenomenon. All the meteorological, geological and geomorphic processes are studied under this umbrella. In context of human environment, it deals with all the types of human activities i.e. population, migration, economic activities etc.

Spatial variation means, the difference in the magnitude of a same phenomenon at two different places i.e. degree of temperature and rainfall at two different places while temporal variation means the occurrence of a same phenomenon at same place but at different time. For example, difference in temperature of Lahore in 1960s and in 2000s.

Topic – 002: Defining Geography -2:

Geography can be defined as:

- Study of natural features of the Earth’s surface.
- Study of cultural feature of the Earth’s surface.
- Study of the Man - Environment interaction

Study of natural features of the Earth’s surface**Topography**

Topography is the study and description of the surface features of land, which includes both natural and artificial features. Topographically, Pakistan has been divided into 5 main categories:

- Mountains (northern and western mountains)
- Plateaus (Potwar plateau & Baluchistan plateau)
- Plains (upper Indus and lower Indus plains)
- Deserts (thar, thal & kharan)

- Coastal areas & delta regions

Climate

Climate is a generalization of day to day weather conditions over a long period of time, usually thirty years. Important climatic conditions of a area are temperature, air pressure, wind and the rainfall.

Climatic divisions of Pakistan are:

- Highland climate
- Lowland climate
- Coastal climate
- Arid climate

Soil

The upper layer of the earth which is composed of different thin rock particles is helpful in the growth of vegetation and plants that is called soil. The soil of Pakistan may be classified according to the regional basis:

- Indus basin Soils
- Bongar soils
- Khaddar soils
- Indus delta soils
- Mountains soils
- Sandy desert soils

Vegetation

Natural vegetation comprises forests, shrubs and grasses, and is determined by climatic conditions and soil types.

Study of cultural feature of the Earth's surface

1. Human activities related to production like agriculture, mining, industry, etc. Activities related to production (Wheat production in Pakistan)
2. Human activities related to services like, transportation, trade, communication, etc

Activities related to services (Trade through Panama Canal)

Topic 003: Study of Man - Environment interaction:

Desert Environment: Deserts receiving less than 10 inches of annual rainfall

Study of Man – Environment Interaction

- Lithosphere

- Atmosphere
- Hydrosphere
- Biosphere
- Particular set of conditions as Mountain Environment

Topic 004: History of Geography:

The introduction of Geography as a separate discipline and the developments of all the recent techniques in the field of Geography to enhance its worth is not the matter of nights. It takes a long time to develop. The History of Geography is too old as that of the mankind on the surface of earth. Different scholars of different ages contributed their services to develop the subject. Greeks are credited to be the father of Geography. The word Geography is derived from the Greek word “Geographia” means the study of Earth. Eratosthenes, a famous Greek Scholar, is considered as the father of Geography. He used the word “Geography” for the first time in the history. Later on, Romans, Arabs, Portuguese, Dutch, French and other European Geographers contributed their efforts. At present, Geography is not limited to the social sciences but is also taught as the natural science in different universities of the world.

Contributions of Greeks and Romans:

Plato, Aristotle, Eratosthenes, Ptolemy, Strabo are called father of geography; focused attention to the measurement and location of places.

Main contributions

- Mathematical traditions (focuses on fixing the location of the places on earth surface) by Ptolemy
- Deductive reasoning (from general to particular) by Plato
- Inductive reasoning (particular to general) by Aristotle
- Literary Traditions (concerned with what was observed) by Strabo
- coined the word Geography by (Greek and Romans)
- Tables of Latitudes and Longitudes, Map Projections
- Topographical work

Father of Modern Geography

Alexander Von Humboldt, Karl Ritter, Friedrich Ratzel

- Geography has become the major area of interest
- Contributions in physical and human geography.

- Field work
- Produced several books

Richard Hartshorne

"To provide accurate, orderly, arranged and rational description and interpretation of the variable characters of the earth surface"

Topic 005: Recent advancements in Geography:

Geography was a traditional subject in the beginning. A number of new avenues are introduced, which has increased the scope and sphere of application of this subject. A brief over view of these recent techniques is given below.

- Introduction of Geographic information system for the purpose of mapping and spatial analysis of a specific phenomenon.
- Introduction of Remote Sensing (RS) has increased the understanding of different objects which are out of the reach of man in past.
- Global Positioning System (GPS) is a recent advancement in the field of Geography. It eases the work of surveyor and Geographer to find out the specific location of an object or a phenomenon.
- Theodolite and Total Station (TS) has replaced the traditional system of surveying i.e. chain-table survey. The values are more accurate than before. TS is an effective advancement in the construction process as well.

Significance of Geography:

- It provides the knowledge about the entire physical and human phenomenon.
- It is difficult to get proper knowledge of natural and social sciences without the study of Geography as its dimensions in different fields are discussed.
- It provides the basic information about the historical discoveries and political systems and forms of Governments.
- The recent advancement like GIS, GPS and TS also playing a pivotal role in the modern developments.
- It is also essential to know about the climatic factors to develop the models to study the pattern of climate shift.

Recent Advancements

Tradition in Geography

- Spatial Tradition
- Regional Tradition
- Cultural-Environment Tradition

- Earth Science Tradition

Spatial Tradition

1. Mapping (Boundaries, densities, etc.)
2. Quantitative techniques as computerized mapping, Geography Information Systems
3. Spatial patterns

Regional Tradition

1. Description of regions
2. World regional geography
3. How regions are different from one another

Culture-Environment Tradition

1. Human impact on nature
2. Impact of nature on humans
3. Natural hazards
4. Cultural, political, and population geography

Earth Science Tradition

1. Physical Geography
2. The lithosphere, hydrosphere, atmosphere
3. Earth-Sun interaction
4. Offshoots are geology, mineralogy, glaciology, geomorphology, and meteorology.
5. The study of the earth as humanities home.

Lesson No. 2

Nature of Geography**Topic - 006:****Nature of Geography**

Geography has been concerned with:

Describe the different features of the Earth

It includes areas which are closer to ocean surfaces they have different landforms and the areas closer to mountainous regions have different landforms same is the case with the lowland areas these features are totally different from the rest of the features

Explain how these features have come to be and what they are

Example: two agents which are producing lands as due to volcanic eruption and the work of glaciers. The earth has variety of landforms. Glaciers landforms are totally different from the volcanic landforms because of location of two different phenomena's.

Study of the large part of the world as Pakistan and part of a country as Lahore

When we are discussing Pakistan as a whole we have example of trade, Pakistan has trading partners, import commodities and export commodities and hinter lands of Pakistan controls the trade of country. Pakistan is an agriculture economy. In Lahore we have administrative zones, it has 9 town and 150 union councils both are areas of geography.

Examine how they influence the distribution of people and their activities

Example: Two types of area desert area (low- land areas) where there is shortage of rainfall and drought areas, this type of area has different types of activities and the mountain type area (high-land areas) where Terrace cultivation is the main economy of the local farmers so there fruits, vegetables and crops are production of the region.

Topic - 007: Scope of Geography

Following is the scope of Geography:

- Providing an accurate, orderly and rational description and interpretation of various features of the earth's surface
- An exact knowledge of the distribution of phenomena on the earth's surface e.g. (Volcanic Mountains) like areas which are related to volcanic eruption is plate boundaries. Plate boundaries are linking the plates tectonic plates, these plates are moving away from each other are called diversion or moving closer to each other are called conversion or the third

type of movement called the lateral plate contact. These are sensitive areas where we can find volcanic mountains

- Physical environments are organized on the earth's surface and how man distributed himself over the earth. Like the climatic conditions, the relief features and soil is suitable for



cultivation of different crops. We will find the major population clusters in these areas.

- Geographers are interested in understanding the character of the earth, continents, countries, regions or areas. Those characters belong to the human activities regarding

production and services.

Topic - 008: Physical Geography:

Physical geography is concerned with the study of landforms which are produced by primary forces (tectonic plates & volcanic) and secondary forces (glaciers, river & wind), extent and nature of the oceans, the atmosphere, processes associated with weather and climate, soil, animals and vegetation.

Branches of Physical Geography

- **Geomorphology** is the study of the origin and development of landforms on the earth.
- **Climatology** is the scientific study of climate. It describes distribution and regional patterns of climate.
- **Hydrology** is the study of surface and underground water properties, phenomena, distribution, movement and utilization.
- **Soil Geography** is the study of the origin, development, characteristics and distribution of soils.
- **Biogeography** is the study of distribution of plants and animals on the earth's surface.
- Plant geography is also called **Phytogeography**
- The study of animals is known as **Zoogeography**
- **Oceanography** is the study of extent and shape of ocean basins, the structure and relief of their floors, movements of sea water, its temperature and salinity. It also includes the study of organisms in the oceans.

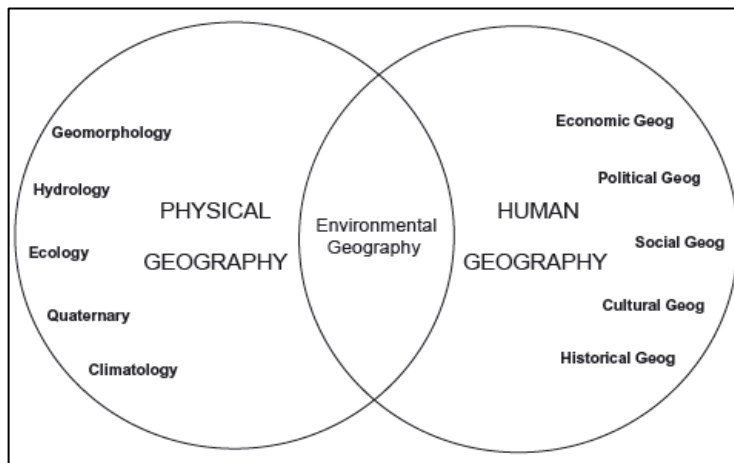
Topic - 009: Human Geography:

Human geography deals with man and his activities. These human activities change the physical landscape and produce the cultural landscape.

- **Cultural Landscape** is composed of agriculture, cattle grazing, fishing, mining, settlements, manufacturing industries, and infrastructure (roads, electricity lines and telecommunication lines).
- **Population Geography** concerned with the study of population density, distribution, migration, growth, and structure.
- **Economic Geography** is the study of resources, production related activities as agriculture (Wheat producing areas).
- **Political geography** concerned with the distribution of political regions and ideas of power and conflicts.
- **Historical Geography** deals with the study of places as they existed in the past including agriculture and other landscape evolution.

Topic - 10: Branches of Human Geography:

Following are the branches of Human geography:



Environmental Geography:

This branch deals with the study of environmental hazards like floods, earthquake, tsunamis, droughts, cyclones and landslides etc. In this branch we also study responses of humans towards these hazards risk assessment, control and mitigation measures of the hazards and disasters.

Practical geography:

This branch of human geography deals with:

- Field work, because of some data which is available in the form of production; ground-truth, surveys conducted by GPS automatic level, theodolite are very important i.e. field research, field study
- Cartography, the art or work of making maps or charts in lab
- Aerial photography and remote sensing is used to take photographs of the earth's resources or any land use from an aircraft or a satellite without making physical contact with the object
- Quantitative methods, dealing with statistical presentations, it is also called mathematical geography.

Lesson No. 3**Relation with Life Sciences****Topic - 11**

The methods and aims of the physical geographer and the natural scientist in the studying the phenomena are same. For examples:

- Physics has supporting fields with climatology. The physical geographers need some knowledge of physics.
- As Botany has supporting fields with Phytogeography. Botanist needs some knowledge of geographical condition.
- Zoology also has a supporting field with Zoogeography.
- Similarly, most physical geographers concerned with geomorphology and biogeography require knowledge of geology and biology or ecology respectively.

Topic - 12: Relation with Social Sciences:**Human Environmental Sciences**

There is desire to work toward some greater knowledge for some genuine understanding of the world:

- Political science is linked with political geography. To explain the ideas of power and conflicts being the main determinants of locational behavior and resource allocation.
- Economics is linked with Economic Geography. Economic geography studies the distribution of resources but the problems of their exploitation from an economic point of view are related with economics.
- Population Geography requires knowledge of Demography (the statistical fields of populations).
- As Anthropology has a supporting field with Cultural Geography.
- As Sociology and Psychology linked with the Social Geography.
- As History linked with the Historical Geography.

Relations with other subjects:

Geography is a vast subject. It is considered as the mother of Knowledge. It is impossible to study other discipline of social and natural sciences without the understanding of Geography. It has links with all other subjects. A brief description of its relation with other discipline is given below.

Relation with social sciences:

A brief overview of its relation with other subjects is given below.

1. Geography and Sociology:

It is difficult to do the study of culture, ethnicity, language and customs of a region without proper knowledge of Geography and geographic feature of that area.

2. Geography and History:

It is impossible for a historian to reveal any historical event without of proper knowledge of physiography of that area.

3. Geography and Archeology:

It is very difficult for an Archeologist to discover any new site without the study of that region.

4. Geography and Political Science:

All the political systems and system of Governments also correlate with the physiography and even climate conditions of that area. As Aristotle said, “the people of tropics are aggressive in nature so there must be a system of Government which can control their behavior i.e. Dictatorship is suitable form of Government for them while the people of Polar Regions are calm by nature so Democracy will flourish there in effective manners”.

5. Geography and Economics:

It is all about the economic Geography.

Topic - 13: Importance of Geography in Education:

Geography is studied in universities, colleges, secondary and primary schools. It is the understanding and communication of spatial information through maps, graphs, diagrams and other forms of illustrations.



It provides world knowledge, which helps people to make sense and well informed about the current events. Information increases in understanding different culture, within country and in the world, e.g. extent of biggest cultural

groups in Pakistan. Environmental perception rises due to the awareness of use and misuse of the resources. Through studying physical and human resources on a variety of scales, we can learn a lot.

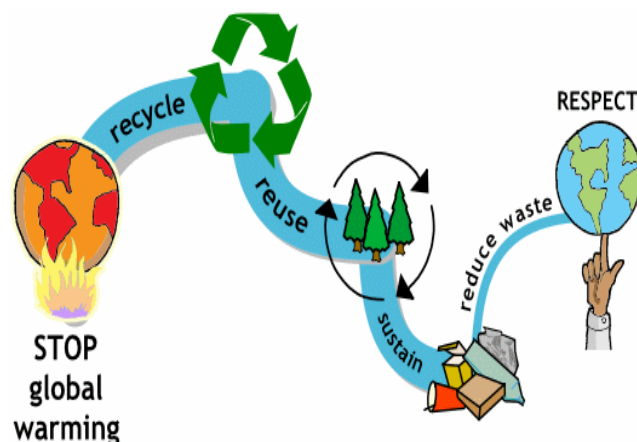


Geography helps in understanding the causes and impacts of hazards and disasters, as earthquakes, landslides, volcanicity, floods, droughts, cyclones, famines and diseases. Geography helps and enables people to acquire specific local knowledge about tourism, fishing, forestry, settlements, agriculture, etc. of their country.

Topic - 14: Importance of Geography in Development:

In Geography we not only develop maps but applying our skills in real life situation as studying phenomena in life as well as in the social sciences with field work ,statistical analysis, etc. The people make judgments on, political, social, economic and environmental issues; as in Pakistan which maintains its living standards by trading cotton products in World-wide markets.

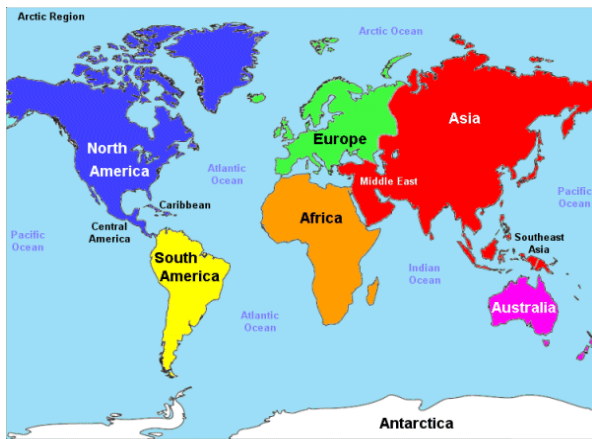
Gives understanding of different communities makes students aware of people's problems and developments. This promotes positive attitudes towards different cultures. Environmental perception enables people to identify the interrelationship between positive and negative processes as reduce, reuse and recycle.



Geography helps in developing the management and planning areas of the hazards and disasters, as earthquakes, landslides, floods, droughts, cyclones, and diseases. Geography helps in giving the specific local knowledge regarding the suitable areas for settlements, tourism, agriculture, industry, mining, infrastructure (roads, railways,) development.

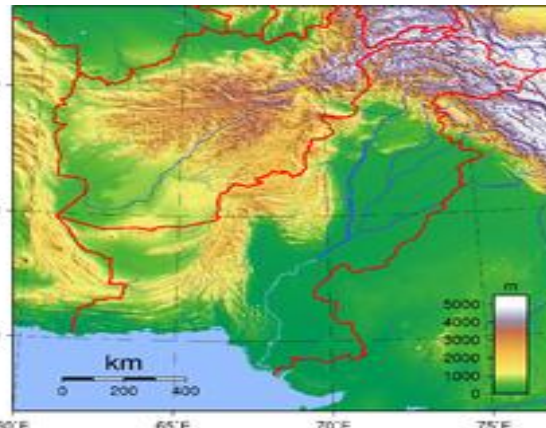
Topic -15: Importance of Geography in Knowledge:

Major Land Masses or Continents and World Regions



Physical map of Pakistan

Physical map of the world shows oceans, continents, islands, mountains, plains, deserts, etc.



Shows highland and lowland areas as some landforms are under agricultural activities and some are best for other human activities. Human or animal Habitats are generally controlled by climate. A penguin lives in the Antarctica. A camel lives in desert.

Lesson No. 4

Introducing Earth**Topic – 16:**

Earth is the third major planet of the solar system. It is the planet which is inhabited by the human beings and all the other living organisms. People live on the surface of the earth in a physical environment that is extraordinary complex and extremely diverse. A large portion of the planet is covered by the water body that is 71% while the remaining is the part of land surface. Earth has diversity in its physiography and its atmospheric composition.

The earth is the third planet from the sun in the solar system orbiting between Venus and Mars at an average distance of 149.6 million km from the sun, and has one natural satellite, the moon. It has an equatorial diameter of 12,756 km, an average density 5.5 times that of water, and is believed to have formed about 4,600 million years ago. The earth, which is three-quarters covered by oceans and has a dense atmosphere of nitrogen and oxygen, is the only planet known to support life.

Earth also called the world and is the only planet which has life. The Earth was formed around 4.5 billion years ago. The earth passed through different phases of development. Some eras were under volcanism and some were under drought. Earth's biodiversity has evolved over hundreds of millions of years. It is currently home to 10-14 million species of life including over 7.2 billion humans. All depend on biosphere and natural resources. The Sun is the only source of energy (Heat and Light). The earth is surrounded by the atmosphere, a layer of some important gases important for the survival of life. Earth's human population is divided among about two hundred sovereign states.

Topic – 17: The Shape of the Earth:

It has been a long debate to express the shape of the earth between different scholars of different time. More than 2600 years ago, Greek scholars correctly reasoned that Earth have a spherical shape. About 2200 years ago, Eratosthenes the director of Greek library at Alexandria, calculated the circumference of Earth by using trigonometric method. The Geographers and the mathematicians of later time believed that Eratosthenes did mistakes to calculate the circumference of the earth. Later on the Mathematicians of later ages gave their own point of view about the shape of the Earth. A few of them are briefly elucidated below.

Newton a famous mathematician challenged the spherical shape of the Earth and considered it like oval. A Scottish Mathematician, McLaren considered earth as a flat surface in 1742. In 1834, Jacobs a Henry's Scientist viewed that earth is an elliptical in shape which is close to the modern point of view about the shape of the earth. In 1885, Poincare flue an idea of pear shape of the earth. At present it is common view that earth is an elliptical by shape but infect this discussion is not to be ended yet.

The Earth is one of the fastest spinning body of the solar system so it shape is roughly spherical, the bulge at equator results from the rotation of the earth.

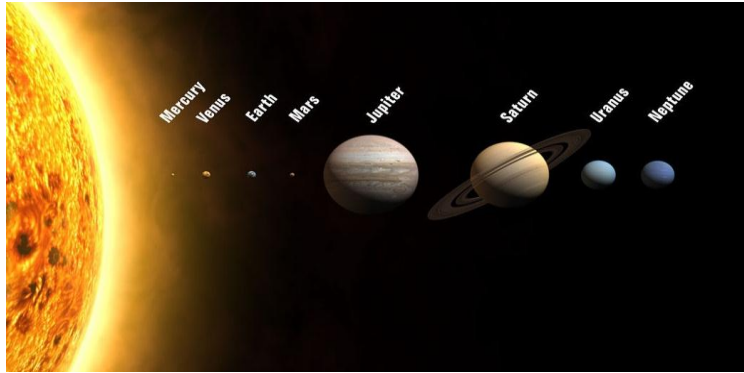
- Average diameter is 12,742 km, whereas
- Equatorial diameter is 12,756 km and
- Polar diameter is 12,714 km.
- The circumference or the distant around equator is 40,000 km.
- The spherical form of the earth is clearly visible in photographs of the earth taken from the satellites.
- If we observe a ship approaching land from the horizon, we see its smoke first and gradually more and more of the ship as it comes up over the horizon.
- Other planets are spherical, so we can assume that the earth is also spherical.
- When there is an eclipse of the moon the shadow of the earth on the moon is round. Only a sphere can cast a circular shadow.
- A person travelling around the world would return eventually to the same spot.
- The sun rises at different times over the surface of the earth. If the earth was flat the sun would rise at the same time over the entire surface.

Topic - 18: The Size of the Earth:

Our planet is just like of a grain in the Sahara desert when it is discussed in the context of whole universe. The diameter of our planet is about 13,000 km (7900 miles).

The mean radius of Earth is 3,959 miles (6,371 kilometers). However, Earth is not quite a sphere. The planet's rotation causes it to bulge at the equator. Earth's equatorial diameter is 7,926 miles (12,756 kilometers), but from pole to pole, the diameter is 7,900 miles (12,720 km) a difference of only 40 miles (64 km).

The total surface area of Earth is about 509 million square kms. About 71 percent is covered by water and 29 percent by land.



The radius of Earth is 6,371kms.

However, the Earth's rotational speed is 1666 kms/ hr which is 37 times more than the speed of the bullet causes bulge at the equator. Mount Everest is the highest top on Earth above sea level, at 29,028 feet. The

lowest point on Earth is the Mariana Trench in the western Pacific Ocean. Its depth is about 36,200 feet below sea level. Earth is the densest planet in the solar system because of its metallic core and rocky mantle. We could fit 1321 Earths inside of the Jupiter.

Lesson No. 5

Introducing Universe**Topic – 19:**

All the matter and energy (Light and heat) that exists anywhere in space and time is called the Universe including planets, stars, galaxies and the contents of intergalactic space. The universe expanded from an extremely dense and hot state and continues to expand today. It is gathered into about 100 billion galaxies. Most galaxies contain billions of stars and large clouds of gas and dust. The size of the Universe is unknown; it may be infinite with a radius of about 46 billion light years. In 2010 astronomers estimated, observable Universe contains 300 billion stars. The diameter of our galaxy Milky Way is 100,000 light - year, local group has about 5 million light years and the known universe has 20 billion light years astronomical distances.

A light year

A light-year is the distance when a beam of light travels with a speed of 300,000 km/sec and covered a distance of 9.446 trillion km in a year.

The light-year is most often used when expressing distances to stars and other distances on a galactic scale, the unit usually used in professional astrometry.

Topic - 20: Galaxy and Milky Way:**Galaxy**

It is the system of millions or billions of stars, together with gas and dust, held together by gravitational attraction.

Milky Way

The Milky Way is the galaxy that contains our Solar System. Its name "milky" is derived from its appearance as a dim glowing band arching across the night sky whose individual stars cannot be distinguished by the naked eye. There are probably more than 100 billion galaxies in the observable Universe. A galaxy range from ten million stars up to one trillion stars. Most galaxies vary from about 10,000 to 200,000 light years in diameter, and are usually grouped in clusters of 20 to several

thousands. The Clusters are grouped in Super clusters. The Milky Way is our home galaxy, is roughly 100,000 light years in diameter, and contains our solar system. This galaxy has 100–400 billion of stars and planets as well. Galaxy is an assemblage of stars, planets and other space material in a disc like shape. The diameter of a galaxy varies; distance between two neighboring galaxies is 3 million light-years. Its name “milky” is derived from its appearance as a dim glowing band arching across the night sky, cannot distinguish individual stars. The Solar System is located within the Milky Way, about 27,000 light-years away from the center of the galaxy. Stars and other material are orbiting at approximately 220km/sec around the center of the galaxy.

Topic - 21: The Sun as a star and its Planets:

A solar system refers to a star and all the objects that travel in orbit around it. Our solar system consists of the sun - our star - eight planets and their natural satellites (such as our moon); dwarf planets; asteroids and comets. The Solar System formed 4.6 billion years ago from the gravitational collapse of a giant interstellar molecular cloud. The vast majority of the system's mass is in the Sun, with most of the remaining mass contained in Jupiter. The four smaller inner planets, Mercury, Venus, Earth and Mars, are terrestrial planets, being primarily composed of rock and metal. The four outer planets are giant planets, being substantially more massive than the terrestrials. The two largest, Jupiter and Saturn, are gas giants, being composed mainly of hydrogen and helium; the two outermost planets, Uranus and Neptune, are ice giants, being composed largely of substances with relatively high melting points compared with hydrogen and helium, called ices, such as water, ammonia and methane. All planets have almost circular orbits that lie within a nearly flat disc called the ecliptic. Solar system is further discussed in the context of inner solar system and outer solar system. The Solar system formed 4.6 billion years ago. The vast majority of the system's mass (99.98%) is in the Sun. All planets are revolving around the Sun and have almost circular orbits. The Solar System comprises the Sun and its eight planets that form the planetary system around it. The inner planets Mercury, Venus, Earth and Mars are composed of rock, as silicates, iron or nickel that remained solid in all conditions. These four inner planets have dense and rocky composition. The outer planets are Jupiter, Saturn, Neptune and Uranus are composed mainly of gases, as hydrogen and helium. The Sun is the major component and star of the Solar system. It has largest mass (332,900 Earth masses) and produce electromagnetic radiation. The Solar System also contains billions of smaller objects, remnants of its early history. Asteroids are from a few hundred meters to several hundred kms across. Comets are icy frozen gases and rock particles.

Inner solar system:

The inner Solar System is the region comprising the terrestrial planets and the asteroid belt. Composed mainly of silicates and metals, the objects of the inner Solar System are relatively close to the Sun; the radius of this entire region is less than the distance between the orbits of Jupiter and Saturn. This region is also within the frost line, which is a little less than 5 AU (about 700 million km) from the Sun. This solar system consists upon the following planets which are also termed as inner planets.

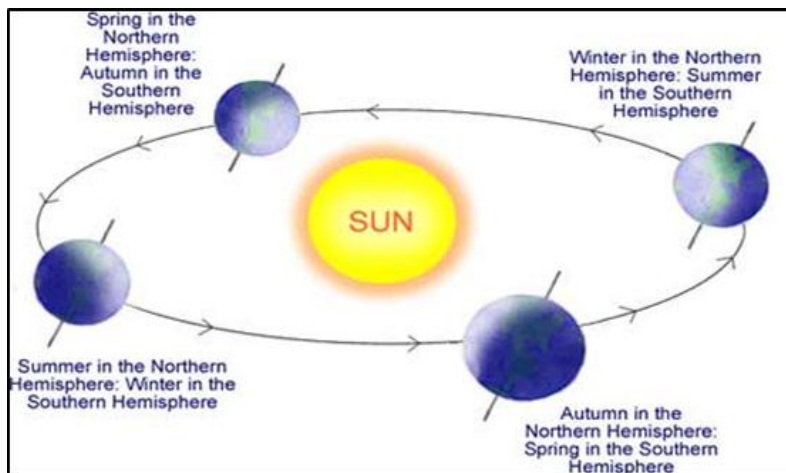
Lesson No. 6

Earth's Rotation

Topic - 22: Earth's Rotation:

It is the process in which earth rotates around its own axis. It rotates from west to east on its axis. It requires about 24 hours to complete one cycle around its axis. It is rotating in anti-clock wise or counter clock wise direction. Sun always seems to appear in the east and set in the west because of spin of earth towards east ward direction. This phenomenon of rotation of earth controls the alternation of day and night. Rotation has several striking several effects on the physical characteristics of the earth's surface. These physical characteristics includes the cariole's effect, increase and decrease of the force of gravity of earth, moon and sun and most important is the time of illusion and darkness on the surface of earth. The Earth has two movements:

- It is the movement of the solid Earth around its own axis at inclined angle (23.5 degree).
- The Earth rotates once in about 24 hours with respect to the sun.

Earth's Revolution

It is the phenomenon in which earth completes its circle around the sun. Earth revolution takes 365 days, 5 hours, 48 minutes and 46 seconds or 365.24 days. This is also known as tropical year or solar year. The path followed by Earth in its journey around the sun is not a true circle but is an ellipse. Due to this elliptical orbit,

the Earth-Sun distance is not constant. It varies from 147,166,480 KM at the perihelion position, perihelion is a combination of two Greek words, Peri- means closest and hellion stands for sun, to 152, 171, 500 km at aphelion. Aphelion stands for the farthest distance from the sun. This phenomenon of revolution of Earth controls the phenomenon of seasonal variation. During the month May, June and July Northern hemisphere enjoys summer season and the southern

hemisphere enjoys winter season and the opposite is true during the months of December, January and February. Throughout the year, as our small blue planet orbits the Sun and experience changing seasons. The warm spring, hot summer, autumn and finally, comes cold, wet, and dry, winter.

The Earth revolves around the Sun once every 365.24 mean solar days. The Earth orbits the Sun at a speed of 108,000 km/h.

Topic - 23: Latitudes and Longitudes:

Geographic Grid:

The complete understanding of the physical features on the surface of earth is very illusive until the grid system is not fully understood. This system of grid system consists upon two types of lines which intersects each other at right angle. These lines are termed as longitude and latitude lines.

Equator:

It is the imaginary line which divides the globe into Northern and Southern Hemisphere.

Prime-Meridian:

It is the line perpendicular to the equator which divides the globe into Eastern and Western hemisphere.

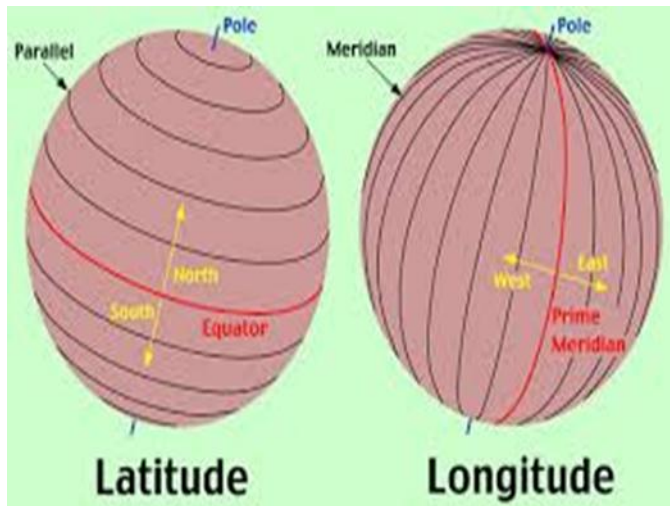
Latitude:

It is the angular distance from the equator. While the line joining these angular distances are termed as latitude. Latitudes run parallel to the equator line. It is expressed in the term of degrees, minutes and seconds. There are seven latitudes in the Geographic Grid System (GGS) are of primary importance. These seven latitudes are:

- Equator, 0 degree
- Tropic of cancer, 23.5 degree North
- Tropic of Capricorn, 23.5 degree South
- Arctic circle, 66.5 degree North
- Antarctic Circle, 66.5 degree South
- North Pole, 90 degree North

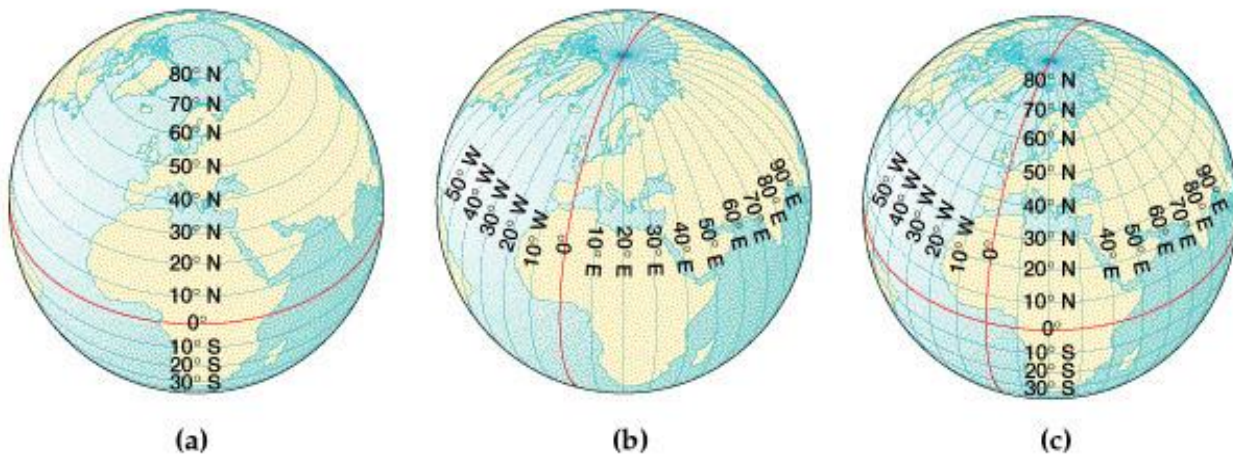
- South pole, 90 degree south

Longitude:

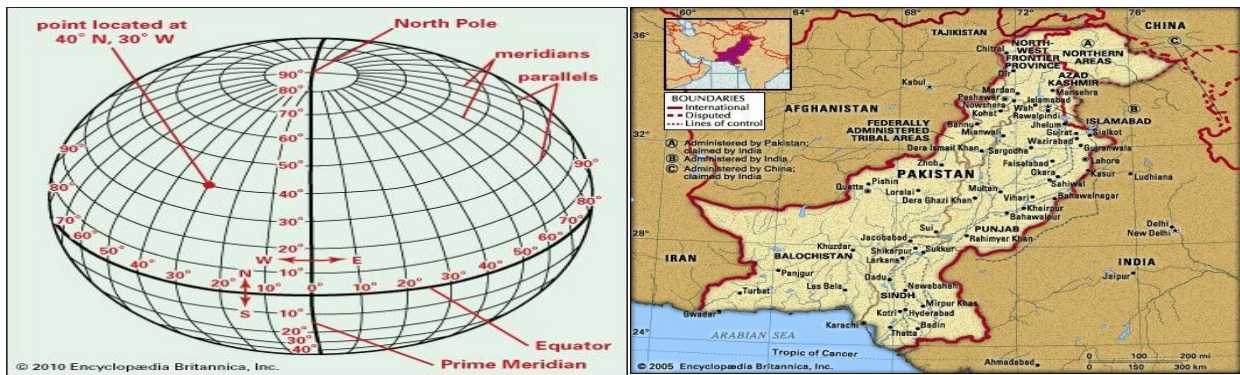


It is the angular distance from the prime-meridian while the line joining these points is called longitudes. These are also expressed in the term of degrees, minutes and seconds. These are also termed as time zones. Global Positioning System (GPS) is the most recent technology in the field of Geography to identify or calculate the exact location by longitude and latitude of a desired object. Remember that the lines of

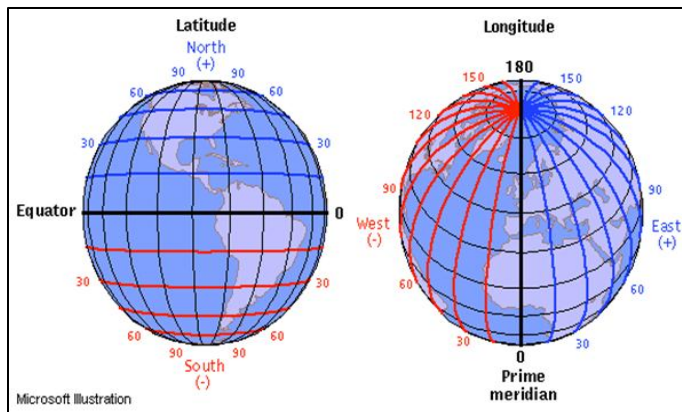
Latitudes are parallel with each other, while the lines of Longitudes meet at the poles.



These lines help us to locate where we are or where any particular place is located.

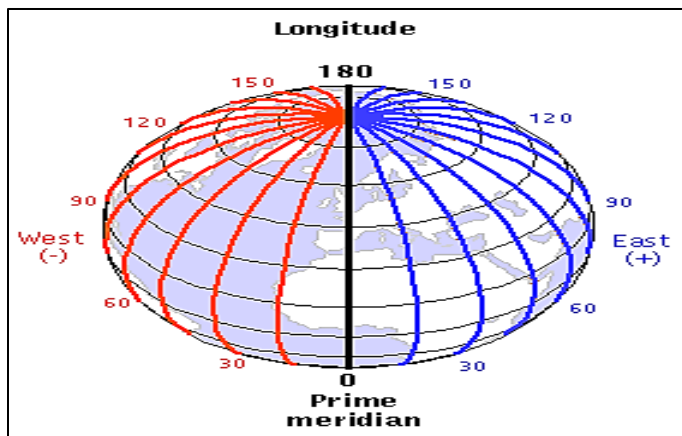


Topic – 24: Longitudes and Time:



The Earth takes 24 hours to rotate once and making a circle or moves 360 degrees. So one degree is covered in 4 minutes. The earth will pass through 15 degrees of longitudes in one hour. A time zone is a region that has a uniform standard time for legal, commercial, and social purposes. Before clocks were invented, people

marked the time of day with solar time. Greenwich Mean Time (GMT) was established in 1675 when the Royal Observatory was built. Time zones are based on Greenwich Mean Time (GMT) the mean solar time at longitude 0° (the Prime Meridian). All time zones are specified from GMT, passing through the Royal Observatory in Greenwich, London. Countries now legally define their standard time to GMT.



Longitude and time:

Longitudes are also termed as time zones. If there is difference of one degree between two places by longitude then there will be difference of 4 minutes by time. There will be a difference of 1 hour between the times of two places then there will be the difference of 15 degree by

longitude. It means that, earth takes 4 minutes to rotate about 1 degree around its axis.

Lesson No. 7

Maps and relief - Introducing Map**Topic – 25:****Definition:**

Map is the representation of Earth's surface as a whole or some part of it on the plan surface along with the title, scale, legend, North arrow and conventional signs.

History of Maps:

Maps are not the invention of recent period of time. There is a long history behind the development of maps. The earliest maps were pictorial in nature and present the idea in rough sketch without consideration of the primary elements. About 3000 years ago, Egyptian prepared the first map which only shows the demarcation of boundaries of one owner. The basic purpose of those maps was to generate revenue. Infact, those were not maps in real sense but were just pictures or sketches. The credit of modern cartographic inventions goes to the Greek Geographers, I.e. Ptolemy, Aristotle and Eratosthenes. The first accurate map in the history of cartography was prepared by Ptolemy, which is presented in his book "Geographia". This book contained a world map along with other 26 small maps. At his world map, Asia and Europe are extended over 180° but according to the modern calculations these two continents cover about 130° while the length of Mediterranean was shown about 62° but in real sense it is about 42°. Besides of these chief faults, the Ptolemy's map is considered as the foundation for the modern cartographic inventions. Romans were the next, who contributed in the field of cartography. Unlike of the Greeks, Roman paid little attentions to the mathematical Geography. The recognition of Earth as spheroid with its poles, Equator and Tropics, Division of Earth into climatic zones, development of system of graticules and the formation of first projection were the contribution of Romans in the field of cartography. During the period of Arabs, a number of improvements were made in the previously developed maps. They followed the Greek's method and prepare the first accurate map showing the Islamic World. In the 15th century the recovery of Ptolemy's "Geographia" is considered as the renaissance in the field of cartography. During this century, The Italians, Spanish, Dutch, Portuguese and German cartographers perfected the art of map making. In 16th century, the introduction of map printing press of Amsterdam opened the door of employment for the cartographers and proved to be a mild stone in the history

of cartography. In 18th century, England became the foremost maritime power in Europe and London became the center of the cartographic developments. During this century another improvement was done by conducting the first national survey in France by C.F Cassini. Whose work was continued by his son at the eve of French revolution. In 19th century, more attentions were given to the cartography. Rich and colorful symbols were used instead of “Black & White” for the first time in the history of maps. The introduction of airplane photography in the 20th century opened a new dimension in the topographical surveying. All the advanced countries of the world have made extensive use of airplane topographic surveying. Recently, USA has collected various types of images through LANDSAT-1 to produce extensive and accurate world map. A map is a symbolic depiction, which highlights relationship between elements of objects, regions and themes.



Cartography is an art of map making and the practice of crafting the physical and man-made features of the Earth. The skilled person is called a cartographer. Maps are not the invention of modern age. The earliest maps were generally pictorial, roughly sketched and inaccurate

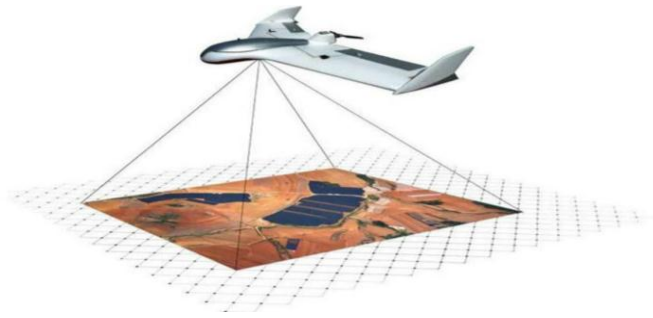


World map (1689)



World map (2004)

Areal Photography



A large scale map shows a small area, with great detail. A map depicting a large area, such as country, is considered a small scale map and shows more territory, but less detailed.

Topic - 26: Introducing Maps 2:

Elements of Maps:

These are basically the fundamental organs of maps. If any of them is absent then the map will be no more than that of the rough sketch. Following are the major elements of map.

- Title
- Scale
- Legend
- N-Arrow
- Conventional signs.

Map and symbols:

The main purpose of map is to communicate data and information to the users. The symbols are considered as the language of map. There are three types of symbols which provide the information about the different features on map.

- **Point symbol:**
 - These are used to represent the specific location of objects.
- **Line symbol:**
 - These are used to represent the roads and railway lines on the maps.
- **Area Symbols:**
 - These represent the marshy areas, residential areas, forests, water body etc.

Shape of features on map:

Different physical or human features are presented on map by different shape. These may be rectangle, square or line. The rectangle may be used to represent building and triangle may present mine while line may be used to present the roads.

Size of Different Features on Map:

These are used to indicate the degree of importance of any feature. For example, large circle may represent a city and small circle may represent a town.

Color and Texture:

Different color scheme is also used to emphasis over different features. For example, red color may indicate an urban or built area while green color may elucidate the Agricultural area.

Landsat Satellite System



Landsat satellite system program is the largest or longest running enterprise for acquisition of satellite imageries of the earth. It was started in 1971. To provide timely, high quality and infrared images of all landmass and near coastal areas on the earth; continually refreshing an existing Landsat database. The earth resource technology satellite was launched in 70's named Landsat system. The first system was launched on February 11, 1972 and most recently,

Landsat 8 was launched in 2013. Landsat 8 consists of three key mission and science objectives:

- Collect and archive medium resolution (30-meter spatial resolution) multispectral image data affording seasonal coverage of the global landmasses for a period of no less than 5 years;
- Ensure that Landsat 8 data are sufficiently consistent with data from the earlier Landsat missions in terms of acquisition geometry, calibration, coverage characteristics, spectral characteristics, output product quality, and data availability to permit studies of land cover and land-use change over time;

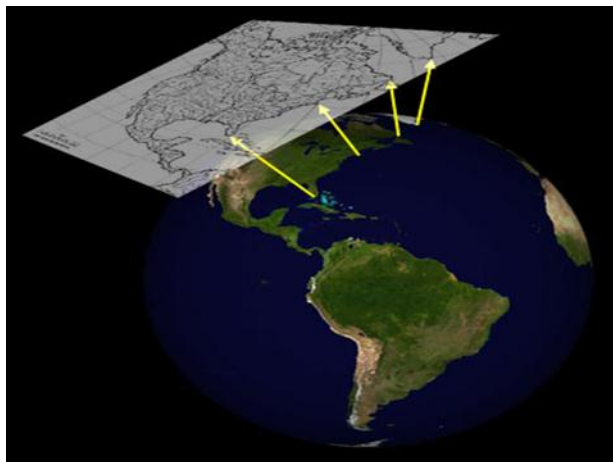
- Distribute Landsat 8 data products to the general public on a nondiscriminatory basis at no cost to the user.

SPOT Satellite Program



Spot satellite is a commercial high resolution optical imaging earth observation satellite system operating from space. It is run by spot image. Spot 1 was launched in December 31, 1990 and spot 5 in May 4, 2002 with 2.5 meter resolution. However spot 7 launched in 2014.

Topic - 27: Types of Map:



The map may be defined as the representation of the earth's pattern as a whole or part of it with conventional signs, drawn to a scale and projection. The frame work of the map is based on the way how the graticule, i.e., the longitudinal and latitudinal network is prepared. This depends on the position of the area on the earth's surface and type of map.

The amount of information to be represented on the map depends on:

- Map Projection
- Conventional signs
- Methods of map-making
- Scale

Types of Maps on the basis of Scale:

Scale is the most essential element of map. Maps are usually drawn to show different detail on large or small scale. The details that are to be shown on it may be varied, if scale is varied. On the basis of scale, map can be categorized into two types.

Small scale maps:

These maps cover large area to shown but provides small information. The ambiguity may exist due to cover of large area. These are not fit for more detailed and accurate information. Examples of small scale maps are, wall maps and chorographical or Atlas maps.

Large scale maps:

These maps cover small are and provide more detailed information e.g. cadastral maps and topographical maps.

Types of Maps on the basis of Purpose:

On the basis of purpose, these maps can be discussed in two types.

Physical Maps:

These maps are also termed as natural maps. These maps indicate the physical or natural phenomenon. These are further subdivided in to following types of maps.

1. Astronomical maps
2. Orographic maps
3. Geological maps
4. Climatic Maps
5. Soil Maps
6. Natural vegetation maps

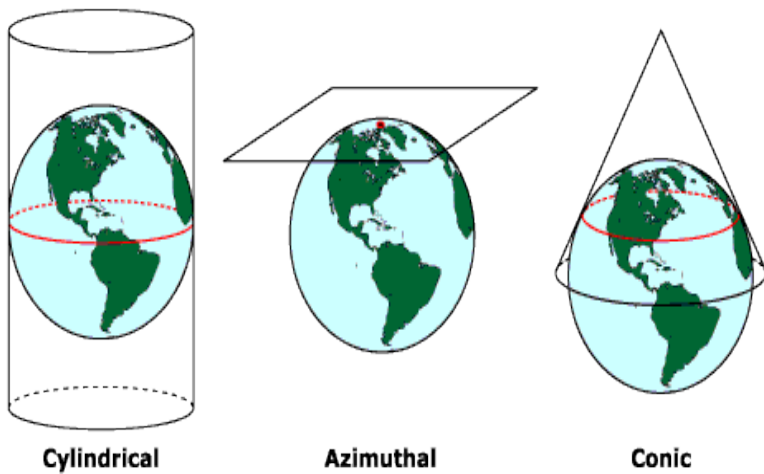
Cultural Maps:

These maps represent the human environment or man-made phenomenon. This type includes the following maps:

1. Economic maps
- Political maps

- Military maps
4. Historical maps
 5. Social maps
 6. Land utilization maps

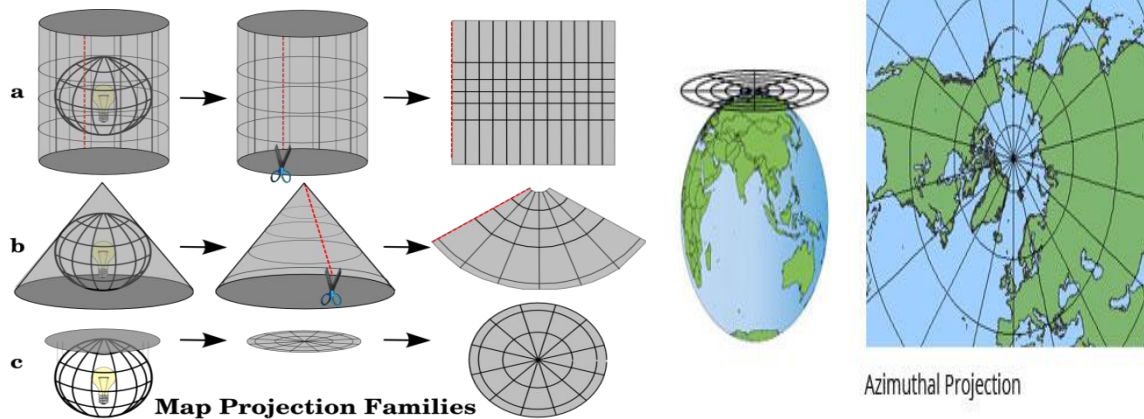
Basic Types of Map Projections

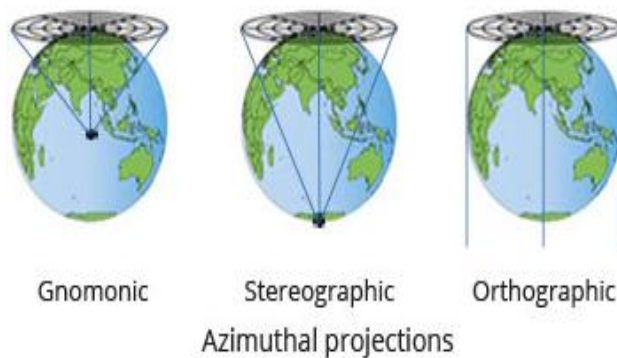


The need for map projections arises from the fact that an ordinary globe is rendered useless for a small country. It is not possible to make a globe on a very large scale.

Topic - 28: Types of Map:

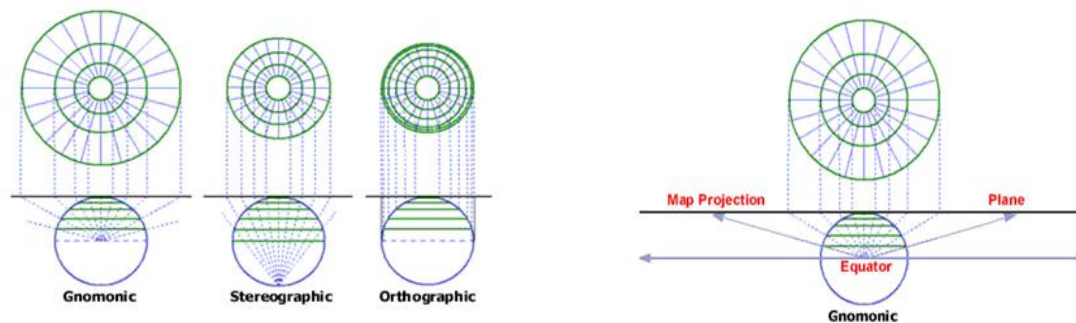
Map projection varies with size and location of different areas on the earth's surface.





Maps and Relief

Maps and Relief



Elevation and Relief:

The term elevation is used to represent the height of land surface above a fixed plane or sea level. This height is measured in feet. That fixed plane is termed as datum, from where further measurements are made. If the value is in negative then it will be termed as depression, if the value is positive then it will be called elevation. The term relief is used in synthetic sense. It indicated the variation in the nature of land surface. It shows the relative heights of highlands and lowlands which are termed as hills, knolls, spurs, valleys etc.

Methods of Representation:

Different methods are used to represent the elevation and relief. These methods are, Pictorial methods, Mathematical methods, and the combination of previous two.

Pictorial Methods:

This method is aimed to provide the true visual picture of terrain. These are further discussed in following methods:

- **Hachures:**

It is the method of representing the relief by means of sets of finally drawn disconnected lines which indicate the direction to which water would flow from highland to lowland.

- **Hill shading**

In vertical illumination, source of light is held at vertically above the place which varies according to the slope. Steeper slope will reflect the darker shading but relatively flat area will show the lighter shading. While in the oblique illumination, source of light is supposed to be beyond the N-W corner of the map. So, the slope which faces to the N-W will be lighted while facing S-E will be darker.

Mathematical Methods:

This method is discussed in following ways:

- **Spot Height:**

These provide the actual height of places above sea level which are fixed by the surveyors. These are shown on maps by dots followed by the number giving heights above sea level in feet or meters

- **Bench Mark:**

These are bench marks places on buildings which indicate the height above sea level. On map these are shown by BM.

- **Trigonometrical stations:**

These are points on the surface of earth which were used as stations for triangulation survey. These are indicated on maps by small triangles.

- **Contours:**

These are the imaginary lines of the ground joining the adjacent places at the same height above sea level.

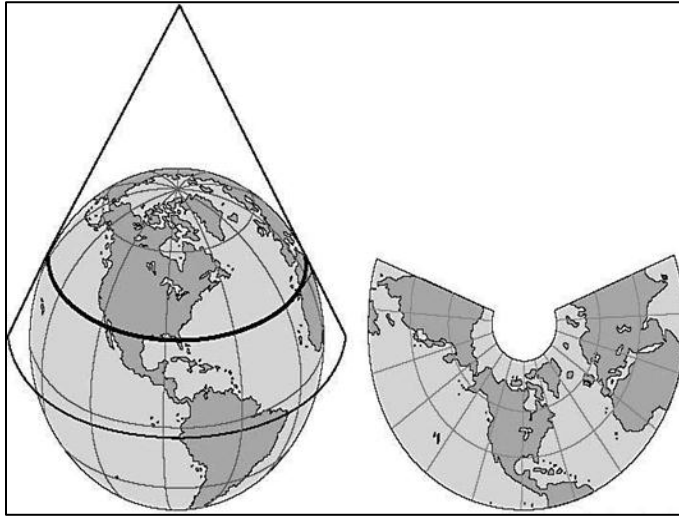
Combination of Previous Methods:

The modern relief maps use several methods in combination. A brief description is given below:

- Contours and Hachures
- Contours, Hachures and Spot-Heights
- Contours, form lines and spot Heights
- Contours and Hill Shading
- Contours and Layer Tints.

Lesson No. 8

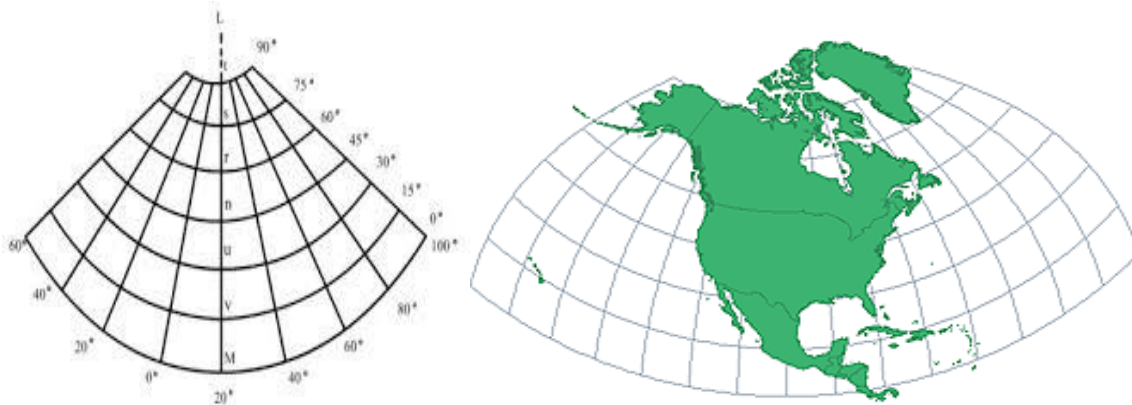
Maps and Relief

Topic – 29**Conical Projection**

Conical projection can be used for middle latitude areas. So it truly represents the areas which are closer to middle latitude or temperate region. A cone may be imagine to touch the globe along circle the cone will lie vertical above the pole on the earth axis produced and the surface of the cone will be tangent to the sphere along some parallel of latitudes. These some parallel or

selected parallel are called standard parallel. Arch of circle after the cone is unfolded along a plain. There may be one or two standard parallel in conical projections other parallels with be concentric with the standard parallel. Some of the conical projections have been modify to sooth maps.

Conical Projection (Bonne's)





Cylindrical Projection

It is used for the areas which are closer to the equator. A cylindrical projection can be imagined in its simplest form as a cylinder that has been wrapped around a globe at the equator. The points on the spherical grid are transferred to the cylinder which is then unfolded into a flat plane. The equator is the "normal aspect" or viewpoint for these projections. This family of projections is typically used to represent the entire world.

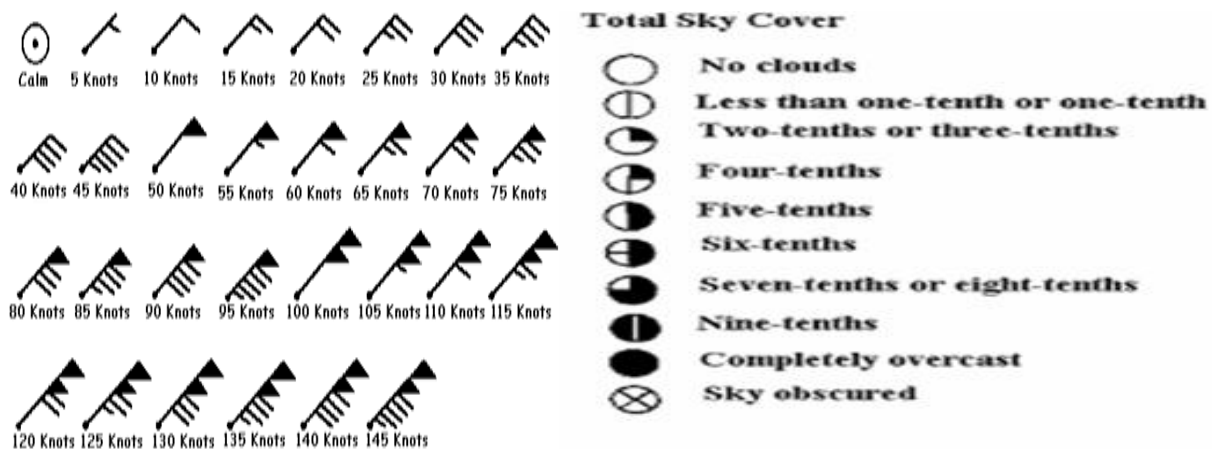
When projected from the center of the globe with the normal aspect, the typical grid appearance for cylindrical projections shows parallels and meridians forming straight perpendicular lines.

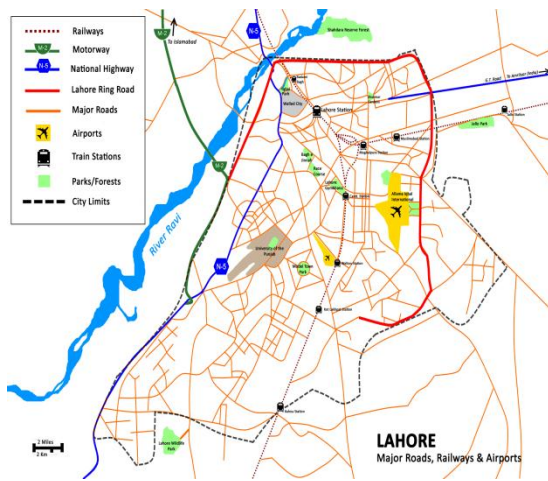
Topic - 30: Types of Map:

Conventional signs

On maps the conventional signs have made it possible to compress maximum of information in the minimum of space without losing their importance. Conventional signs are symbols used on maps to represent different features. The symbols are explained in the key of the map.

- Weather Symbols
- Cultural symbols





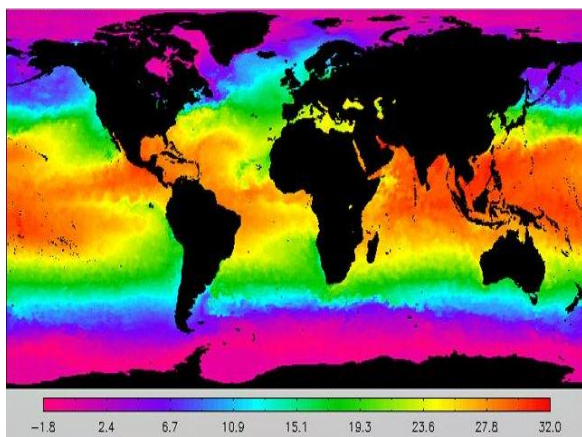
Methods of Map making

Most important thing is map making is its methods. Cartographer by its unique skills and technique may give a lively touch to his drawing which otherwise becomes less attractive. There are various ways by which the earth is mapped; computer maps are being precisely constructed. Satellite is also being used to map large areas of earth accurately. The methods of the mapping depend on the size of the area on the degree of accuracy aimed at and on amount of detail required. On the topographical survey maps every point on bear a true relationship with the corresponding points on the grounds.



Tools used for making maps

The most important component in method of map making is the tools. With the help of survey tools we can draw a map of the area by actual survey the earth as a whole or part of it is mapped with the help of the instrument like chain and tape survey, plane table survey and prismatic survey. These are the major tools used in map mapping. In this era modern survey tools are used like theodolite (use mapping of roads and streets) and total station is the most recent survey tool.

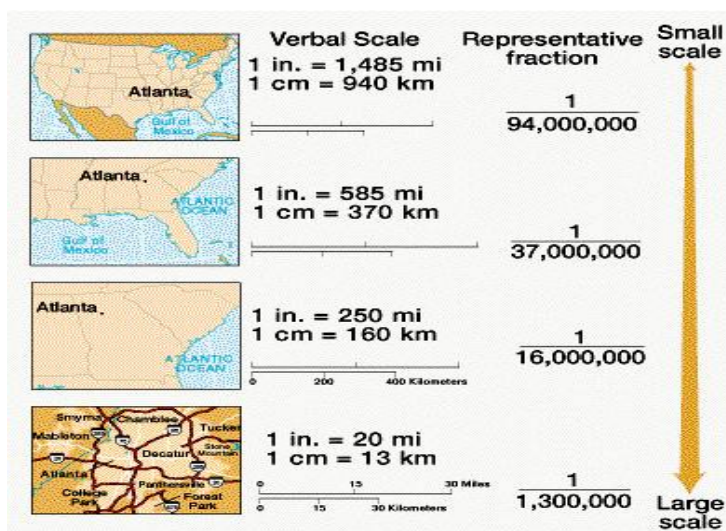




Topic - 31: Types of Map:

For understanding things maps can be classify into different categories:

- 1) Scale 2) Purpose

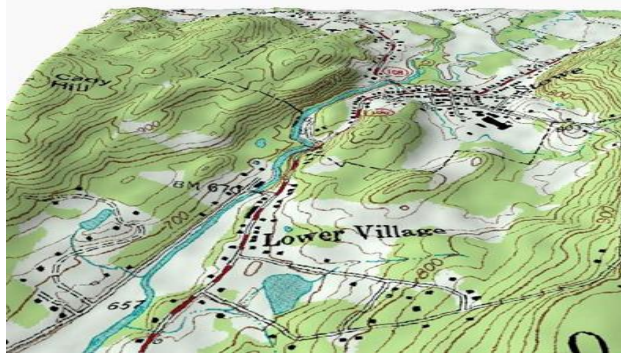


The maps are usually drawn to show different detail on a large or small scale.

According to Scales

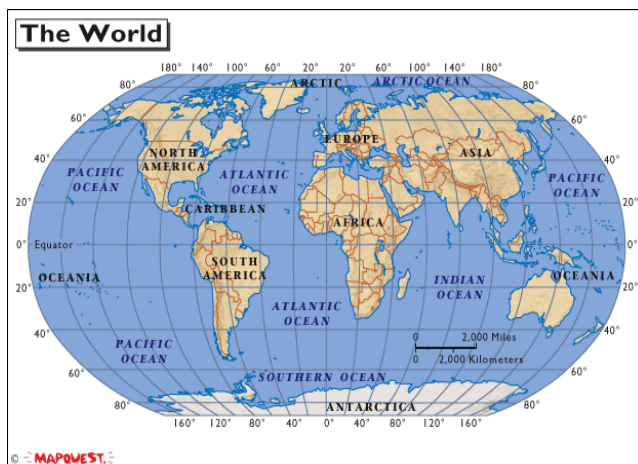
Cadastral:

Large scale map, are drawn to register the ownership of property by demarcating the boundaries of fields and buildings.



Topographical map:

Large scale maps are based on precise surveys. They show general surface features in detail both natural land scape and cultural landscapes.



Wall Maps:

Small scale maps are used in the class room. The world as a whole or in hemisphere is represented on the wall maps. These are prepared for continents or countries large or small according to need.

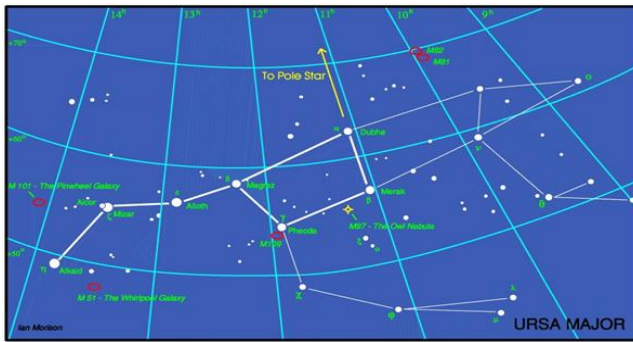
Atlas Maps:

Very Small scale maps give a more or less highly generalized picture regarding the physical, climatic and economic conditions of different regions of the earth.

Topic - 32: Types of Map:

According to purpose:

Based on the content of the map, both natural features and man-made features evolved over different areas



Astronomical maps:

Showing heavenly features are known as astronomical map

Orographic maps:

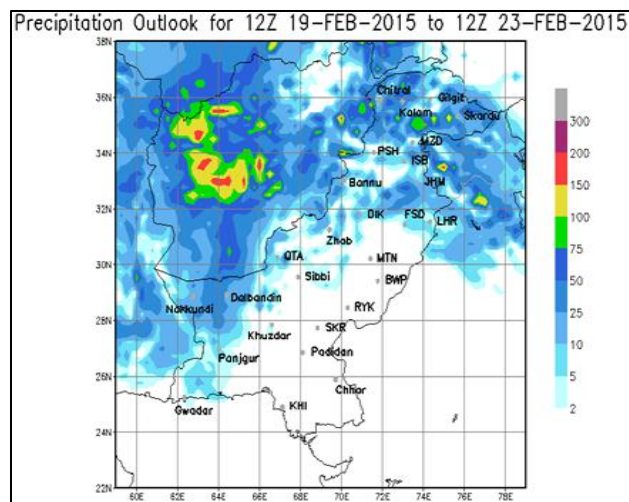
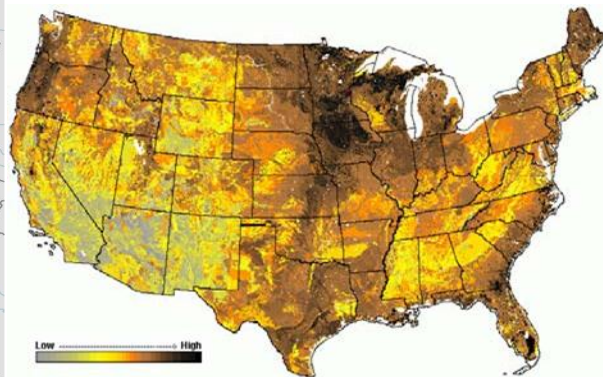
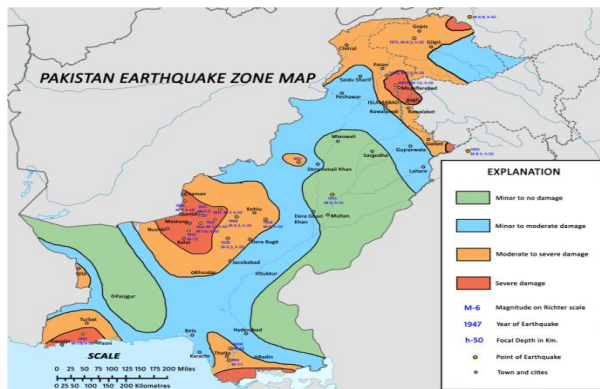
The maps depicting surface forms are also

called relief maps. The level of land, its slope and drainage

Geological maps:

The detail of rocks and mineral composition of the regions are marked on geological maps.

Soil Maps: These maps showing the various types of soils covering the area.



Weather maps:

The maps showing the average condition of weather elements over a shorter period ranges from daily, monthly to seasonal weather conditions.

Climatic maps:

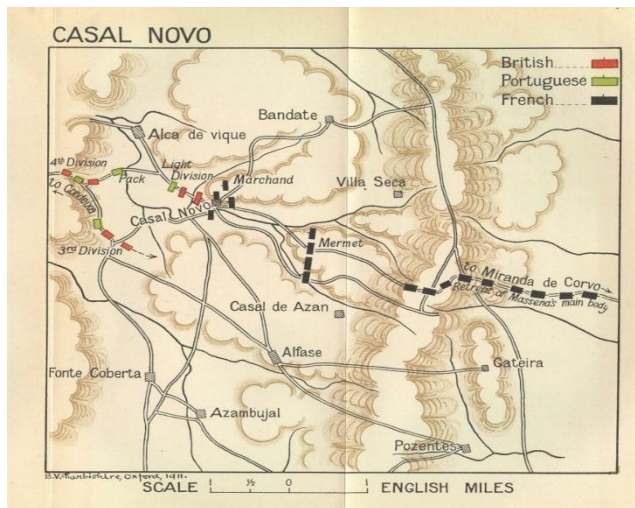
When averages of weather conditions over long period say 30 years or more are charted out on

maps, they are defined as climatic maps.



Cultural maps:

The maps showing the cultural patterns over the surface of the earth



Military maps:

These maps record strategic points, routs and battle plans.

Lesson No. 9

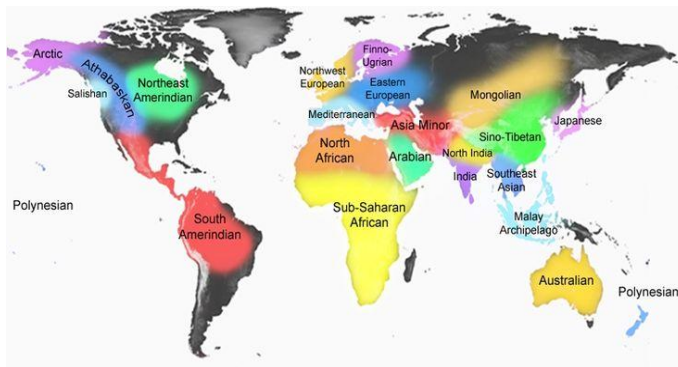
Types of Map

Topic - 33:

Political maps: shows Boundaries between different political states or units.

Social maps:

Social organizations-tribes and races, their languages, religion are depicted on maps.

**Communication maps:**

These maps show only the means of communication as roads, railway, airways, etc.

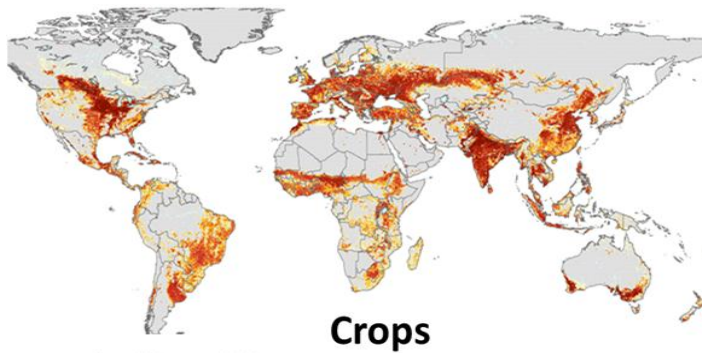
Economic maps:

The distribution of important agricultural,

mineral and industrial products with important centers

Distributional maps:

These maps show characteristic features of a certain area, items may be natural like temperature, flora and fauna or it may be cultural, showing population.

**Choropleth maps:**

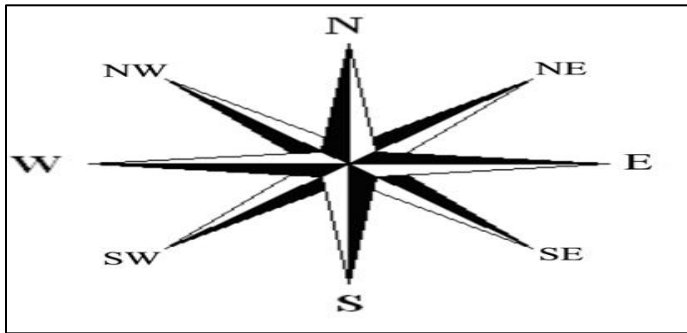
Different shading by horizontal, vertical and slanting lines may be adopted to show different densities of population and other data.



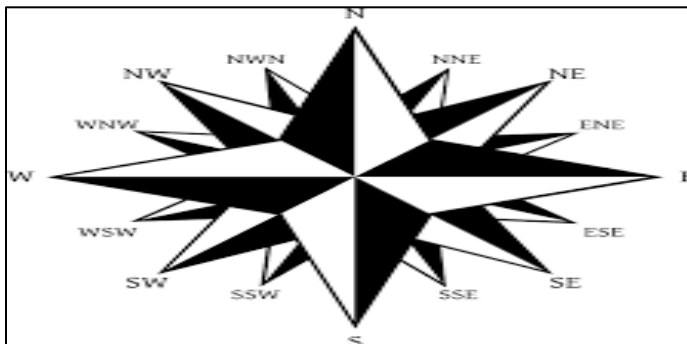
Historical maps:

Past events are symbolized on these maps.

Topic - 34: Determination of Directions:



The four cardinal directions or cardinal points are the directions of north, east, south, and west, commonly denoted by N, E, S, and W.



Intermediate points between the four cardinal directions form the inter cardinal, or ordinal directions are Northeast (NE), Southeast (SE), Southwest (SW), Northwest (NW). Further, the intermediate direction of every set of inter cardinal and cardinal direction is called a

secondary-inter cardinal direction, like the NNE, ENE.



Magnetic Compass

Magnet compass is an instrument used for navigation and orientation that shows direction relative to the geographical cardinal direction or compass rose. The north mark on the compass rose really

point to the north, north corresponds to zero degree and angle increases clockwise. East is 90 degree south is 180 and west to 270 degree. The degree increases to the right side of the compass or we can say is a clock wise rise.

Lesson No. 10

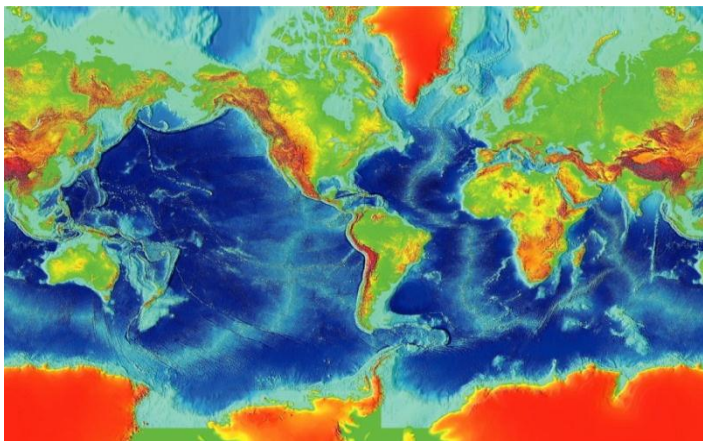
Representation of relief features

Topic - 35:

The term elevation means the height of the land surface above a fixed plane. The height is measured in feet or in any other unit.

The term relief is used in a systematic sense; it indicates the variation in the nature of the land surface. It shows the heights of highlands and lowlands. Like

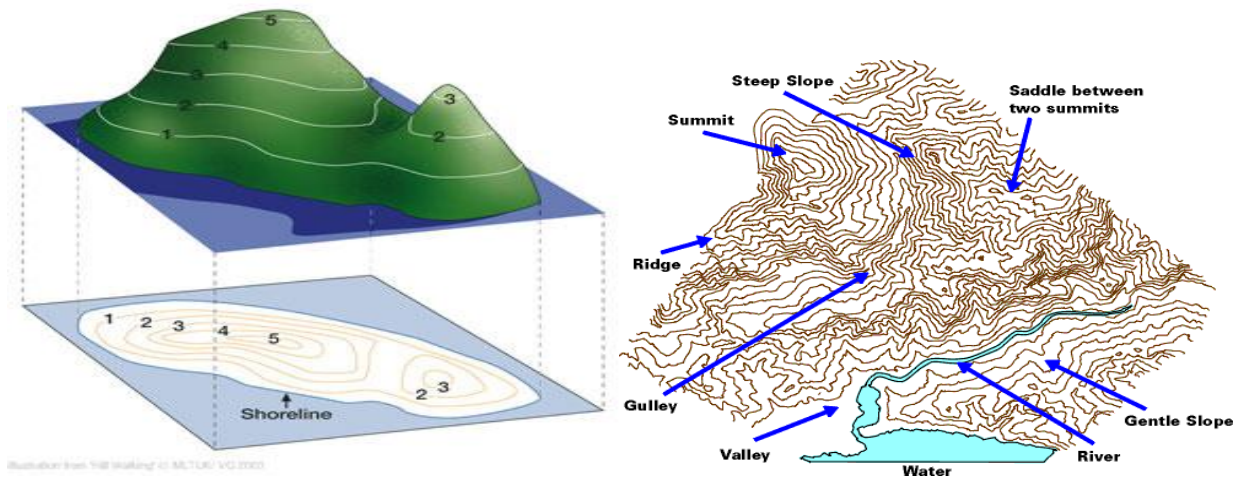
the mountains of Pakistan are to the north of country most of the north is covered with high lands but Lahore is in the plain areas lowland areas, as you move from north to south the highlands starts to decrease.

**Methods:**

Giving a more or less true visual picture of the elevation and relief we are using these methods

1. Mathematical**2. Pictorial****Mathematical method:**

Contouring is the standard methods of representing relief are imaginary lines of the ground joining places of same height above sea level. These lines are fixed by accurate surveys. The contour interval of a contour map is the difference in elevation between successive contour lines.



Spot Heights give the actual height of places above sea level, fixed by surveys. They show a height value.

Topic - 36: Representation of relief features:



Bench Marks: These are marks placed on buildings, or on other places, indicating the height above sea level, determined by actual surveys. All the heights are determined by the surveys, ground surveys which are conducted by certain techniques recent techniques like total stations, theodolite and automatic level or GPS. On maps these are indicated by the letters B. M. followed by the height in feet or meters above

sea level. Form lines resemble contours, but represent no actual elevations, sketched from visual observation or from unreliable map sources, to show collectively the configuration of the terrain.



Trigonometrical Stations: These are points on the surface of the earth which were used as stations for triangulation survey. Triangular surveys are done by certain techniques; the older techniques are chain and tape survey, plane table survey, theodolite survey prismatic survey

and recent tools are used in triangulation survey are total station, automatic level and GPS. In trigonometrical stations map are made by the process of certain surveys and these surveys are actually linked with the height of the regions. Trigonometrical Stations are indicated on map by triangle followed by the height above sea level.

Topic 37: Representation of relief features:

Pictorial methods:

Pictorial method aims at giving a more or less true visual picture of the elevation and relief features:

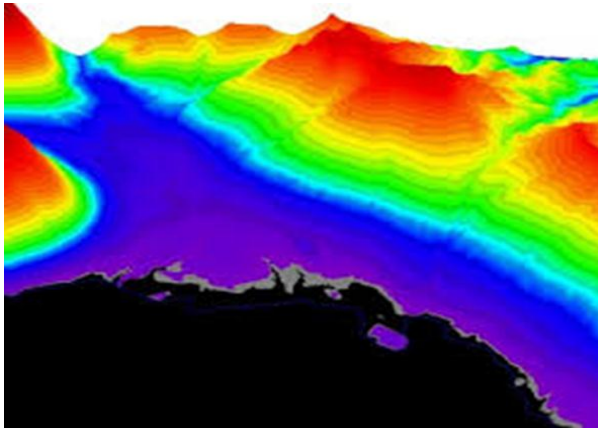


Hachure is method of representing the relief by means of sets of finely-drawn disconnected lines which indicate the direction of water flow. It does not show the absolute height. They are a form of shading, although different from the one used in shaded maps. Hachures are

strokes (short line segments or curves) drawn in the direction of the steepest slope. Steeper slopes are represented by thicker, shorter strokes, while gentler slopes are represented by thinner, longer and farther apart strokes. The hachures are traditionally monocolour, usually black, gray or brown.

Hill Shading:

In this method steeper the slope is the darker the shade be. Relatively flat area like plateau, plain, valley bottom have lighter shading.



A digital terrain model

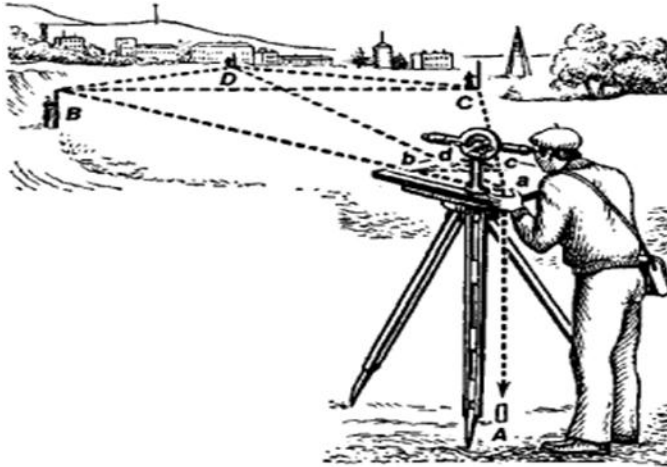
A digital terrain model is a topographic model of the bare earth or relief features or a 3D representation of a terrain's surface. The digital surface model the earth surface and includes all objects on it but in contrast to it the digital terrain model represents the bare ground surface with plants and buildings.



Shaded relief today can be created digitally, using a digital elevation model (DEM) as its basis.

The Digital Elevation Model may be converted to shaded relief using software such as Photoshop GIS or Arc Map's Spatial Analyst extension.

Lesson No. 11

Geographical fieldwork:**Topic - 38:**

Surveying is the art of making measurements of the natural and man-made features on the earth's surface. The information or data that we get from the surveys are presented either graphically or numerically. Surveying is divided into geodetic and plane surveying. In geodetic surveying large areas of the earth's surface are involved, and the curvature of the earth

must be taken into account. In plane surveying relatively small areas are under consideration, and it is taken that the earth's surface is flat or horizontal plane.

Branches of Surveying

Surveys are often classified by:

Topographic surveys:

These produce maps and plans of the natural and man-made features.

Engineering Surveys:

These include all the surveys work required before, during and after any engineering works.

Cadastral Surveys:

These are undertaken to produce plans of property boundaries for legal purposes. In many countries the registration of ownership of land is based on these plans.

Topic 39

Geographical fieldwork

The recent techniques are used in geography especially in field surveys for the representation of various data, and in mapping.

River Fieldwork

These types of fieldworks are conducted to investigate the causes and impact of river hazards.

- **Flooding**

To prevent these hazards we need to investigate the causes and impact of the river, the causes can be ice melting due to rise in temperature and excessive rainfall. With the help of ground survey we can prevent these floods.

- **River processes**

It investigates downstream changes in the channel, it investigates meanders or river plain.

Coastal Field work

Coastal fieldwork is controlled by different types of processes:

- **Coastal processes**

Coastal processes investigate the land forms and sediment analysis.

- **Coastal management**

Investigating methods, perceptions and impacts

Urban Field work

- Urban inequalities are exclusion and unequal spaces, disability. These areas are controlled by high income group, medium and low income groups.
- Urban rebranding are strategies and managing urban rebranding. E.g. domestic use of water, which can be reused in kitchen garden or watering the plants.

Rural Fieldwork

Rural field work deals with rural characteristics, Multi-village studies of settlement hierarchies. Change in Counter-urbanization and other recent change.

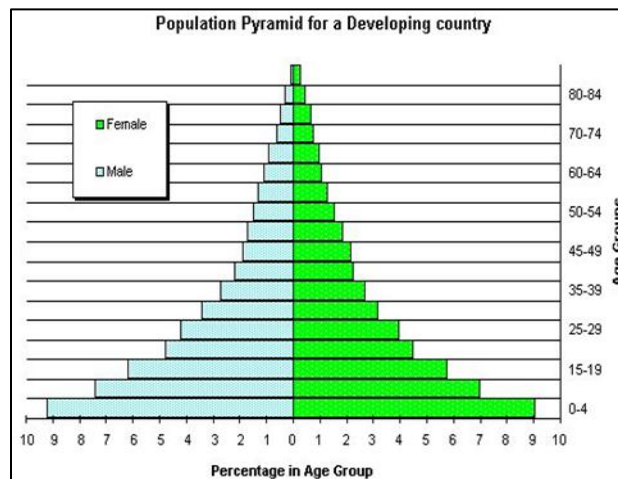
Ice Field work

Ice field work deals with the Glacial and fluvio-glacial processes and landforms

Ecology fieldwork

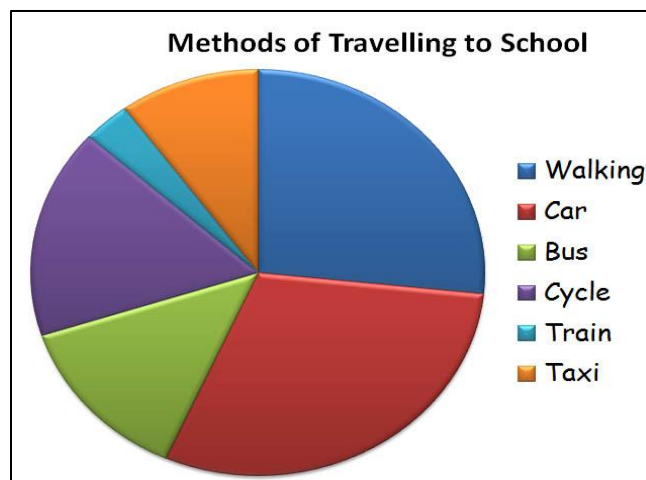
It deals with Sand Dunes and area covering vegetal covers.

Topic - 40: Statistical Techniques:



Statistical techniques are used in geography for the interpretation of numerical information or facts and figures as population statistics or education statistics. Geographers like many other scientists both in social and physical domains are facing with an information explosion. One of the most powerful uses of statistics technique is in helping the geographer to decide relationship between two sets of

sample data. The major use of statistics is in helping us to make predictions, or post dictions (past time).



Statistical Techniques in Data Presentation:

After the conducting of field survey the next more significant part is its presentation. The collected data may be presented either in the form of maps or charts. If the data is presented by using the maps then it will be the spatial presentation of data and if it is presented in the form of charts, pie-charts,

line graphs, bar-graphs, tables etc. These statistical techniques are used to perform different temporal or spatial analysis about a specific phenomenon. These techniques are more useful in to

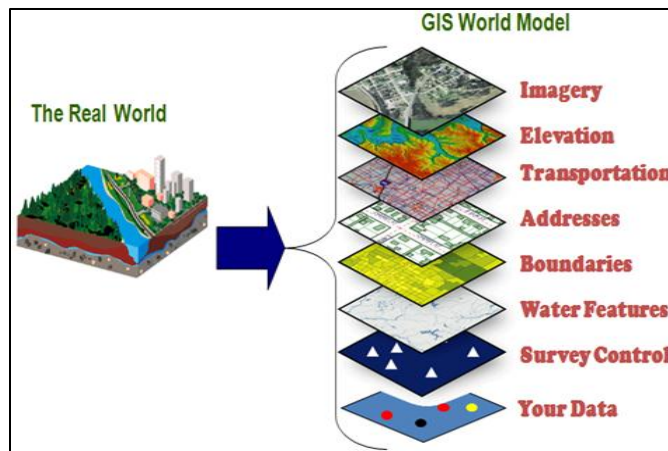
perform the analysis about the data collected from the human-environment. Data is also presented by using the color scheme.

Statistical interpolation:

Interpolation is the process in which the unknown values are speculated on the basis of collected data. This may be either statistical interpolation or spatial interpolation. Statistical interpolation is the use of a set of observations of a state variable to supplement a set of estimated values of that variable. More specifically, it can be a way of constraining an NWP model, by combining the output of that model with actual observational data to achieve a more realistic result. In practice, the output from a model will be on a regular grid, whereas observations will come from irregularly-positioned stations. In this case, what we are trying to achieve through statistical interpolation is a combination of the two datasets in such a way that the overall variance of the result is minimized. For example, if the calculated values are like 1,2,3,4,6,7,9 then what would the missing values. So in order to investigate these values statistical interpolation is used. On the basis of this technique of interpolation the missing values will be 5 and 8.

Recent Techniques in Geography 4

Topic – 41:



Geographical Information System

Geographic Information System (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. GIS can enhance weather systems on surface maps, as air masses, fronts, and surface observations. Thus, weather information could be provided to public. A Geographic

Information System allows users to visualize multiple layers of geographic data in order to reveal relationships, patterns, and trends. GIS can be utilized to map, analyze, and answer real-world questions. It stores information in multiple layers, each layer pertaining to a certain type of data. GIS was used to construct this computerized 3-D model of the Iron Age in central Jordan. The model is actually a digital representation. GIS store geospatial data in digital form, enhance the characterization of earth surfaces, and facilitates the understanding of landform structure and other geomorphological phenomena.

Geographic Information System:

A geographic information system (GIS) is a computer based system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. The GIS is sometimes used for geographical information science or geospatial information studies to refer to the academic discipline or career of working with geographic information and is a large domain within the broader academic discipline of Geo-informatics. What goes beyond a GIS is a spatial data infrastructure, a concept that has no such restrictive boundaries. In a general sense, the term describes any information system that integrates stores, edits, analyzes, shares, and displays geographic information. GIS applications are tools that allow users to create interactive queries, analyze spatial information, edit data in maps, and present the results of all these

operations. Geographic information science is the science underlying geographic concepts, applications, and systems. GIS is a broad term that can refer to a number of different technologies, processes, and methods. It is attached to many operations and has many applications related to engineering, planning, management, transport/logistics, insurance, telecommunications, and business. For that reason, GIS and location intelligence applications can be the foundation for many location-enabled services that rely on analysis and visualization. GIS can relate unrelated information by using location as the key index variable. Locations or extents in the Earth space–time may be recorded as dates/times of occurrence, and x, y, and z coordinates representing, longitude, latitude, and elevation, respectively. All Earth-based spatial–temporal location and extent references should, ideally, be relatable to one another and ultimately to a "real" physical location or extent. This key characteristic of GIS has begun to open new avenues of scientific inquiry. There is a vast range of application of the GIS; almost it covers all the aspects of applications. It is broader technology which possesses influence upon all the types of activities. Its range of application begins from the interior of the earth to the space.

Applications of GIS:

A brief description of GIS application is enlisted. Uses of GIS range from indigenous people, communities, research institutions, environmental scientists, health organizations, land use planners, businesses, and government agencies at all levels. Uses range from information storage; spatial pattern identification; visual presentation of spatial relationships; remote sensing - all sometimes made available through internet web interfaces, involving large numbers of users, data collectors, specialists and/or community participants. Some examples include:

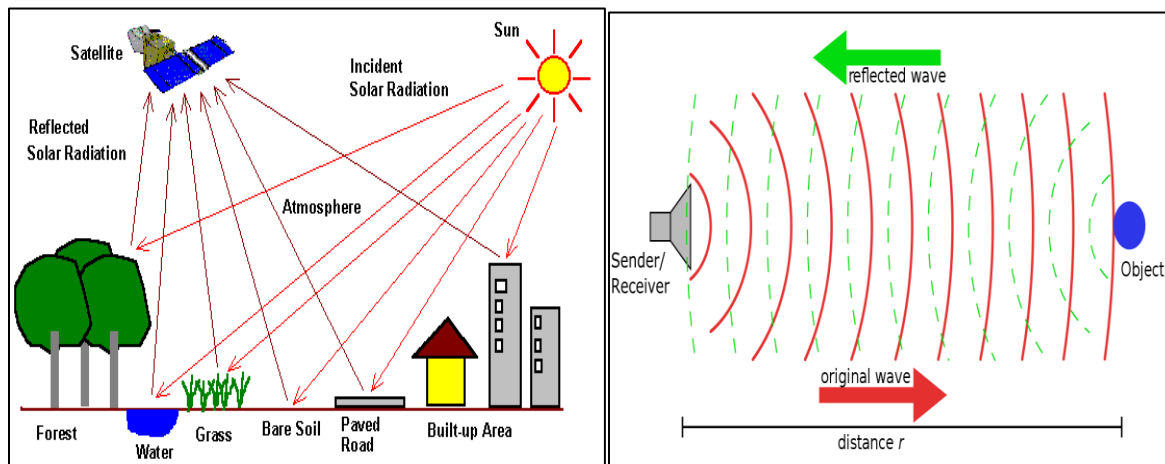
- Historical geographic information systems
- GIS and Hydrology
- Remote sensing applications
- Traditional knowledge GIs
- Public Participation GIS
- Road networking
- Wastewater and storm water systems
- Waste management
- Crime mapping

Recent Techniques in Geography 5

Topic – 42:**Remote Sensing**

Remote sensing refers to gathering information from great distances and over broad areas, usually through instruments mounted on aircraft or orbiting spacecraft. The instruments mounted on remote sensors measure electromagnetic radiations coming from the Earth's surface and

atmosphere as received at spacecraft platform. All the natural and man-made features are capable of reflecting, transmitting, absorbing, and emitting electromagnetic radiation.

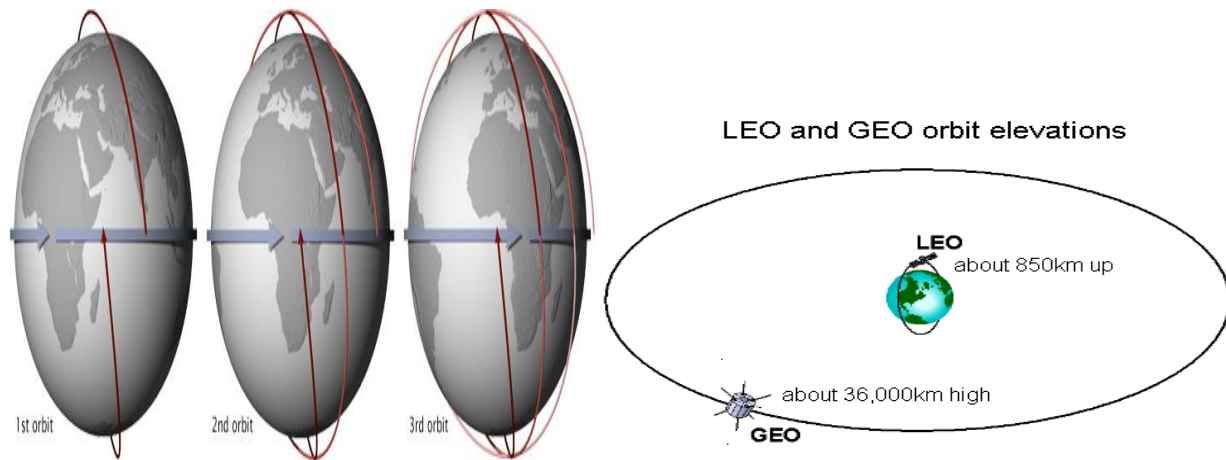


Remote Sensing is an exciting and expanding field within physical geography.

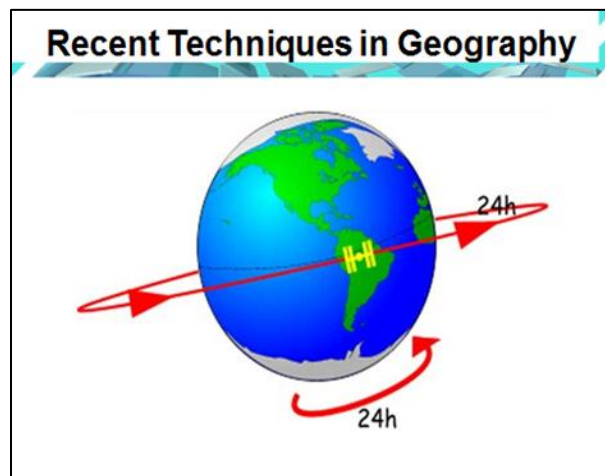
Topic - 43: Recent Techniques in Geography 6:

Remote Sensing

The Orbiting Earth Satellites which carry remote sensing systems, is become a major branch of geographic research. They can image and monitor large geographic areas or the entire Earth.



Medium Earth Satellites are smaller to LEO satellites in functionality. They have a larger coverage area than LEO satellites.



Remote Sensing:

It is the technology in which the information can be collected about any object on the surface or in the space without having any physical contact with that object is called remote sensing or RS.

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on site observation. Remote sensing is

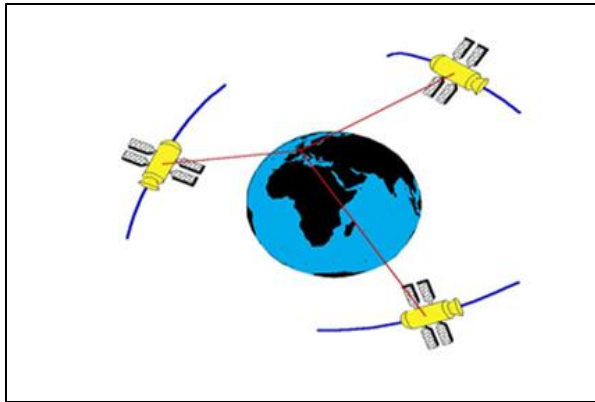
a sub-field of geography. In modern usage, the term generally refers to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation). It may be split into active remote sensing (when a signal is first emitted from aircraft or satellites) or passive (e.g. sunlight) when information is merely recorded.

Applications of remote sensing data:

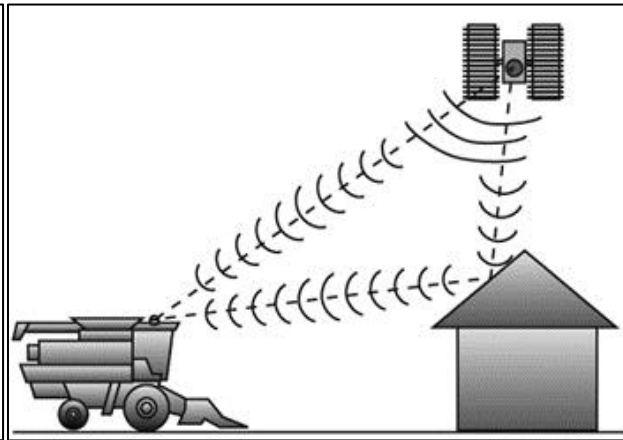
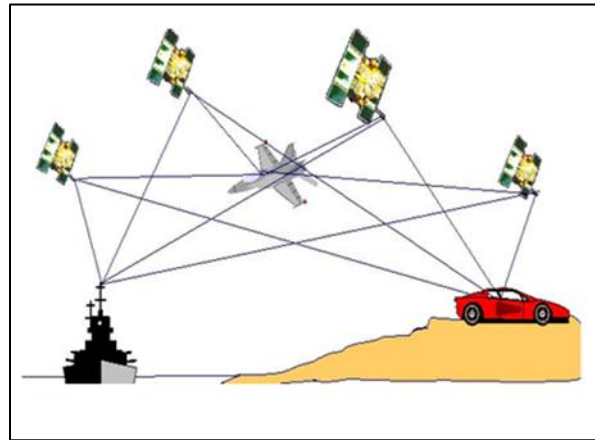
Remote Sensing has its applications in all the walks of life. A brief over view is described below:

- Conventional radar is mostly associated with aerial traffic control, early warning, and certain large scale meteorological data. Doppler radar is used by local law enforcements' monitoring of speed limits and in enhanced meteorological collection such as wind speed and direction within weather systems in addition to precipitation location and intensity. Other types of active collection include plasmas in the ionosphere. Interferometry is used to produce precise digital elevation models of large scale terrain.
- Laser and radar altimeters on satellites have provided a wide range of data. By measuring the bulges of water caused by gravity, they map features on the seafloor to a resolution of a mile or so. By measuring the height and wavelength of ocean waves, the altimeters measure wind speeds and direction, and surface ocean currents and directions.
- Ultrasound (acoustic) and radar tide gauges measure sea level, tides and wave direction in coastal and offshore tide gauges.
- Light detection and ranging (LIDAR) is well known in examples of weapon ranging, laser illuminated homing of projectiles. LIDAR is used to detect and measure the concentration of various chemicals in the atmosphere, while airborne LIDAR can be used to measure heights of objects and features on the ground more accurately than with radar technology. Vegetation remote sensing is a principal application of LIDAR.
- Radiometers and photometers are the most common instrument in use, collecting reflected and emitted radiation in a wide range of frequencies. The most common are visible and infrared sensors, followed by microwave, gamma ray and rarely, ultraviolet. They may also be used to detect the emission spectra of various chemicals, providing data on chemical concentrations in the atmosphere.
- Stereographic pairs of aerial photographs have often been used to make topographic maps by imagery and terrain analysts in traffic ability and highway departments for potential routes, in addition to modeling terrestrial habitat features.

Recent Techniques in Geography 7

Topic - 44:**Global Positioning System**

The Global Positioning System (GPS) is a satellite-based system that can be used to locate positions anywhere on the earth. The Global Positioning System (GPS) provides critical capabilities to military, civil, and commercial users around the world.



Pakistan is set to become the fifth Asian country to use China's domestic satellite navigation system.

Global Positioning System:

The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver.

If we discuss about the structure of GPS, it consists upon three primary segments i.e. Space segment, user segment and controlled segment.

Applications of GPS:

A brief over view of the application of GPS is outlined below:

- Astronomy: both positional and clock synchronization data is used in astrometry and celestial calculations. It is also used in amateur astronomy using small telescopes to professional's observatories, for example, while finding extra solar planets.
- Automated vehicle: applying location and routes for cars and trucks to function without a human driver.
- Cartography: both civilian and military cartographers use GPS extensively.
- Disaster relief/emergency services: depend upon GPS for location and timing capabilities.
- GPS-equipped radiosondes and dropsondes: measure and calculate the atmospheric pressure, wind speed and direction up to 27 km from the Earth's surface
- Radio occultation for weather and atmospheric science applications.
- Fleet tracking: the use of GPS technology to identify, locate and maintain contact reports with one or more fleet vehicles in real-time.

Recent Techniques in Geography:

The fields of Geography are not only limited to the old and traditional methods and techniques. A number of new developments are made in the field of Geography which placed Geography in the field of Sciences. These recent techniques not only facilitate the Geographers but also facilitate the common people at equal pace. The sphere of the application of these techniques is not only limited to the physical environment but also play an active role in the human environment as well. In the physical environment these techniques are used to monitor or investigate the physical or natural phenomenon happening in the natural environment while in the human environment these techniques are used to monitor the human activities in a specific region. These techniques are used to develop the different models to monitor the climatic pattern and climate shift while these recent techniques also play a mild stone in order to formulate the policies to tackle the situation. These recent techniques include the modern tools of surveying and the recent technologies like

Geographic Information System (GIS), Remote Sensing (RS), and Global Positioning System (GPS) etc. these techniques along with the brief description are elucidated below.

Geographical Field Work:

Geography is not the knowledge of myth or speculations but infect it deals with the systematic study and the personal observation of the surveyor or researchers. The researchers conducted under the discipline of Geography mainly of primary nature. So, in order to pursue the field work the researchers have to rely upon the effective techniques which provide him the accurate data.

Geographical field work means the personal observation about a specific phenomenon either that is physical in nature or human by nature after outgoing of the surveyor from the busy routine work. This field work may be either in temporal prospective or spatial prospective about a phenomenon.

The Geographical field work is described in two fundamental dimensions.

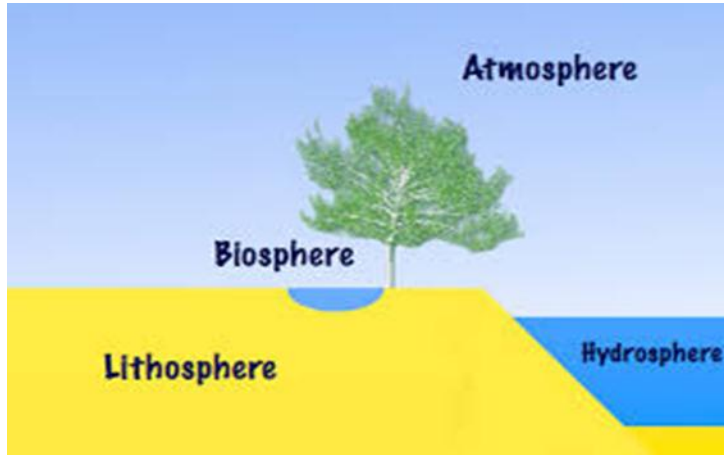
1. Field work in physical environment
2. Field work in Human environment

Field Work in Physical Environment:

This type of field work mainly relates with the monitoring of physical environment or the natural phenomenon occulating in space. These are conducted to monitor the temperature, rainfall pattern, moisture, wind speed etc. these phenomenon are monitored by employing different tools like Thermo-meter, Reengage, Annometer etc. This type of field work is purely scientific by nature. It is done for the purpose of developing a climatic model or interpolate about the upcoming weather conditions. This type of surveys are also conducted to explore the hidden natural reserves and geological by nature.

Lesson No. 15

Spheres of the Earth 01

Topic - 45:

The planet Earth is the only livable place for the human being. It consists upon different spheres which play a vital role in the prosperity of human-being. These sphere influence in all the walks of life i.e., from breathing to food and shelter. All the necessities of human-existence primarily depend upon these spheres. These are basically

the blessings of Almighty to our planet, which has increased its significance than its counterparts. These range from the bare soil to the large water bodies and from the water bodies to the atmosphere. The planet Earth is the only livable place for the human being. It consists upon different spheres which play a vital role in the prosperity of human-being. These sphere influence in all the walks of life i.e., from breathing to food and shelter. All the necessities of human-existence primarily depend upon these spheres. These are basically the blessings of Almighty to our planet, which has increased its significance than its counterparts. These range from the bare soil to the large water bodies and from the water bodies to the atmosphere. These are four in numbers i.e. Lithosphere, Hydro-sphere, Atmosphere and Bio-sphere. All of them are briefly described below.

Lithosphere

This is composed of rock structure like earth crust. This surface is composed of 29 % the total planet

Atmosphere

It is in the form of gases compositions most of the gases are very important for existence of life

Hydrosphere

Hydrosphere is covered by the water surface and about 70 % of the total earth is comprises of water. It comprises of salt water.

Biosphere

This is actually life over the surface of planet the life in the form of marine, human, plant and animal.

Lithosphere:

It is the outer most portion of earth surface. The word lithosphere is derived from the ancient Greek lithose meaning “rocky” and sphaira meaning “sphere” and It is the place where we live and do all our activities to grow food and to build houses for our existence. A lithosphere is the rigid outermost shell of terrestrial surface that is defined by its rigid mechanical properties. On Earth, it comprises the crust and the portion of the upper mantel that behaves elastically on time scales of thousands of years or greater. The outermost shell of a rocky planet, the crust, is defined on the basis of its chemistry and mineralogy. The land forms contain features- as mountains, hills, and plains provide varied habitats for plants, animals, and humans. The solid rock of the lithosphere bears a shallow layer of the soil in which the nutrients elements become available to organisms. The surface of the lithosphere is eroded into landforms.

There are two types of the Lithosphere on the basis of the chemical properties of the soil surface i.e. oceanic lithosphere and continental lithosphere.

- Oceanic lithosphere is associated with oceanic crust and exists in the ocean basins. Its mean density is about 2.9 grams per cubic centimeter.
- Continental lithosphere is associated with continental crust and its mean density is about 2.7 grams per cubic centimeter.

Importance of lithosphere in the Environment:

Lithosphere is the solid outer part of the earth. It is the place where we live and also play a significant role in the environment. These are outlined below:

- Suitable to live
- Agriculture and the growing f crops is possible

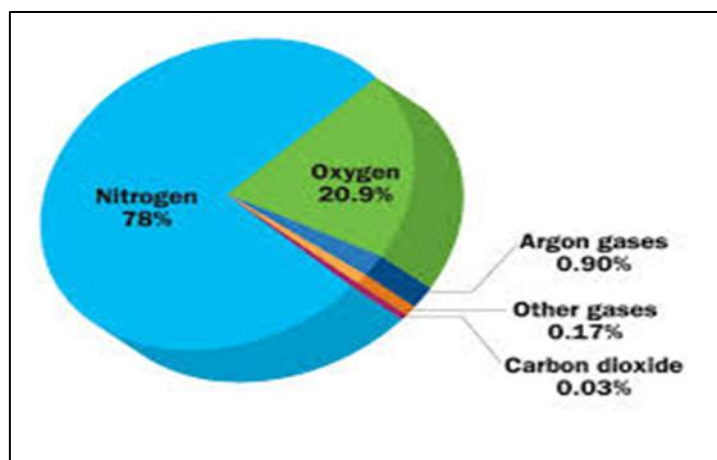
- Play a vital role in the prosperity of man
- Low temperature as compared to the other layers of Earth
- Rich in natural resources which are exposed at the time of volcanic eruption.
- It controls the stability of Earth crust

Environmental Problems of Lithosphere:

Besides of the positive role, there are also some environmental problems of lithosphere are:

- Soil degradation, erosion and pollution
- Deforestation
- Landslides and earthquakes
- Loss of agricultural land for nonagricultural purposes

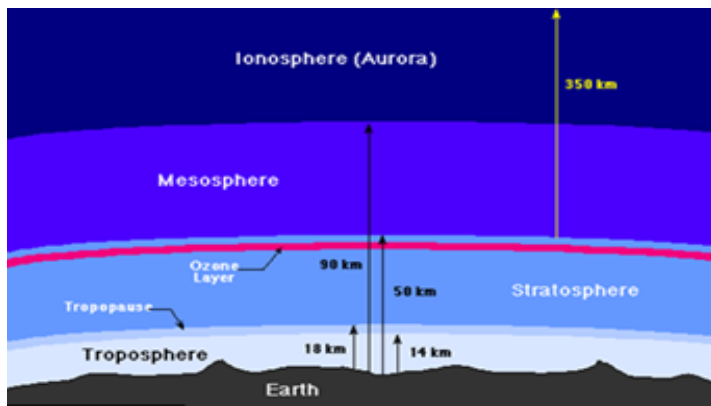
Topic - 46 : Spheres of the Earth 02:



Atmosphere

The Atmosphere is a thin, shell like envelope or shield composed of gases surrounding the planet Earth that is retained by earth's gravity. The atmosphere of earth is a layer of gases surrounding the planet Earth that is retained by earth's gravity.

The atmosphere absorbs ultraviolet solar radiation, warming the surface through greenhouse effect, and reducing temperature extremes between day and night (the diurnal temperature variations). The earth is the only planet where atmosphere is suitable for life. So the life sustainability is due to atmospheric condition. The atmospheric composition on Earth is largely governed by the by-products of the life that it sustains. Dry air from atmosphere contains 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.038% carbon dioxide, and traces of hydrogen, helium, and other "noble" gases (by volume), but generally a variable amount of water vapor is also present, on average about 1% at sea level.



Layers of the Atmosphere:

There are four major layers of Atmosphere i.e. Troposphere, Stratosphere, Mesosphere, Thermosphere.

Troposphere

This is the lowest atmospheric layer and is about seven miles (11km) thick. Most clouds and weather are found in the troposphere. The troposphere is thinner at the poles (averaging about 8km thick) and thicker at the equator (averaging about 16 km thick). The temperature decreases with altitude

Stratosphere:

The stratosphere is found from about 7 to 30 miles (11-48 kilometers) above the Earth's surface. In this region of the atmosphere is the ozone layer, which absorbs most of the harmful ultraviolet radiation from the Sun. The temperature increases slightly with altitude in the stratosphere. The highest temperature in this region is about 32 degrees Fahrenheit or 0 degrees Celsius.

Mesosphere:

The mesosphere is above the stratosphere. Here the atmosphere is very rarefied, that is, thin, and the temperature is decreasing with altitude, about -130 Fahrenheit (-90 Celsius) at top.

Thermosphere:

The thermosphere starts at about 55 kilometers. The temperature is quite hot; here temperature is not measured using a thermometer, but by looking at the motion and speed of the rarefied gases in this region, which are very energetic but would not affect a thermometer. Temperatures in this region may be as high as thousands of degrees.

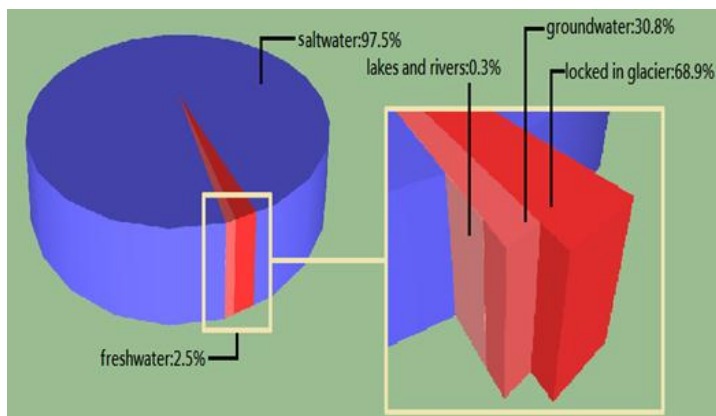
Exosphere:

The exosphere is the region beyond the thermosphere.

Importance of Atmosphere:

This sphere of physical environment of earth surface is equally important for the environment in following respects. From the perspective of the planetary geologist, the atmosphere is an evolutionary agent essential to the morphology of planet. The wind transports dust and other particles which erodes the relief and leaves deposits. Frost and precipitations, which depend on the composition, also influence the relief. Climate changes can influence a planet's geological history. Conversely, studying surface of Earth leads to an understanding of the atmosphere and climate of a planet — both its present state and its past. For a meteorologist, the composition of the atmosphere determines the climate and its variations. For a biologist, the composition is closely dependent on the appearance of the life and its evolution.

Topic 47: Spheres of the Earth 03:

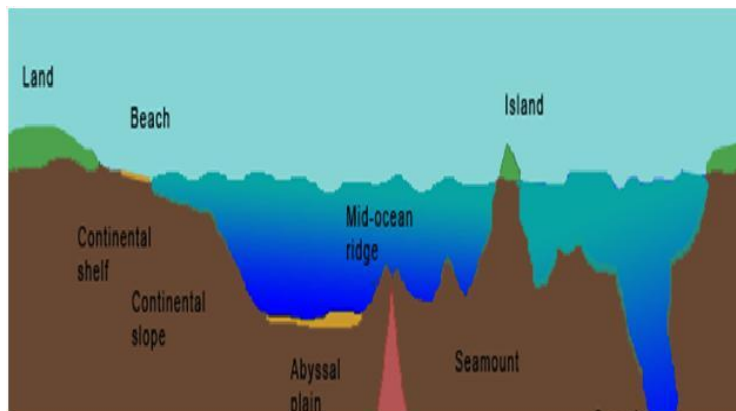


Hydrosphere

The hydrosphere includes the oceans, seas, lakes, ponds, rivers and streams. It is the portion of water surface over the surface of Earth. It covers about 71% of the total area over the planet. It considers all the water resources like, Atmospheric water resources, surface

water resources and ground water resources. It also includes the frozen and the liquefied state of water. It is the most pervasive and least well defined of the four spheres of Earth's physical environment. This includes water in liquid and frozen forms, groundwater, glaciers, oceans, lakes and streams. Saltwater accounts for 97.5% of this amount. Approximately 75% of the Earth's surface, an area of some 361 million square kilometers, is covered by ocean. Freshwater accounts for only 2.5%. Of this fresh water 68.9% is in the form of ice and permanent, snow cover in the Arctic, the Antarctic, and in the mountainous regions. 30% exists as fresh ground waters. Only 0.3% of the total amount of fresh waters is easily accessible. It is found in lakes, reservoirs and river systems. Freshwater accounts for only 2.5%. Of this fresh water 68.9% is in the form of ice and permanent, snow cover in the Arctic, the Antarctic, and in the mountainous regions.

30% exists as fresh ground waters. Only 0.3% of the total amount of fresh waters is easily accessible. It is found in lakes, reservoirs and river systems.



Components of Hydrosphere:

The major ingredients of hydrosphere are:

Surface water resources:

These water resources include oceans, rivers, lakes, swamps etc.

Atmospheric water resources:

These water resources consist upon the precipitation, humidity, thunderstorms, rainfall etc. it may be in the form of drizzles, water droplets or in snow form.

Ground water resources:

These are the more purified and the safe water reserves. These resources include aquifer and ground water table etc.

Importance of Hydrosphere:

Water is life. Human existence on the planet earth is impossible without of the sufficient quality and quantity of water. Hydrosphere overlaps all other three spheres of Earth's physical environment. For example, liquid water, ice and even water vapors occur in the soil and rocks of the lithosphere.

Water vapors and cloud particles composed of liquid water and ice are the important constituent of the lower portion of the earth's atmosphere. In the biosphere, water is critical component of every living organism of biosphere. Life is impossible without water and every living thing primarily depends upon the efficient quantity of water. It is necessary for plant kingdom and animal kingdom, the two major kingdom classifications of living organisms. Indeed, the total mass of every living thing is more than half water, the proportion ranging from about 60% for some animals, for some animals is about 95% and the human body consists upon about 97% of water. Some other importance of the hydrosphere for human-being is pinned point below:

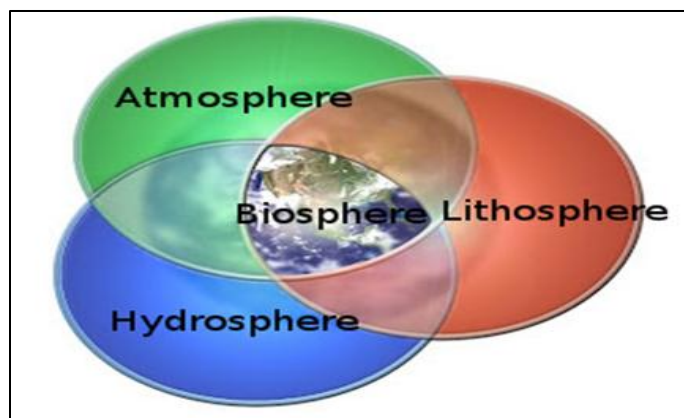
- It provides water for drinking.

- Water is also required for irrigation in rainfall deficit areas.
- Hydrosphere plays an important role in maintaining the global water cycle and bringing precipitation through the process of water cycle.
- Aquatic bodies play a great role in our ecosystem by supporting several aquatic floral and faunal lives.
- It acts as a global pollution sink, and dissolves several pollutants which are present in the atmosphere.

Topic - 48: Spheres of the Earth 04:

Biosphere

The Biosphere comprises of all living organisms of the earth. Life-forms on the earth utilize the gases of the atmosphere, the water of the hydrosphere, and the nutrients of the lithosphere. Most of the biosphere is contained in the shallow surface zone called the life layer. It includes the surface of the lands and the upper 100m or so of the ocean. On land, the life layer is the zone of interactions among the biosphere, lithosphere, and atmosphere, with the hydrosphere represented by rain, snow, still water in the ponds and lakes, and running water in rivers. In the ocean, the life layer is the zone of interactions among the hydrosphere, biosphere, and atmosphere, with the lithosphere represented by nutrients dissolved in the upper layer of sea water. Currently the biosphere has a biomass (or amount of living things) at around 1900 gigatonis of carbon. It is not certain exactly how thick the biosphere is, though scientists predict that it is somewhere around 12,500 meters. The biosphere extends to the upper areas of the atmosphere, including birds and insects



Zones of Biosphere:

Zones of Biosphere are divided into following three zones.

Core Zone:

In core or natural zone human activity is not allowed. This area is legally protected and undisturbed ecosystem.

Buffer zone:

It is the immediate surrounding area of core zone is buffer zone. Here limited human activities like research, education and research strategy is permitted.

Manipulation zone:

Manipulation or transition zone is the outermost or peripheral area of biosphere reserve. With the cooperation of reserve management and local people several human activities like settlements, cropping, recreation, and forestry are carried out without disturbing the environment.

Importance of Biosphere Reserve:

Some more important aspects of importance of Biosphere reserves are given below:

Conservation:

Biosphere reserves conserve genetic resources, species, ecosystems and landscapes without uprooting inhabitants. Rather the traditional life style and traditional resources of the local people are maintained.

Development:

Sustainable economic, cultural, social and ecological developments are ensured.

Restoration:

Biosphere reserve helps to rebuild any damage caused to ecosystems and habitats.

Education and Research:

Biosphere reserve provides a lot of scientific information for specific scientific studies and research. Exchange of information on restoration, conservation and development of biosphere can be made at national and international levels.

Lesson No. 16

Rocks

Topic – 49:

Minerals are naturally occurring inorganic substances, often with a crystalline structure. They are composed largely of the most abundant elements in the Earth's crust. Quartz is the second most abundant mineral in the earth's continental crust, after feldspar. There are many different varieties of quartz, several of which are semi-

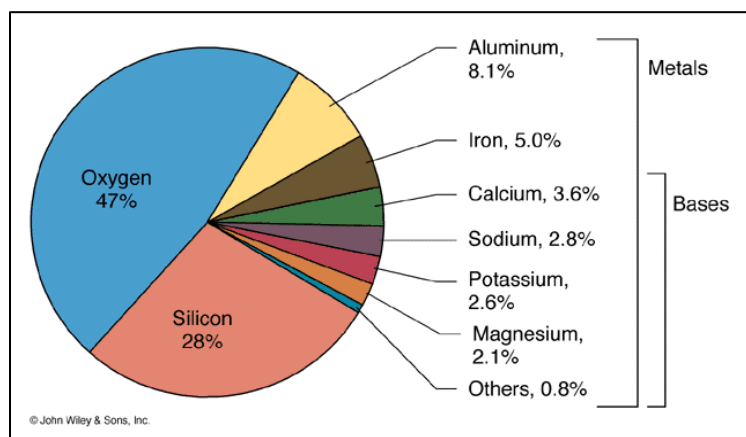
precious gemstones. There are over 4,900 known mineral species; over 4,660 of these have been approved by the International Mineralogical Association (IMA). The minerals compose over 90% of the Earth's crust. The diversity and abundance of mineral species is controlled by the Earth's chemistry. Silicon and oxygen constitute approximately 75% of the Earth's crust, which translates directly into the predominance of silicate minerals. Minerals are distinguished by various chemical and physical properties. Differences in chemical composition and structure distinguish various species, and these properties in turn are influenced by the mineral's geological environment of formation. Changes in the temperature, pressure, or bulk composition of a rock mass cause change in its minerals. But, for the substance to be considered as mineral, it must be:

- Solid by nature
- Naturally found in nature
- It should be inorganic
- It must have a specific chemical composition
- It should contain atoms arranged in a regular pattern to form solid crystals

Only about one-fourth of the elements are involved in the formation of minerals to any significant magnitude. These minerals are integrated to form rocks. The rock forming minerals can be grouped in to seven families on the basis of their chemical properties and internal structure. These families are outlined:

- Silicates

- Oxides
- Sulfides
- Sulfates
- Carbonates
- Halides
- Native Elements



As of April 2015, 118 elements have been identified, of these, only the first 98 are known to occur naturally on Earth. The remaining 20 heavier elements, not found today either on Earth or in astronomical spectra, have been produced artificially: these are all radioactive. Rock is a naturally occurring aggregate of one or more minerals. For example, the common rock granite is a combination

of the quartz and feldspar minerals. The Earth's outer solid layer, the lithosphere, is made of rock. Most rock in the earth's crust is extremely old, dating back many millions of years, but new rock is formed due to eruption of lava. Rocks have been used by mankind throughout history. From the Stone Age, rocks have been used for tools. The minerals and metals found in rocks have been essential to human civilization.

Topic - 50: Types of Rocks:

Rock of the earth's crust fall into three major classes:

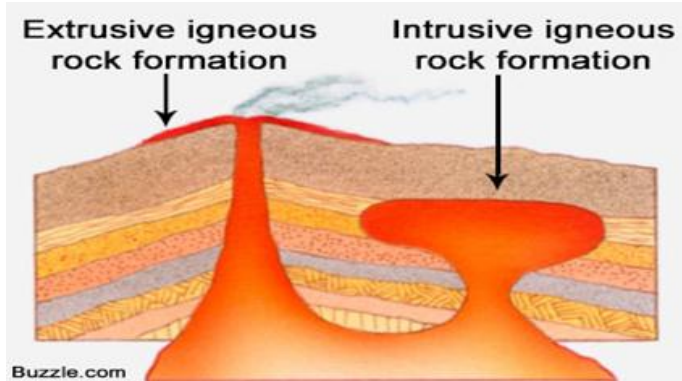
- Igneous Rocks
- Sedimentary Rocks
- Metamorphic Rocks



Igneous Rocks:

Igneous rock (derived from the Latin word igneous meaning of fire) forms through the cooling and solidification of magma or lava. This magma can be derived from partial melts of pre-existing rocks in either a planet's mantle or crust.

Typically, the melting of rocks is caused by one or more of three processes: an increase in temperature, a decrease in pressure, or a change in composition. These rocks are harder and are not easily eroded by the different factors like river, winds, waves etc. They are solidified from mineral matter in a high temperature molten state. Igneous rocks are formed when molten material moves from deep within the earth and solidified there or erupted from the earth's crust.



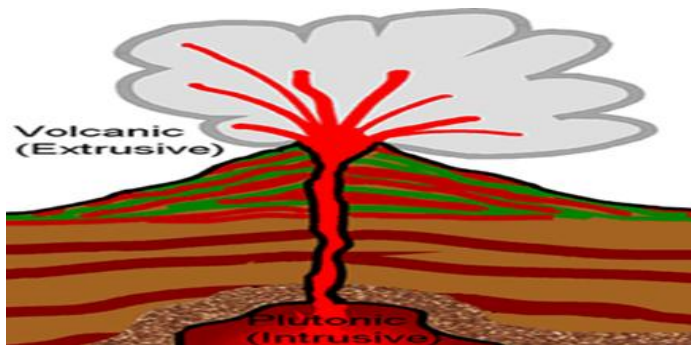
Types of Igneous Rocks:

There are two types of igneous rocks on the basis of nature of solidification of magma or lava. These two types are Intrusive igneous rocks or extrusive igneous rocks.

Intrusive igneous Rocks:

These rocks are also called plutonic rocks.

Plutonic or intrusive rocks result when magma cools and crystallizes slowly within the Earth's crust. A common example of this type is granite. Beneath the surface of earth the Magma can be solidified either in horizontal or vertical dimension i.e. sill and dyke.



Extrusive Igneous Rocks:

These volcanic rocks are formed on the surface of Earth, either from the cooling of lava or accumulation of pyroclastic material such as volcanic ash or cinder. When lava cools on the earth surface, the solidification may be completed within hours. So, the mineral crystals in many volcanic rocks are so small as to be

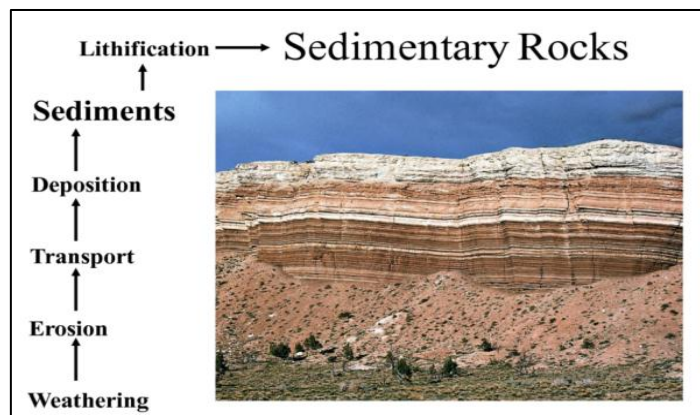
invisible without microscope. These rocks are also termed as volcanic rocks and the excellent examples are basalt, which consists upon only dark colored minerals, pumice is formed by the gas-rich material and tuff consists upon pyroclastic fragments. About 64.7% of the Earth's crust by volume consists of igneous rocks; making it the most plentiful category. Of these, 66% are basalts and gabbro, 16% are granite, and 17% granodiorites and diorites. Only 0.6% is senates and 0.3% peridotite sand dunites. The oceanic crust is 99% basalt, which is an igneous rock of mafic composition. Granites and similar rocks, known as meta-granites, form much of the continental crust. Over 700 types of igneous rocks have been described, most of them having formed beneath the surface of Earth's crust. These have diverse properties, depending on their composition and the temperature and pressure conditions in which they were formed. In some special circumstances host important mineral deposits (ores): as tin and uranium are commonly associated with granite and diorite, whereas ores of chromium are commonly associated with gabbro.

Topic - 51: Sedimentary Rocks:



The mineral particles in sedimentary rocks can be derived from the preexisting rock of any of three rock classes as well as from newly formed organic matter. These rocks are formed from layered accumulations of mineral particles derived mostly by weathering and erosion of preexisting rocks. So these rocks have stratification or layered structure. External processes i.e. mechanical or chemical

operating on the rocks cause to disintegrate. This disintegration produces fragmented material some of which is removed by the water, winds, ice, or the combination of these geomorphic agents. These disintegrated particles are taken away by these geomorphic agents from their place of origin and are deposited anywhere else. In this way the same process is repeated from many years and accumulation of these particles resulted into the formation of sedimentary rocks. It is soft as compared to the igneous rocks.



There are three major classes of sediment.

1. Clastic sediment.
2. Chemically precipitated sediment.
3. Organic Sediment.

Clastic Sedimentary Rock:

The fragments of pre-existing rocks or minerals that make up a sedimentary rock

are called clasts. Sedimentary rocks made up of clasts are called clastic (clastic indicates that particles have been broken and transported). Clastic sedimentary rocks are primarily classified on the size of their clasts.

Non clastic sedimentary Rocks:

These sedimentary rocks occur when minerals / mineraloids are precipitated directly from water, or are concentrated by organic matter / life. Components have not been transported prior to deposition. No clasts are present.

Chemical precipitated sediment:

Many of these form when standing water evaporates, leaving dissolved minerals behind. These are very common in arid lands. Where seasonal “playa lakes” occur in closed depressions. Thick

deposits of salt gypsum can form due to repeated flooding and evaporation over long periods of time.



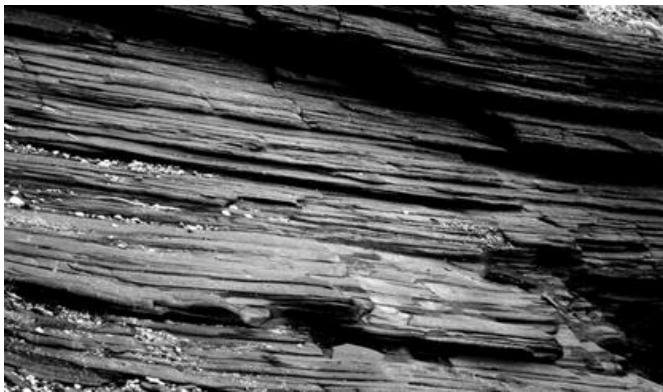
Organic Sediment:

Organic sediment is any accumulation of sedimentary debris caused by organic processes. Many animals use calcium for shells, bones, and teeth. These bits of calcium can pile up on the seafloor and accumulate into a thick enough layers to form an "organic" sedimentary rock.

Hydrocarbon compounds:

Hydrocarbon compound in sedimentary rocks are important because they provide an energy resource or fossil fuels on which modern human civilization depends

Topic - 52: Metamorphic Rocks:



All rock have under gone chemical or physical changes, either by heat, pressure or both to cause degree of alteration and modification of the rock. Metamorphic rock changed in texture and structure as classified into new rock. Recrystallization of the original minerals can also occur. Metamorphic rocks are originally either sedimentary or igneous rocks that have been drastically changed by heat or pressure.

Metamorphic rocks are formed by subjecting any rock type, igneous or another older metamorphic rock to different temperature and pressure conditions than those in which the original rock was formed. This process is called metamorphism; meaning to "change in form". The result is a profound change in physical properties and chemistry of the stone. The original rock, known as the protolith, transforms into other mineral types or other forms of the same minerals, by recrystallization. The temperatures and pressures required for this process are always higher than those found at the Earth's surface: temperatures greater than 150 to 200 °C and pressures of 1500 bars. Metamorphic rocks compose 27.4% of the crust by volume.

Igneous or sedimentary rocks may be altered by the tremendous pressure and high temperatures that accompany the mountain-building processes of the earth's crust. And the resulting structure is called metamorphic structure.

Contact Metamorphism:

This type of metamorphism occurs beneath the surface of Earth where magma comes in contact with the surrounding rocks and alters the chemical or physical characteristics through heat or pressure due to mutual contact.

Regional Metamorphism:

It takes place where the large volume of rock deep within the crust is subjected to heat and pressure for long periods of time.

Lesson No. 17

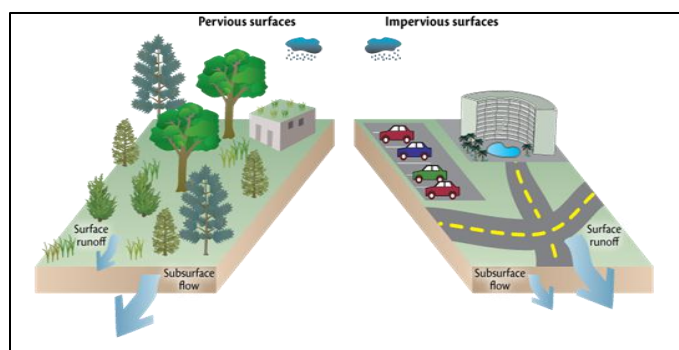
Economic importance of rock

Topic – 53:

Rocks are the natural asset which is deposited for the welfare of mankind. The important minerals and rocks are used in all the spheres of human life i.e. from construction to business. Rocks are also important in the making of many objects, such as plates, jewelry and toothpaste. Most houses are also built of materials obtained from rocks. Some of the most valuable rocks used in the manufacturing of items include graphite, slate, limestone, gypsum and pyrite. These types of rocks help in the production of stationery and the building of houses. Coal, which is an organic rock made mainly from plant materials, has various uses. It can be used in the production of gas, and its residue is used in making plastics and several synthetic materials.

**Soil:**

The old rocks have thin, poor soil, while the younger rocks in the volcanic areas tend to develop a deeper, more workable soil.

**Water Supply:**

Water is greatly affected by the nature of the rock. All the circulations of the water over the earth's surface are affected by the rocks.

**Fossil fuel:**

Fossil fuel is a general term for buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years.

Topic - 54: Economic importance of rock:



Building materials:

Limestone, granites, and sandstone are all of economic value and are used for building houses. Roofing slate is obtained from fine grained metamorphic rocks.

Ornamental stones:

The hard, brittle and crystalline minerals found in rocks especially in metamorphic and igneous rocks, as schist and mica.



Salts:

There are economic deposits of salts in various parts of the world, like in Khewara, Salt range, Pakistan. Others are phosphate, soda ash, sea salts and rock salts.



Metallic ores Metals:

They are found usually in forms of ores as iron ore, copper, and gold. In Pakistan Sendek and Reko Dig reserves are rich in copper, gold and many other metallic ore and metals

Most elements occur in combination with other elements. Rock mining provides employment opportunities for casual

workers, especially in places where formal jobs are difficult to find. Rocks contribute greatly to the economy of a country or region where they are found. Rocks are also used in the medicine industry. Bismuth is helpful for people with stomach upsets, while silver is used in the manufacturing of dental equipment.

Lesson No. 18

Land forms and Landscapes**Topic – 55:**

It is a specific geomorphic feature on the surface of the earth, ranging from large-scale features such as plains, plateaus, and mountains to minor features such as hills, valleys, and alluvial fans. Landforms are the single type of physical feature on the earth surface. For example, mountainous landforms, desert landforms etc. while the landscape is

the term which is used for the combination of different land forms. Landscape is of two types: cultural landscape and natural land scape. Cultural landscape includes the human environment and manmade constructions while the natural landscape includes the natural features. For example, if there are mountains and plain areas are present at a specific region then it will be termed as natural landscape.

Types of Landforms:

There are two types of landforms, which are categorized on the basis of forces which play a vital role in their genesis.

Primary landforms:

The Primary landforms are produced by endogenic processes or internal forces. They produce initial or primary landforms. Tectonic and volcanic processes bring fresh rock to the earth's surface. These landforms are formed beneath the surface and are not influenced by the erosional process of geomorphic agents. These are formed due to the endogenetic forces i.e. plate tectonic and volcanism.

Secondary land forms:

The secondary landforms are producing exogenic processes. These processes work at the earth's surface. They lower continental surfaces by removing and transporting mineral matter. The

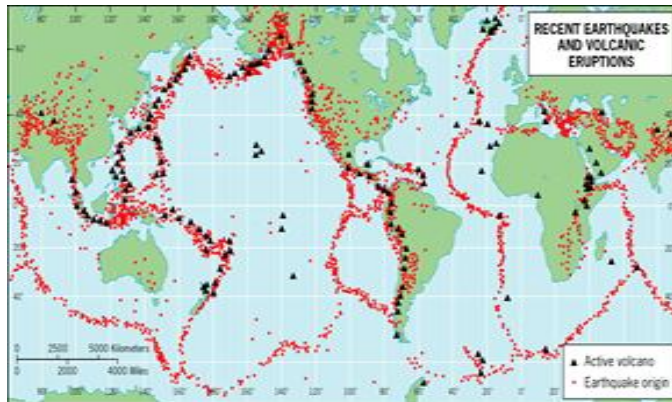
secondary landforms are also called sequential landforms. They are produced by running water, waves and currents, glacial ice, and wind.

Difference between primary and secondary landforms:

The earth is made of a series of primary landforms that are eroded giving way to secondary landforms. A primary landform is that in which is untouched by erosion, created by tectonic activity, they lay in wait for erosion to shape them into something else. A secondary landform is a primary landform that has been shaped by erosion over time. An example of this could be a mountain, which was formed originally through tectonic activity, but over time has been eroded into a different shape than it primarily was; it has been rounded, carried away, and through isostasy raised. Another example could be a syncline of soft sediment that over time is shaped into a valley. This picture is of me on Sulfur Mountain, which once was a primary form, and now is a secondary form.

Forces responsible for the genesis of Landforms:

There are two types of forces which play a significant role in the formation of landforms. These are discussed on the basis of their area of influence. These are of two types, endogenic and exogenic forces.



Endogenic forces: The sphere of influence of these forces is beneath the surface of earth. The best examples are plate tectonic, volcanism and Earth Quake.

Exeogenic Forces:

These are the geomorphic forces which has the potential to deform the surface by

influencing the lithosphere. The sphere of influence of these forces is upon the surface instead of interior of the earth. The examples of exogenic forces are, rivers, winds, glaciers and coastal waves and tides.

Erosional landform:

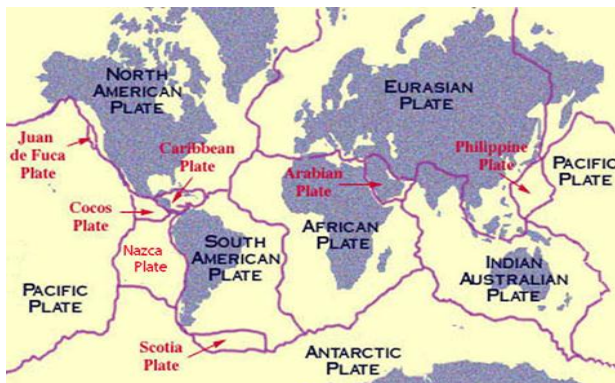
This type of landform is formed due to the process of erosion in which the weathered material is displaced from their source of origin to another place. The land forms due to wind blow in desert area are shown by the following diagram:



The Exogenic processes wear down initial landforms to create sequential landforms.

Topic – 56: Plate Tectonic:

The science of lithospheric plate motions is called plate tectonics. Tectonic plates are composed of thin oceanic and thicker continental lithosphere. The continental plate is lighter one as compared to the oceanic plate. Oceanic plate is called oceanic crust whereas continental plate is called the continental crust. Oceanic crust is denser than the continental crust. Plate tectonics is the theory as the outer rigid layer of the earth is divided into a couple of dozen "plates" move around across the earth's surface relative to each other, like slabs of ice on a lake. Prominent mountain masses and mountain chains are created either by extensional tectonic activity or by compressional tectonic activity.



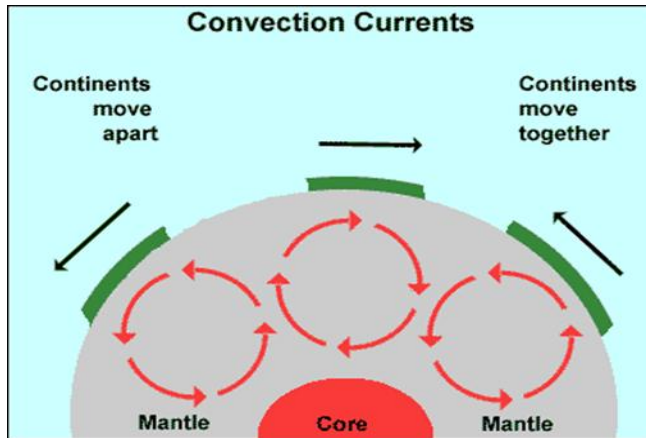
Major Tectonic Plates:

Following are the seven major plates which form the earth crust and the remaining surface area is accounted for much smaller plates.

- Pacific Plate – 103,300,000 km²
- North American Plate – 75,900,000 km²
- Eurasian Plate – 67,800,000 km²
- African Plate – 61,300,000 km²
- Antarctic Plate – 60,900,000 km²
- Australian Plate – 47,000,000 km²

- South American Plate – 43,600,000 k

Most plate occurs within the ocean while some are marked by the mountain belt such as Himalayas. The continents are gradually moving towards each other and steadily moving towards each other. In doing so the continents have been shuffled around oceans have been opened and closed and



mountains and volcanoes have been formed.

Conventional currents are responsible for the movement of the earth lithospheric plates. Hot mantle is thought to be rise cool and then move in a circular motion. Now this is one of the movements of the plates. This shows that the earth surface is covered with certain areas which are under the formation of the landforms and these landforms are created because of the certain forces.

Topic – 57: Plate tectonic theory:

According to this theory, Earth Quake is occurred due to the movement of plate tectonics beneath the surface of Earth. This movement is of three types, convergence, divergence or lateral movement. Plate tectonics is a scientific theory that describes the large-scale motion of Earth's lithosphere. This theoretical model builds on the concept of continental drift which was developed during the first few decades of the 20th century. The geo scientific community accepted the theory after the concepts of seafloor spreading were later developed in the late 1950s and early 1960s.

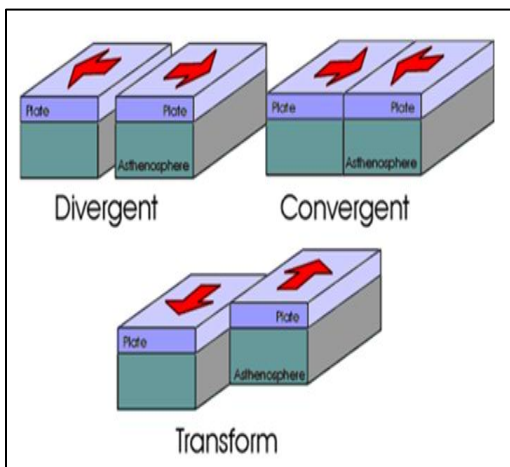


Plate Tectonic Movement:

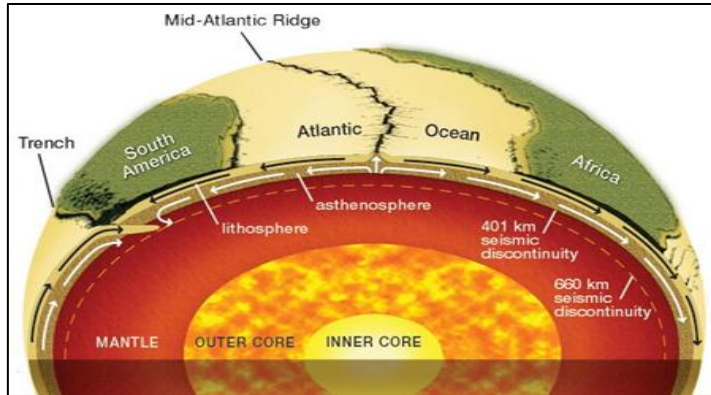
There are three types of Plate tectonic boundaries are observed by the Geologists.

Convergence:

In this type of movement, plates move towards each other.

Divergence:

In this type of movement, plates move away from each other.



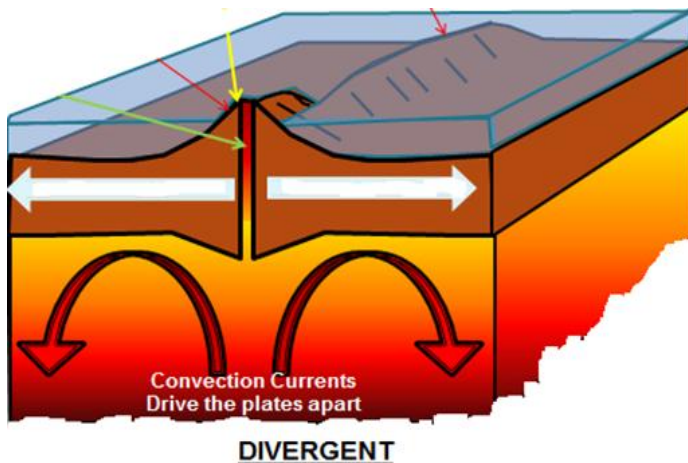
Transform movement:

In this type of movement plates move parallel to each other but collision is not possible. The activity that occurs when two tectonic plates interact with each other can have a major impact on the landscape of the Earth. Although the process can take millions of years, the landforms that are formed in this way

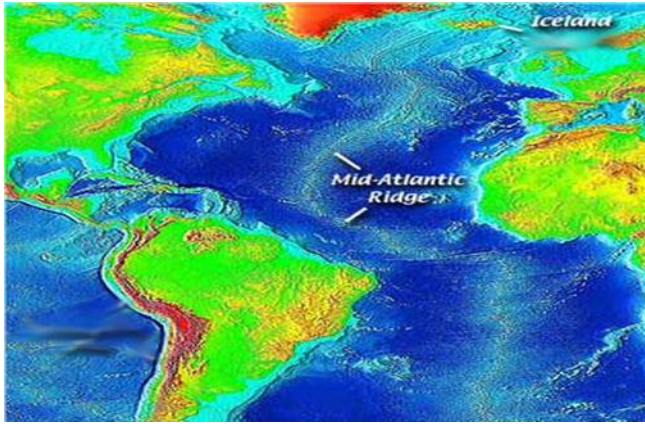
are some of the most impressive. The earth tectonic plates are known to be in constant motion shifting by up to fifteen cm each year. However the mechanism that causes them to move has been hotly debatable. Some scientists have argued that organized convection cell in the mantle move the tectonic plates. The relatively cool tectonic plate's lithospheric plates are underlying by mantle rock that is hot enough to flow.



Radio telescopes are helping to provide data about the movement of the tectonic plates. The two stations are located on separate plates so the relative plate motion can be determined.



There are three main types of boundaries. Plate growth occurs at divergent boundaries while plate consumption occurs at convergent boundaries which are marked deep ocean trenches. Divergent and convergent boundaries form 80% of the plates whereas the remaining are called as transform boundaries. When the two plates are moving away other the hot material move upward and create the landform which is today called volcanoes.

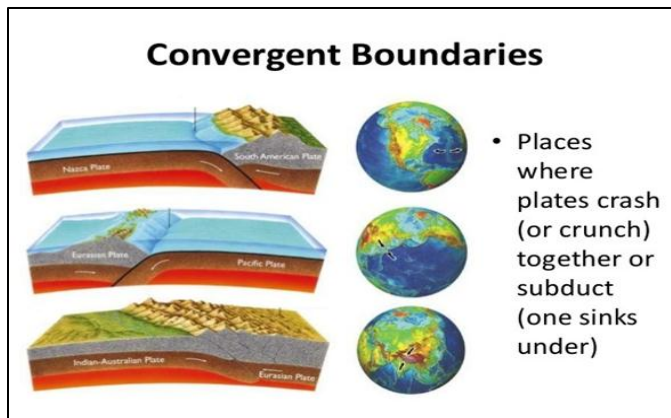


Ocean Ridges

On divergent boundaries, plates move away from each other, creating a new crust as magma is pushed up from the mantle. The movement of the tectonic plates transports the newly formed crust away from the crest of the ridge in both directions. The underwater mountain range known as the Mid-Atlantic Ridge is an example of this. The Mid-Atlantic Ridge spreads at an average rate of 2.5

centimeters each year, having resulted in thousands of kilometers of plate movement and creating the mountains that exist today over the course of millions of years.

Topic - 58: Plate Tectonic Theory:

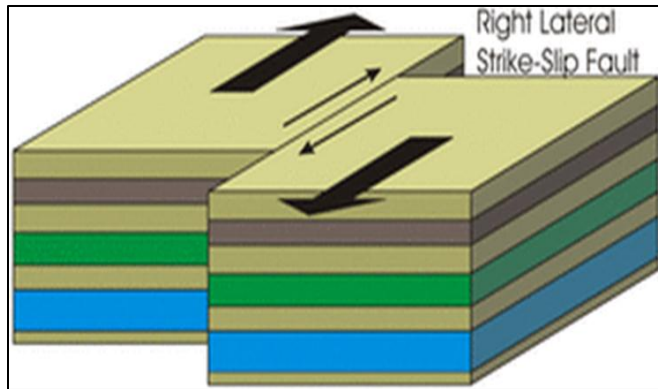


When plates move towards one another continental crust is thicker than the oceanic crust. The subduction process that occurs when an oceanic plate converges with another oceanic plate can lead to volcanoes being formed. The volcanic debris and lava build up on the ocean floor over millions of years and eventually results in a submarine volcano rising above sea level to create an

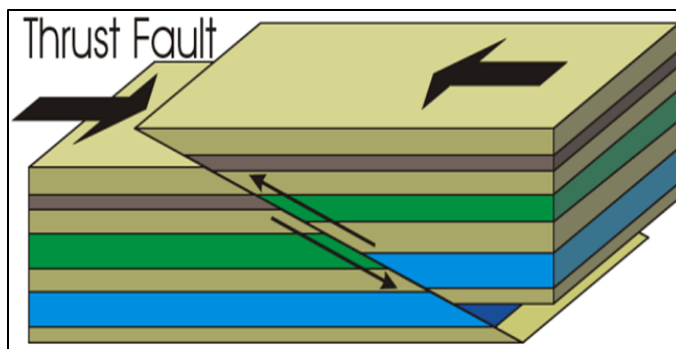
island. A curved chain of these volcanoes usually occurs in these cases, known as island arcs. The magma that forms these arcs is a result of the descending plate or the overlying oceanic lithosphere melting partially. Six of the seven largest plates are predominantly continental, but the largest of all, the Pacific plate is oceanic. It means most of the plates are continental plates.

Topic – 59: Plate Tectonic Theory:

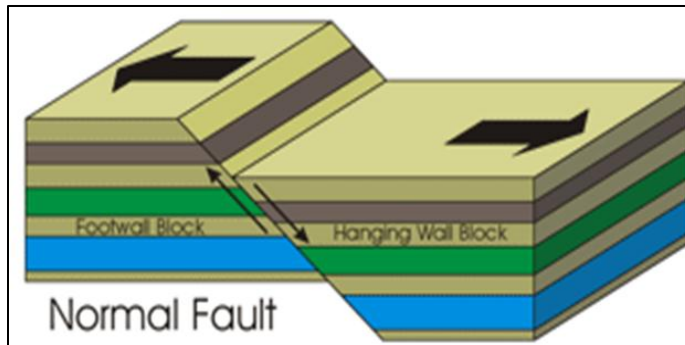
The third most important boundary is the lateral or transform. In this type the horizontal sliding movement across the boundary occurs. Most of the area of the earth is under the divergent or convergent zone. The red are shows where we have divergent. The black color are consists of convergent plate boundary. The transform plates are mostly on the small tectonic plates.



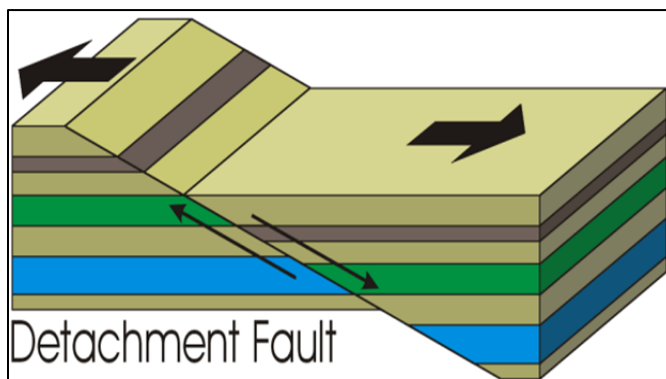
Most transform forms are hidden in the deep oceans where they form a series of zigzag accommodating sea spreading. The most important feature which exist in the transform fault is the right lateral slight slip fault. So when the two plates are moving parallel to each other some plates are in high speed while some are in low speed. So here we have the formation of the slight slip fault.



A thrust fault is a type of fault or break in the earth crust in which there has been relative movement. In which rocks of the lower static position are pushed up.



In normal fault the hanging wall has moved downward relative to the foot wall. Normal fault occurs where two blocks of rocks are pulled a part as by tension.



Detachment faulting is associated with the large scale divergent. It often has a very large displacement even tens of km. they are found close to divergent boundary.

Lesson No. 19

Volcanic Activity

Topic – 60:

The Primary landforms are also produced by volcanic activities and bring fresh rock to the earth's surface. The volcanism is a typical volcanic system is based around a central "plumbing" network that transfers magma from its crustal chamber to the surface. The earth's volcanoes occur because its crust is broken into dozen of major and minor tectonic plates those float on a hotter, layer mantle. So they are generally found where tectonic plates are diverging or converging.

Volcanism is the process of which magma molten rock from inside the earth rises through the earth's crust onto the surface. Magma chambers within the crust are created by isolated or localized melting and upward migration of partially molten rocks or crust or mantle rock magma travels from the chamber up to the Earth surface either through features or fractures in the crust or by melting a path surrounding the rock. Volcanic products include gas, ash and fragmented rocks. These can pour gently out onto the earth's surface or be blasted through the atmosphere to be spread globally by high level winds.

Cross section of volcano

A volcano has many characteristics such as:

- **Main vent** this is the source of molten lava
- **Layers of ash and lava** fragments of lava or rock smaller than 2mm in size that are blasted into air by volcanic explosion
- **Lava flow** molten rock that erupts from a volcano that solidifies as it cools
- **Crater** this is airborne material from the volcano
- **Eruption cloud** a cloud of Ash formed by volcanic explosion
- **Secondary cone** entrance of volcano, the part of conduct that ejects lava and volcanic ash

- **Magma chamber** feeds the volcano from the interior of the earth crust or lithosphere or from coming the asthenosphere or upper part of the mantle.

Types of volcanoes

- 1) **Active Volcanoes** have been in continuous eruption for decades. For example mount St. Helens in United states, Etna and Stromboli have been erupting for hundreds or thousands of years
- 2) **Extinct Volcanoes** are those that scientists consider unlikely to erupt again, because the volcano no longer has a lava supply. Edinburgh castle in Scotland is located atop an extinct volcano
- 3) **Dormant Volcanoes** are the volcanoes that are quiet, but might possibly erupt again. A dormant volcano is sleeping, but it could awake in the future. For example Mauna Kea in Hawaii in United states, Mount Edziza, Mount Kilimanjaro in Tanzania.

Topic – 61: Volcanic Activity-2:

Volcanic Activity

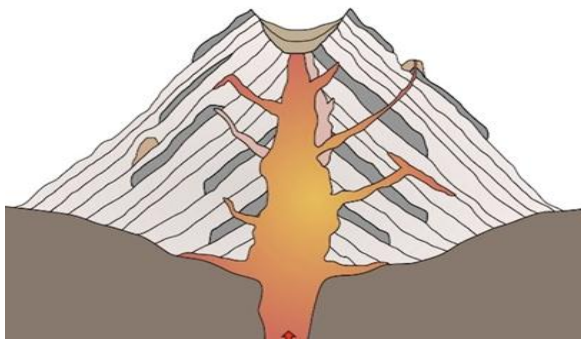
The volcanic material erupted at the surface varies according to the properties of the magma. So type of material controls the types of volcanoes or volcanism.



Shield Volcanoes

These are large, broad volcanoes that look like shields from above – hence the name. The lava that pours out of shield volcanoes is thin, so it can travel for great distances down the shallow slopes of the volcano. These volcanoes build up slowly over time, with hundreds of eruptions, creating many layers. They're not likely to explode catastrophically. Perhaps the best known shield

volcanoes are the ones that make up the Hawaiian Islands, especially Mauna Loa and Mauna Kea.



Composite Volcanoes

Composite volcanoes or strata volcanoes make up some of the world's most memorable mountains: Mount Rainier, Mount Fuji, and Mount Cotopaxi, for example. These volcanoes have a conduit system inside them that channels magma from deep within the Earth to the surface. They can have clusters of vents, with lava breaking

through walls, or issuing from fissures on the sides of the mountain. With all this material coming

out, they can grow thousands of meters tall. As we've seen with the famous Mount Saint Helens, composite volcanoes can explode violently.



Lava Domes

Volcanic or lava domes are created by small masses of lava which are too viscous (thick) to flow very far. Unlike shield volcanoes, with low-viscosity lava, the magma from volcanic domes just piles up over and around the vent. The dome grows by expansion of the lava within, and the mountain forms from material spilling off the sides of the growing dome. Lava domes can explode violently, releasing a huge amount of hot rock and ash.



Cinder Cone Volcanoes

These are the simplest type of volcano. They occur when particles and blobs of lava are ejected from a volcanic vent. The lava is blown violently into the air and the pieces rain down around the vent. Over time, this builds up a circular or oval-shaped cone, with a bowl-shaped crater at the top. Cinder cone volcanoes rarely grow larger than about 1,000 feet above their surroundings.

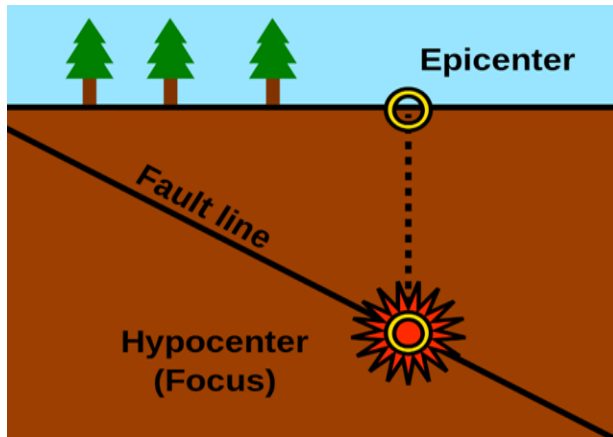


Clara Volcanoes

It is a dangerous form of volcanism. A Clara is a broadly circular depression forms when a volcanoes magma chamber depleted and spot of over lying rock is removed. The shape and size of the volcanoes is controlled by the chemical composition of the material and gas contents.

The global distribution of volcanoes relate to the earth's tectonic plates. About 80% of volcanoes occur at convergent plate boundaries, 5% occur at divergent boundaries.

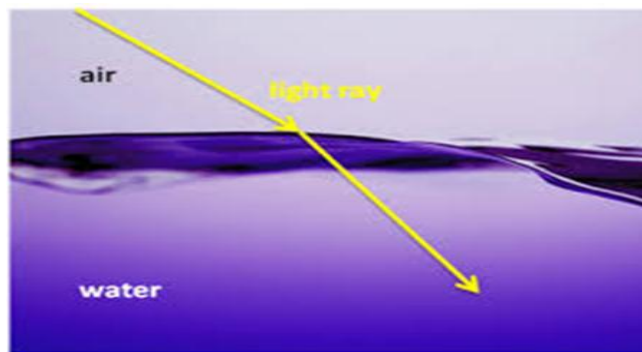
Topic – 62: Earthquake:



An earthquake is the shaking of the surface of the Earth, which can be violent enough to destroy major buildings and kill thousands of people. This shaking sometimes causes displacement of the ground. The word earthquake is used to describe any seismic event — whether natural or caused by humans — that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An

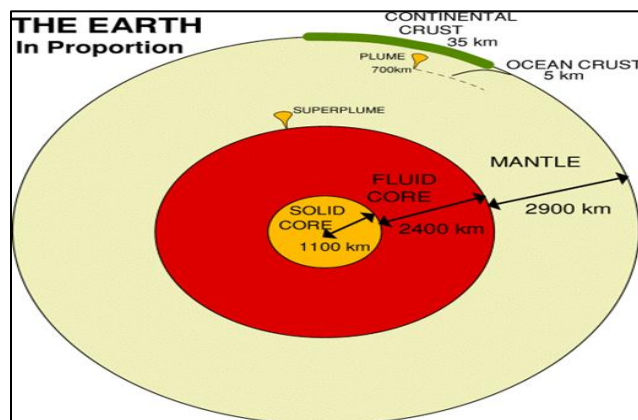
earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter. The world's most important earthquake zones are located in and around the boundaries of the tectonic plate boundaries. As the Pacific ring, Trans-Eurasian belt and the Mid Oceanic ridges.

Topic – 63: Earthquake:



Seismic waves are waves of energy that travel through the Earth's layers, and are a result of an earthquake. Seismic waves are studied by geophysicists called seismologists. Seismic wave fields are recorded by a seismometer, hydrophone (in water), and the propagation velocity of the waves depends on density of the medium. Velocity tends to increase with depth.

The layers of the earth are as shown below:

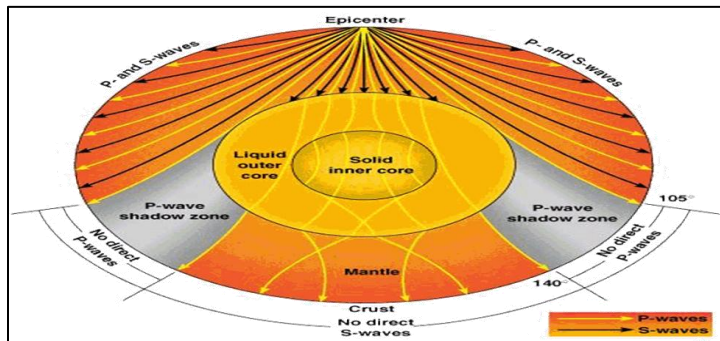


The temperature of the earth is thought to be around 4700 degree Celsius. Heat is convected through an overlying outer core of the liquid mantle to the base of the mantle where the temperature is around 3500 degree Celsius. At such temperature the rocks would normally be molten but the immense pressure keeps the rocks of the mantle solid. However the heat from the core causes the rock of the mantle shifting by just a few cm a year and convecting heat away from the core as they do so. Hot

mantle rocks slowly rise towards the surface cooling and becoming denser until they sink back to form a convection cell. Top of the cell coincide with the base of the cool and brittle outer lithosphere. Surface waves travel along the Earth's surface. They travel more slowly than seismic body waves which are P waves and S waves.

Topic – 64: Earthquake Waves:

Among the seismic waves there are three types of Earth Quake waves, i.e. S waves, P waves and surface waves. “S” waves are also called shear or shake waves and these waves can pass through the solid part of inner core while “P” waves cannot pass through solid particles but has the potential to pass through the liquid while surface waves can pass through both solid and liquid medium.

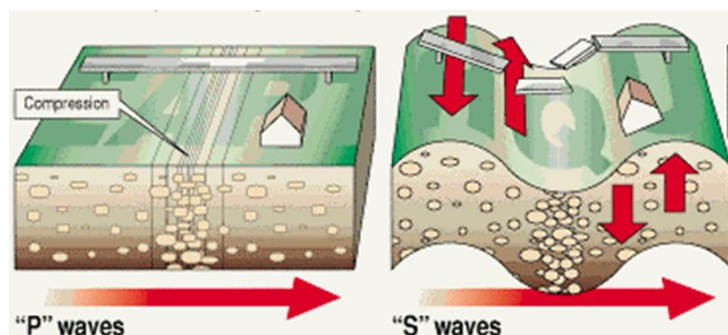


Among the many types of seismic waves, one can make a broad distinction between body waves and surface waves.

- Body waves travel through the interior of the Earth.
- Surface waves travel across the surface. Surface waves decay more slowly with distance than do body

waves, which travel in three dimensions.

- Particle motion of surface waves is larger than that of body waves, so surface waves tend to cause more damage.



P waves and S waves are different because of their motion. P waves are compressional. They can travel at the speed twice the speed of the S waves. S waves are transverse in nature. They have speed nearly 60% of the P waves.

Topic – 65: Earthquake in Pakistan:

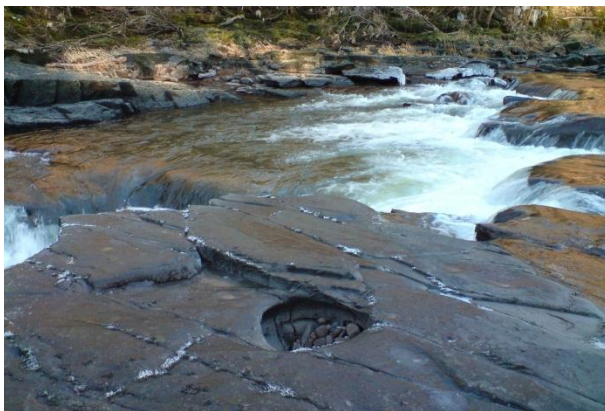
Pakistan geologically overlaps both with the Indian and the Eurasian tectonics plates where it's Sindh and Punjab provinces lie on the North-western corner of the Indian plate. The Baluchistan province and most of the Khyber-Pakhtunkhwa lies within the Eurasian plate. In 2013 over 350 people have been killed in an earth quack which struck southwest of awaran, Baluchistan, Pakistan. Over 300 thousand people were affected. Pakistan is an earthquake prone country. A number of earthquakes have hit Pakistan resulting in losses of life and property. Pakistan Meteorological Department (PMD) presently has a network of eleven seismic stations. By using recorded data the seismicity and zoning maps of Pakistan have been developed by PMD

Lesson No. 20

River Action**Topic – 66:**

Flowing water is continuously reshaping the landscapes and its erosional and depositional work create different land forms over the earth surface. Three stages of the river are U stage, V stage, delta stage. Waterfalls are found in the upper course of a river. They usually occur where a band of hard rock lies next to soft rock. They may often start as rapids. Waterfalls develop when a change of lithology (rock type) takes place along the river's course resulting in

differential erosion. When the rock type of the river's channel changes from a resistant rock to a less resistant one (e.g. granite to limestone), the river erodes the less resistant rock faster producing a sudden drop in the gradient of the river with the resistant rock being higher up than the less resistant rock. As the river flows over the resistant rock, it falls onto the less resistant rock, eroding it and creating a greater height difference between the two rock types, producing the waterfall. Braided channel formed when the river is split into several channels separated by islands. This feature is developed with large loads of sand and gravel. It is mostly occur when a river has variable discharges.

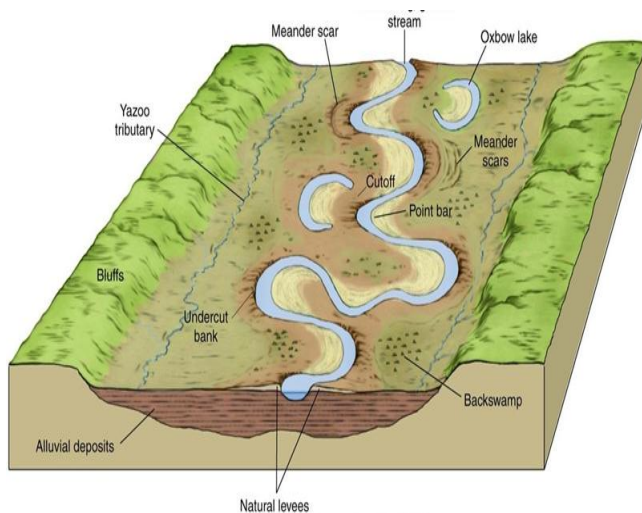
Topic – 67: River Action:

The landforms made by the rivers have three stages. First stage is called the youth stage, second stage is called mature stage, and third stage is called old stage. An alluvial fan is a cone shaped deposit of sediment built up by streams. If a fan is built up by debris flows it is properly called a debris cone. When water has the high volume it is actually flowing from the northern area to the south of Pakistan.

Rapids are sections of a river where the gradient of the river bed is relatively steep resulting in an increase in the river's turbulence and velocity. They form where the gradient of the river is steep and the bed is composed mainly of hard rocks.



Oxbow lakes are an evolution of meanders that undergo extensive deposition and erosion. Strong erosion takes place on the outside bend of a meander while deposition takes place on the inside bend. As a result, the neck of a meander narrows. During extremely high discharge (e.g., a flood), it's more efficient for a river to flow across the neck of a meander rather than around it. When discharge returns to normal levels, the river continues to follow this new course.

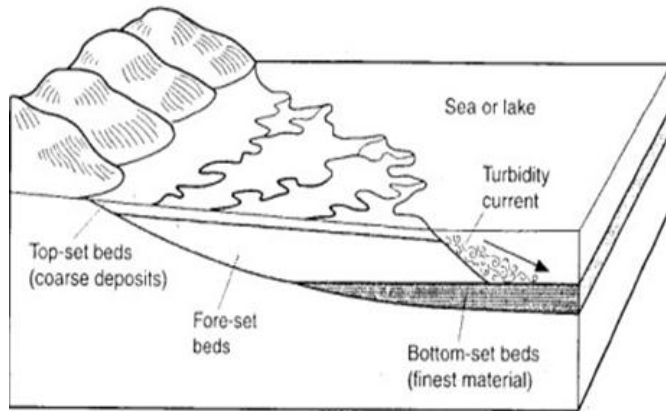


Floodplains are large, flat expanses of land that form on either side of a river. The floodplain is the area that a river floods onto when it's experiencing high discharge. When a river floods, its efficiency decreases rapidly because of an increase in friction, reducing the river's velocity and forcing it to deposit its load. The load is deposited across the floodplain as *alluvium*. The alluvium is very fertile so floodplains are often used as farmland.



Natural Levees are natural embankments produced, ironically, when a river floods. When a river floods, it deposits its load over the flood plain due to a dramatic drop in the river's velocity as friction increases greatly. The largest & heaviest load is deposited first and closest to the river bank, often on the very edge, forming raised mounds. The finer material is deposited further away from the banks causing the mounds to appear to taper off. Repeated floods

cause the mounds to build up and form levees.

Topic – 68: River Delta:**Structure of a simple delta**

delta covers an area of about 42000 square km.

A river delta is a landform that forms at the mouth of a river, where the river flows into an ocean, sea, lake, or reservoir. Deltas form deposition of sediment carried by a river. Deltas are depositional landforms found at the mouth of a river where the river meets a body of water with a lower velocity than the river (e.g. a lake or the sea). For a delta to develop, the body of water needs to be relatively quiet with a low tidal range so that deposited sediment isn't washed away and has time to accumulate. Here we can see the delta of the Indus River in Pakistan. The

Lesson No. 21

Glacier's Action:**Topic – 69:**

A glacier is a body of dense ice that is constantly moving under the force of gravity; it forms where the accumulation of snow exceeds its ablation (melting and sublimation) over many years. Glacial landforms are formed by the action of glaciers. Most of today's glacial landforms were created by a movement of large ice sheets during the quaternary glaciations. Some areas like Fennoscandia and the southern Andes have extensive occurrences of glacial landforms; other areas, such as the

Sahara, display very old fossil glacial landforms.



Glaciers are found in areas where ice and snow remains all years around. At present 10% of the earth surface is covered by the glaciers. The Baltoro Glacier in the Karakoram, Northern Pakistan, 62 kms in length, it is one of the longest alpine glaciers on earth. The glaciers which are floating over the surface of the water are called ice berg. One third area of the ice berg is above the water and the remaining is under the water. Glaciers are categorized by their morphology.

Alpine glaciers, also known as Mountain glaciers or Cirque glaciers form on the slopes of mountains. An alpine glacier that fills a valley is sometimes called a Valley glacier. Glacial bodies which are larger than 50,000 km² are called Ice sheets or continental glaciers. Several kilometers deep, they obscure the underlying topography as Antarctica and Greenland.

Topic – 70: Valley Glacier:

Valley glaciers are streams of flowing ice that are confined within steep walled valleys. They are smaller but faster than Continental Glaciers. As the glaciers expanded, due to their accumulating weight of snow and ice, they crush and abrade scoured surface rocks and bedrock. The

resulting erosional landforms include striations, cirques, glacial horns, arêtes, trim lines, U-shaped valleys, Roches mouton's, over deepening and hanging valleys.

- Cirque: Starting location for mountain glaciers
- Cirque stair way: a sequence of cirques
- U-shaped valley: U-shaped valleys are created by mountain glaciers. When filled with ocean water so as to create an inlet, these valleys are called fjords.
- Arête: spiky high land between two glaciers, if the glacial action erodes through, a spillway (or col) forms.

Topic – 71: Glacier Action:



Glacial landforms are landforms created by the action of glaciers. Most of today's glacial landforms were created by the movement of large ice sheets during the Quaternary glaciations. Glaciers are not landforms. The action of glaciers, however, creates landforms. It is a process known as glaciation. Glacial ice is an active agent of erosion, which is

the gradual wearing away of Earth surfaces through the action of wind and water. Glaciers move, and as they do, they scour the landscape, "carving" out landforms. They also deposit rocky material they have picked up, creating even more features.

Topic – 72: Glacier Action:



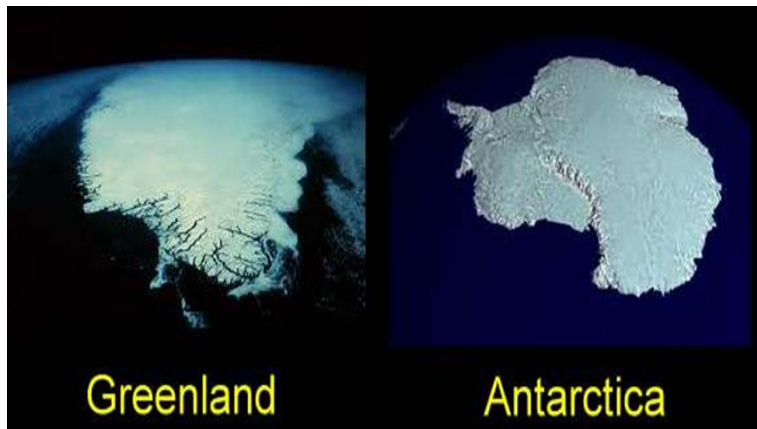
The material which is eroded by the mountain glaciers is deposited over the surrounding landscapes. The eroded rock material is called till. The features produced by the till deposits are called moraines. Later, when the glaciers retreated leaving behind their freight of crushed rock and sand (glacial drift), they created characteristic depositional landforms. Examples include glacial moraines, eskers, and kames. Drumlins and

ribbed moraines are also landforms left behind by retreating glaciers. The stone walls of New England contain many glacial erratic, rocks that were dragged by a glacier many miles from their bedrock origin.

- Esker: Built up bed of a sub-glacial stream.
- Kame: Irregularly shaped mound.
- Moraine: Feature can be terminal (at the end of a glacier), lateral (along the sides of a glacier), or medial (formed by the emerge of lateral moraines from contributory glaciers).
- Outwash fan: Braided stream flowing from the front end of a glacier.

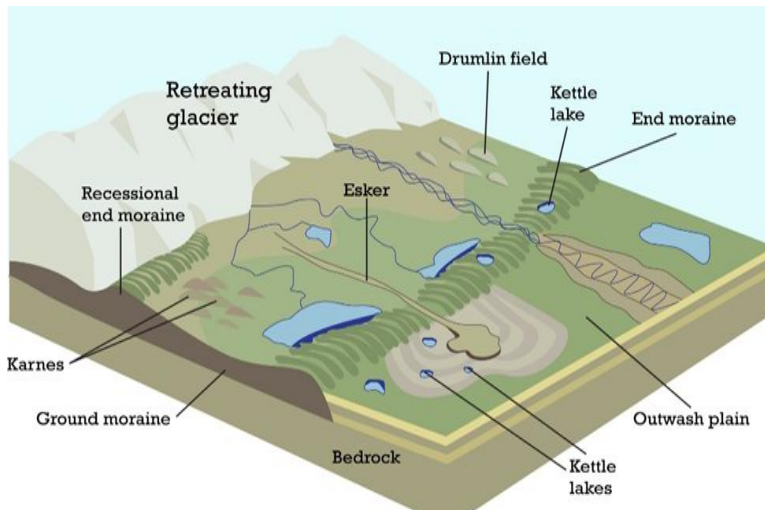
The glaciers are found in inaccessible areas or in extremely cold environments. They are difficult to survey and monitor. Satellite remote sensing is a valuable tool for studying the glaciers.

Topic – 73: Continental Glacier:



Continental glaciers are mass of ice, much larger than alpine glaciers. Small continental glaciers are called ice fields and Big called ice sheets. Greenland and Antarctica are entirely covered with ice sheets which are up to 3500 m thick. Two major continental glaciers are shown in the figure.

Domed and roughly circular ice caps are bigger than ice fields but smaller than ice sheets. Smaller outlet glaciers can flow from ice caps. Continental glaciers bury the landscape and only the highest mountain peaks poke out through the ice surface. These mountain peaks are called Nunataks.



Features of the glaciers are as shown in the following diagram. Feature can be observed when the glaciers are melted. Important features are:

- Drumlin field
- Esker
- Kettle lakes
- Outwash plain

Drumlin field:

- egg shaped hill;
- formed under glaciers;

- sloped or pointy end points in direction of ice flow;
- formation
- ice melts under glacier
- deposits of gravel are made

- glacier moves forward
- deposits are bull-dozed along and catch up in rough areas forming piles

Esker

- long deposits of eroded glacial material;
- formed by sub-glacial streams that deposit material like all rivers;
- sometimes known as Highways of the North because they are good for traveling
- on with ATV's

Kettle lakes

A kettle (kettle hole, pothole) is a shallow, sediment-filled body of water formed by retreating glaciers or draining floodwaters.

Outwash plain

- like a river Delta;
- melt water flowing from a glacier deposits silt like river deltas;
- silt is deposited in layers;
- small particles are carried further away;
- Larger particles drop closer to the glacier.

Lesson No. 22

Wind Action

Topic – 74:

Aeolian processes, also called wind activity. Wind has the ability to shape the surface of the Earth. Winds may erode, transport, and deposit materials. Wind is an effective agent in regions with sparse vegetation, and in areas with lack of soil moisture. Wind is a powerful eroding force in arid environments such as deserts. When wind has erosion it has two types of actions:

1. Deflation
2. Abrasion

Deflation means the removal of loose, fine, grain particles by the turbulent action of the wind whereas abrasion means the wearing down of the surface by grinding action.

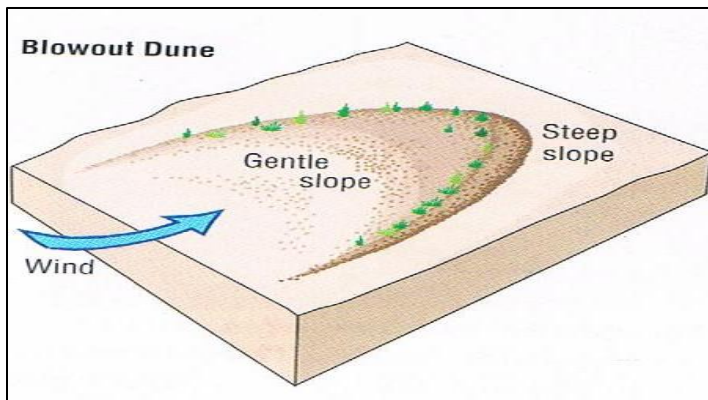
Particles are transported by wind through suspension, saltation or bouncing and creeping (rolling or sliding) along the ground. Small particles may be held in the atmosphere in suspension.

Topic – 75: Wind Action:

Upward currents of air support the weight of suspended particles and hold them in the surrounding air. Wind near Earth's surface suspends particles less than 0.2 mm in diameter.

Aeolian landforms are formed by either the erosive or constructive action of the wind. As the wind erodes the land it has the effect of sandblasting the surface, leaving rock surfaces such as those found in the desert. Dune is a hill

or mountain of sand which is formed due to the deposition of wind. In this process the weathered material carried by the wind is deposited after reduction in the velocity of wind.



Barchans is a convex-shaped sand dune with a gentle slope up the side of the wind direction and a 30-35 degree slip face that faces away from the wind.

Blowout is a small hollow in the bared rock, which is placed in desert, is created due to abrasion of wind.

Topic – 76: Wind Action:



Wind actions are totally controlled by the wind velocity and wind direction.

Following is the example of longitudinal dunes. They are generally formed in areas that are located in the areas that are located behind obstacles where sands are in abundant and winds are constant.

Star dunes are pyramidal sand mounds with slip faces on three or more arms that radiates from the high center of the mounds. They grow upwards rather than laterally. Sometimes star dunes are up to 500m tall and may be tallest dune on the earth.



Loess is an accumulation of sediment or silt that is joined together by calcium carbonate. It covers about 10% of the earth surface. The following is the loess deposit near china.

Lesson No. 23

Weathering**Topic – 77:**

Geomorphological processes are natural mechanisms of weathering, erosion and deposition that result in the modification of the landforms at the earth's surface. Weathering is the breaking down of rocks, soil and minerals as well as artificial materials through contact with the Earth's atmosphere, biota and water. In the process of weathering the displacement of disintegrated particles is not done.



When rocks are exposed with atmosphere they react in different ways. The mechanism of weathering is discussed under the umbrella of its controlling factors. It is categorized in to three types' i.e. physical weathering, chemical weathering and Biological weathering. All of these are explained below:

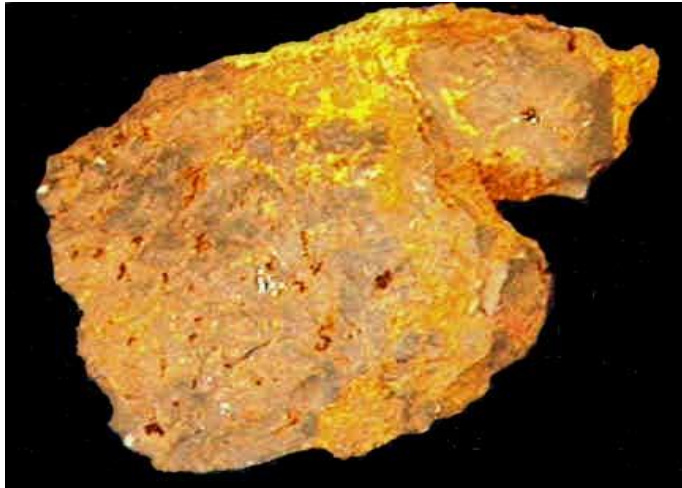
Physical Weathering is the breaking down of rocks without substantial change to their

chemical structure is known as physical or mechanical weathering. A big rock is disintegrated into small fragments. Mostly, mechanical weathering is occurred near the surface but in certain cases it may occur at considerable depth. Different processes are involved in the mechanism of physical or mechanical weathering.

Frost wedging is the most important single agent of mechanical weathering is the freeze-thaw action of water. At the time of rainfall or the flow of running water, water is percolated to the interior of rocks through the small cracks on the rock surface. As Temperature reduced that percolated water began to freeze and exerted pressure and caused disintegration of rock. When water freezes, it expands by almost 10 percent.

Topic – 77: Chemical weathering:

Chemical Weathering is the decomposition of rocks and minerals. In warm and wet climates, chemical weathering occurs far more rapidly than in arid areas. Almost all the minerals are exposed to chemical weathering when exposed to atmospheric and biotic agents. The following is the limestone covered area.



Here are some examples of chemical processes i.e.: oxidation, hydration, and hydrolysis. Oxidation is the reaction of rock minerals with oxygen, thus changing the mineral composition of the rock. When minerals in rock oxidize, they become less resistant to weathering. Iron, a commonly known mineral, becomes red or rust colored when oxidized. The following is the example.



Hydrolysis is a chemical reaction of water with another substance to produce a new compound which is relatively softer and weaker than the parent material. Igneous rocks are more

The burning of the fossil fuels and vehicle emissions creates atmospheric pollution. So the Nitrogen dioxide and sulphur dioxide are released and compounds react with in atmosphere to form acid rain.

Topic – 79 :Biological weathering:



Living organisms contribute to the weathering process in many ways.

Organisms, especially micro-organisms, play an important role in the weathering of rocks. Human, animals and plants are responsible for breakdown of rock into small fragments. Growing **plant roots** can exert stress or pressure on rock. Although the process is physical,

the pressure is exerted by a biological process (*i.e.*, growing roots). Biological processes can also

produce chemical weathering, for example where plant roots or microorganisms produce organic acids which help to dissolve minerals.



Microbial activity breaks down rock minerals by altering the rock's chemical composition, thus making it more susceptible to weathering. One example of microbial activity is lichen; lichen is fungi and algae, living together in a symbiotic relationship. Fungi release chemicals that break down rock minerals; the minerals thus released

from rock are consumed by the algae. As this process continues, holes and gaps continue to develop on the rock, exposing the rock further to physical and chemical weathering.



The surface of bared rocks are also disintegrated into small fragments or particles due to the grazing of animals or the walk of animals over the surface. But this phenomenon is activated at the rocks which are already mechanically weathered.

Lesson No. 24

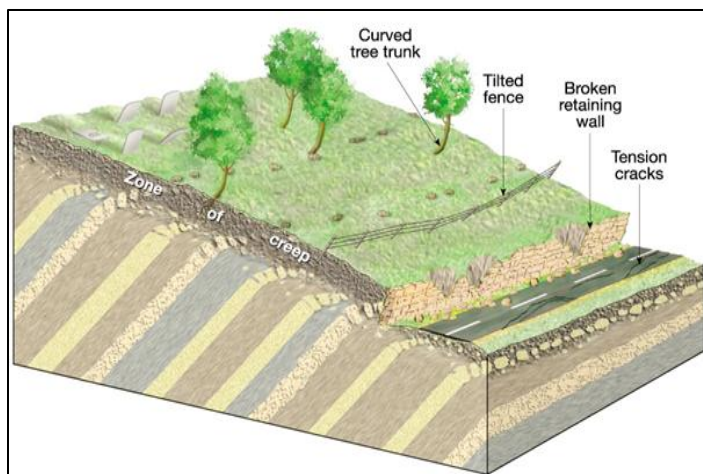
Mass Wasting

Topic – 80:

Mass wasting, also known as slope movement or mass movement, is the geomorphic process by which soil, sand and rock move down slope as a mass, under the force of gravity. In mass wasting, several factors and processes contribute to the downward movement of rock material under the force of gravity. Sometime they have disastrous results on the local

environment. The major factors which trigger the phenomenon of mass wasting are enlisted:

- earthquakes
- increased overburden from structures
- increased soil moisture
- reduction of roots holding the soil to bedrock
- undercutting of the slope by excavation or erosion
- weathering by frost heave

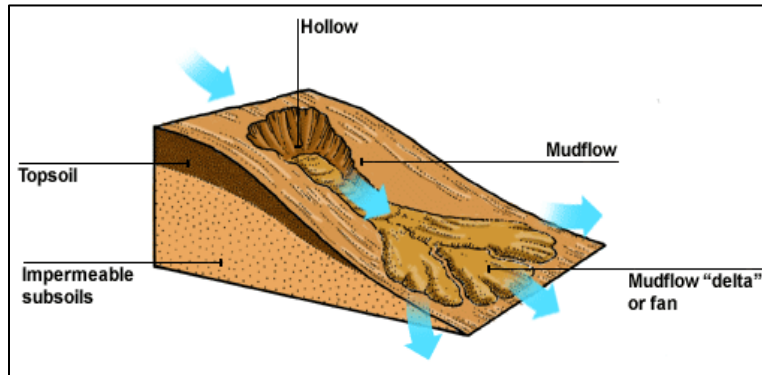


Soil creep is a long term process. The combination of small movements of soil or rock in different directions over time are directed by gravity gradually downslope. More the slope will be steep faster will be the movement of creeps. The creep makes trees and shrubs curve to maintain their perpendicularity, and they can trigger landslides if they lose

their root footing. The surface soil can migrate under the influence of cycles of freezing and

thawing, or hot and cold temperatures, inching its way towards the bottom of the slope forming terracotta's. This happens at a rate that is not noticeable to the naked eye.

Topic - 81: Types of Mass wasting:



Types of mass wasting are:

1. Flow
2. Land slide
3. Fall

Movement of soil and regolith that more resembles fluid behavior is

called a flow. These include avalanches, mudflows, debris, earth flow and lahars. Water, air and ice are often involved in enabling fluid like motion of the material.



A landslide, also called a landslip, is a rapid movement of a large mass of earth and rocks down a hill or a mountainside. Little or no flowage of the materials occurs on a given slope until heavy rain and resultant lubrication by the same rainwater facilitate the movement

of the materials, causing a landslide to occur. The common forms of landslides are slump, debris slide, rock slide, rock fall, debris fall and avalanche.

A fall, including rock fall, occurs where regolith cascades down a slope, but is not of sufficient volume or viscosity to behave as a flow. Falls are promoted in rocks which are characterized by presence of vertical cracks. Falls can result from undercutting by water as well as from undercutting by waves. They usually occur at very steep slopes such as a cliff face. The rock material may be loosened by earthquakes, rain, and plant-root wedging, and expanding ice, among other things. The accumulation of rock material that has fallen and resides at the base of the structure is known as talus.

Topic - 82: Mass wasting in Pakistan:

The lake was formed due to a massive landslide at Atta bad village in Gilgit-Baltistan, occurred on January 4, 2010. The landslide killed twenty people and blocked the flow of the Hunza River for five months.

In 2005 there was an earth quack in Pakistan which was 7.4 rector scale. It was one of the dangerous earthquakes in the history of Pakistan. About more than 1.5 people were killed in this earth quack. Due to its shaking the surrounding areas of mountains were affected. The land sliding of 2010 was due to this. In this land sliding parts of mountain move down. Hunza River was completely blocked. And today we are dealing with a lake called Atta bad lake. Today machines are playing role for development over there.

Lesson No. 25

Whether and climate**Topic - 83:**

Weather is the day to day condition of the atmosphere at a particular place while climate is average of weather condition at a particular place over a long period of time. Four elements defining the weather and climate i.e. temperature, rainfall, precipitation, wind circulation etc. but, infect there is a large difference between both of these terms. The term weather is used to define the condition of weather variable for short period of time i.e. daily, weekly or monthly while climate is used to define the weather condition of a specific region for long period of time i.e. about thirty years or more.

Weather: For example, in Lahore, the weather is warm in the afternoon. But later in the day, when there are clouds blocking Sun's rays, the weather would become cooler.

Climate: For example, although the weather in Pakistan may be cool and dry during winter season, Pakistan's climate is hot and dry most of the time.

Meteorology studies weather, Climatology studies climate. Both are Atmospheric sciences.

Topic – 84: Weather elements:

There are several elements that make up the weather and climate of a place. The major of these elements are five temperature, pressure, wind, humidity, and precipitation. Analysis of these weather elements can provide the basis for forecasting weather on short time, medium and long time so here we can define the climate of a place.

Temperature is a very important factor in determining the weather, because it influences or controls other elements of the weather. How hot or cold the atmosphere is.

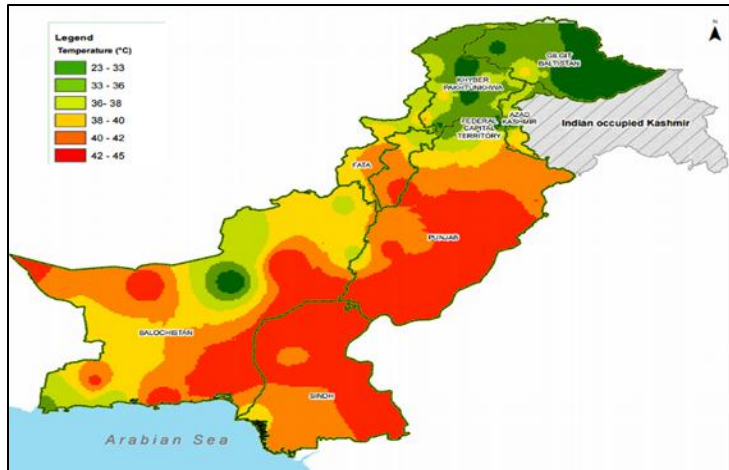
Humidity is the amount of water vapor present in the atmosphere. During day humidity is lower than in evening. In monsoon season the humidity level is higher than other seasons in Lahore.

Precipitation is the product of a rapid condensation process (if this process is slow, it only causes cloudy skies). It may include snow, hail, sleet, drizzle, fog, mist and rain.

Atmospheric pressure (or air pressure) is the weight of air resting on the earth's surface. Pressure is shown on a weather map, with lines called isobars.

Wind is the movement of air masses, on the Earth's surface. These are specially called permanent, seasonal and local winds.

Topic – 85: Factors effecting climate:



There are many different factors that affect climate around the world. Due to these factors we are experiencing different climates in different parts of the Earth. The most important natural factors are:

1. Distance from the sea
2. Ocean currents
3. Direction of prevailing winds
4. Shape of the land or 'topography'
5. Distance from the equator

It is now widely accepted that human activity is also affecting climate, For example the urban areas are act like heat island or hotter than open spaces.

Topic - 86: Factors affecting the climate:



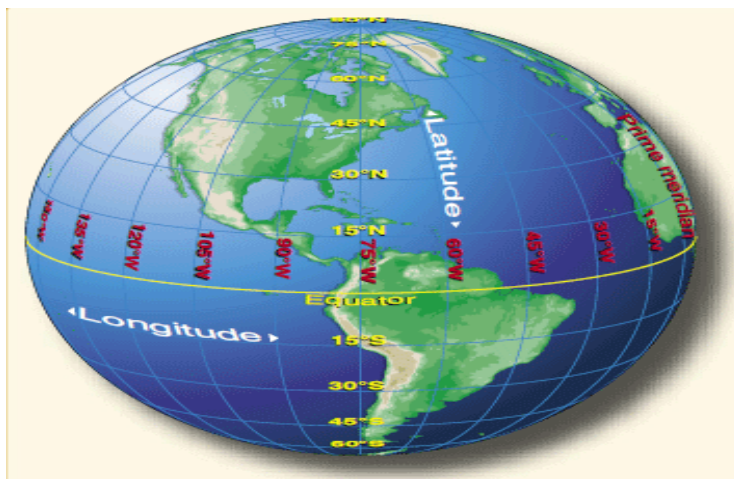
One of the factors affecting the climate is wind. When wind is coming from the Mediterranean region it is moist and when wind is close to the equator it is warm. The oceanic winds have the capacity to take the moderating influence of the sea to coastal areas as is reflected in cool summers and mild winters. This effect is pronounced only

on the windward side. The leeward side or the interiors do not get the moderating effect of the sea, and therefore experience extremes of temperature.



The distance from the equator affects the climate of a place. At the poles, energy from the sun reaches the Earth's surface at lower angles and passes through a thicker layer of atmosphere than at the equator. This means the climate is cooler further from the Equator. The poles also experience the greatest difference between summer

and winter day lengths: in the summer there is a period when the sun does not set at the poles; conversely the poles also experience a period of total darkness during winter. In contrast, day length varies little at the equator.



The factors above affect the climate naturally. However, we cannot forget the influence of humans on our climate. Early on in human history our effect on the climate would have been quite small. However, as populations increased and trees were cut down in large numbers, so our influence on the climate

increased. Trees take in carbon dioxide and produce oxygen. A reduction in trees will therefore have increased the amount of carbon dioxide in the atmosphere.



The Industrial Revolution, starting at the end of the 19th Century, has had a huge effect on climate. The invention of the motor engine and the increased burning of fossil fuels have increased the amount of carbon dioxide (a greenhouse gas - more on that later) in

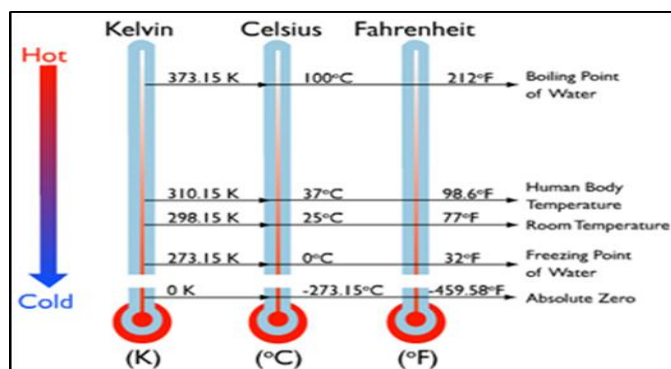
the atmosphere. The number of trees being cut down has also increased, reducing the amount of carbon dioxide that is taken up by forests.



The greenhouse gases. They include carbon dioxide, water vapour and Ozone. They occur both naturally and due to human activities. A greenhouse gas is one which traps heat radiated from the surface of the earth.

Lesson No.26

Temperature

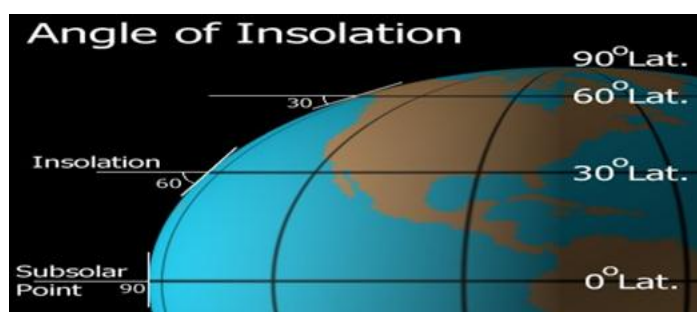
Topic - 87:

Temperature is a physical property of a system that underlies the common notions of hot and cold. Temperature is the degree of hotness or coolness of an object. But, the Atmospheric temperature is a measure of temperature at different levels of the Earth's atmosphere. It is governed by

many factors, including incoming solar radiation, humidity and altitude. Several scales and units exist for measuring temperature, the most common being Celsius(C; formerly called centigrade), Fahrenheit (F), and especially in science Kelvin (K). Temperature is important in all fields of natural science, including physics, geography, geology, chemistry, atmospheric sciences, medicine, and biology—as well as most aspects of daily life.

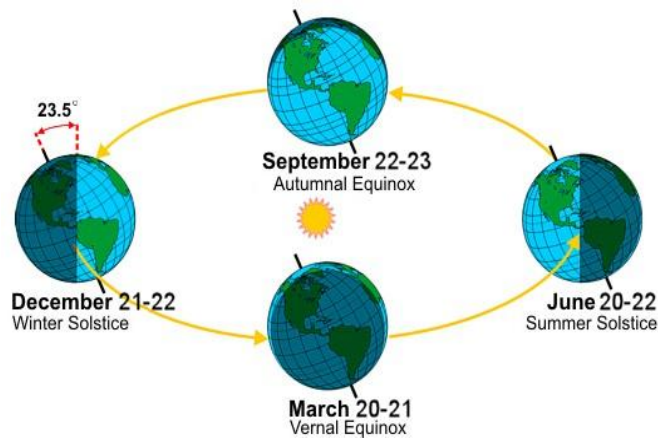
Topic - 88: Horizontal distribution of the temperature:

The earth's surface is covered by different types of the environment, may be vegetal or mountainous, so the horizontal distribution of temperature varies according to the surface condition. The angle of incidence or the angle which the sun's rays make with the earth's surface, determines the amount of solar radiation which a particular place on the earth will receive. A smaller angle means the same amount of radiation will have to serve a larger area on the earth and the intensity will be less concentrated. A larger angle means the sun's rays will be nearly vertical over the place and the given amount will have to serve a smaller area. As a result, the radiation received will be more concentrated and the intensity will be greater.



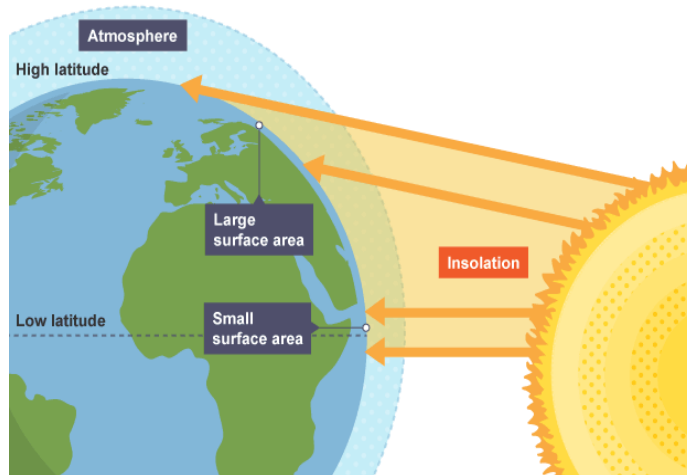
The amount of solar radiation received obviously depends on the length of time that the sun shines over a particular place. At the equator, where the duration of sunshine is 12 hours daily throughout the year, the amount of radiation received is

more compared to the other places on the earth. At winter solstice (22 December), the southern hemisphere receives more sunshine as it is summer there, while at summer solstice (21 June), the northern hemisphere receives more sunshine as it is summer time there.



The temperature of the air resting over a landmass differs markedly from that of the air resting over an expanse of water in the same latitude: (i) Reflection is more by land than by sea. Especially snow covered areas reflect up to 70%-90% of insolation, (ii) Average penetration of insolation, and therefore heat, is more in water—up to 20 meters, than in land—where it is up to 1

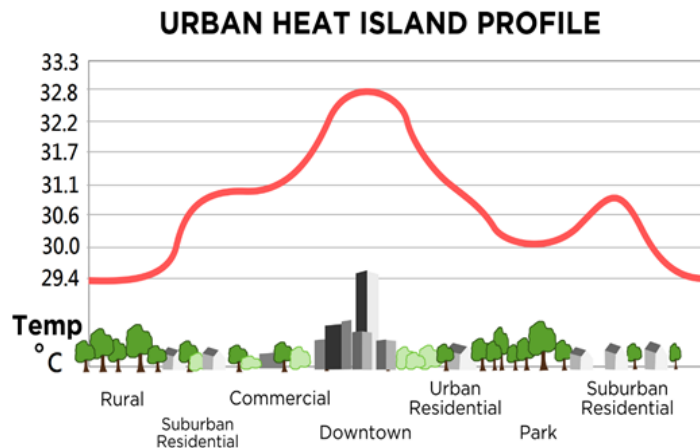
meter only. Therefore, land cools more rapidly, (iii) The specific heat of water is 2.5 times higher than landmass, therefore water takes longer to get heated up and to cool down, (iv) The currents, tides and drifts exist only in oceans which carry the heat to lower layers. This delays the process of heating and cooling.



Ocean currents influence the temperature of adjacent land areas considerably. Warm currents raise the temperatures of the coastal areas, whereas cold currents lower them. For instance, in higher latitudes, the eastern coasts have much lower temperatures than the western coasts due to the influence of cold currents. Similarly, the North Atlantic Drift, an extension of

the warm Gulf Stream, keeps winter temperatures in Great Britain and much of Western Europe warmer than one would expect for their latitudes. Because of the prevailing westerly winds, the moderating effects of the ocean currents are carried far in land.

Topic - 89: Urban and rural environment:

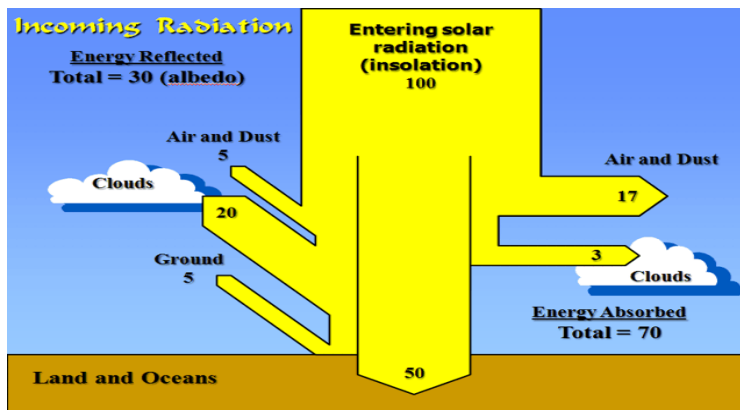


As urban environment is hotter than the rural environment so many cities are darker and absorb solar energy. In city there are little absorption of water. City temperature is raised. In other words we say that center of the city is covered with high rises. That's why most of the day time temperature is high. This is called urban heat island. Today 60% of the total

population is urban. That's why city environment is playing major role in the temperature distribution of the continental areas.

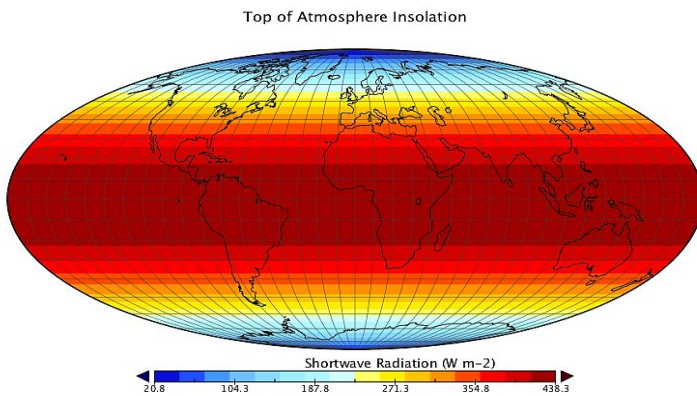
Topic - 90: Vertical distribution of the temperature:

The temperature decreases with increase in altitude, that is 6.5 degree celcius /1000 meters. This is called Environmental Temperature Lapse Rate(ETLR).



The troposphere is about 12 kilometers thick on average; it is thicker in summer than in winter. The troposphere over low latitude regions is usually thicker than over high latitude regions. The troposphere over the equator is about 18 kilometers thick, while its thickness in the regions

nearest the two poles is only about eight to nine kilometers. The temperature in the troposphere usually decreases with height at the average lapse rate of 6.5 °C per kilometer. The air in the troposphere is more unstable and with strong convection. Almost all the water vapor in the atmosphere exists within this layer; therefore, common weather phenomena such as clouds, fog, rain, and snow, occur only in this layer and more often than not in its lower part.



Temperature inversion is a reversal of the normal behavior of temperature in the troposphere in which a layer of cool air at the surface is overlain by a layer of warmer air. But, under normal conditions air temperature usually decreases with height.

Topic - 91: Global warming and Green House effect:



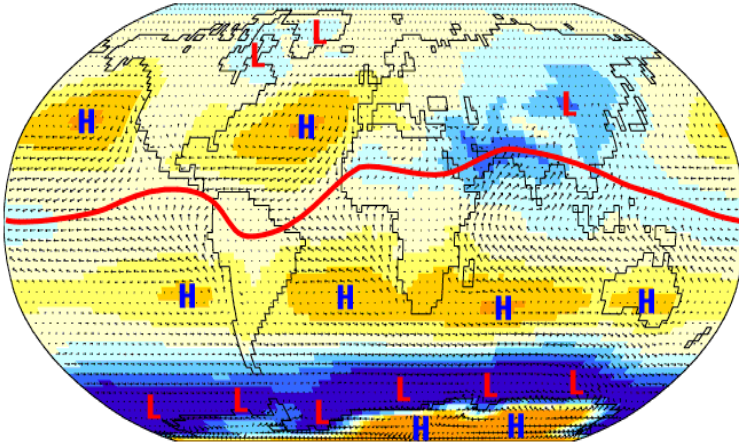
The temperature of the earth is rising due to increase in Greenhouse gases in the atmosphere. The greenhouse effect is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be in the absence of

its atmosphere. If a planet's atmosphere contains radioactively active gases (i.e., greenhouse gases) the atmosphere radiates energy in all directions. Part of this radiation is directed towards the surface, warming it. The percentage of greenhouse gasses is outlined below:

- water vapor, 36–70%
- carbon dioxide, 9–26%
- methane, 4–9%
- ozone, 3–7%

Lesson No.27

Air pressure

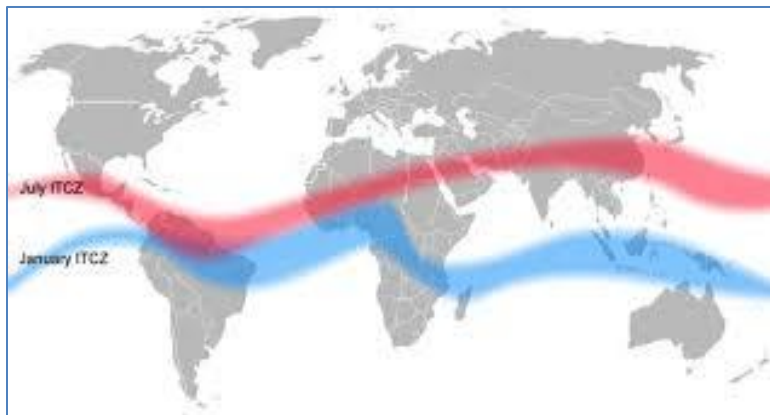
Topic – 92:

The atmospheric pressure is controlled by atmospheric temperature. High temperature leads to low air pressure, whereas low temperature leads to high air pressure. An example of air pressure is the average sea-level air pressure of 101.325 kPa.

There are four major air pressure belts

which are outlined:

1. Equatorial low pressure belts
2. Subtropical high pressure belts
3. Sub-polar low pressure belts
4. Polar high pressure belts

Topic – 93: Wind:

world. They are also called prevailing or permanent winds.

The atmospheric circulation is controlled by atmospheric pressure systems. Winds always move from high pressure systems to low pressure systems.

There are three main planetary winds that constantly blow in the same direction all around the

Trade Winds:

These winds blow from the subtropical high pressure belt towards the Equator. They are called the north-east trades in the northern hemisphere and south-east trades in the southern hemisphere.

Westerly winds:

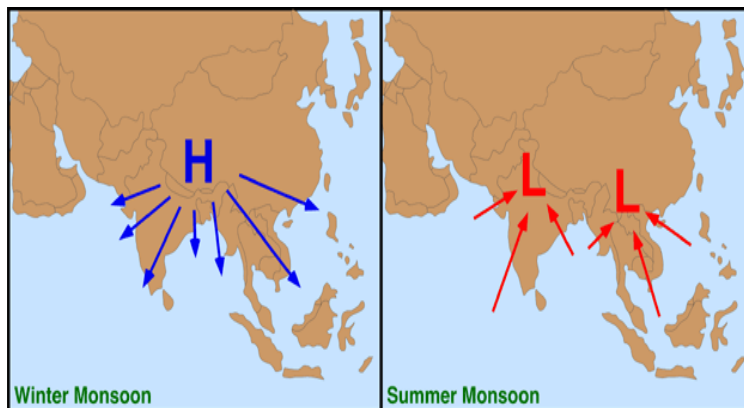
Westerlies blow from the same subtropical high pressure belts, towards 60° S and 60° N latitude.

They are called the sought Westerly winds in the northern hemisphere and North Westerly winds in the southern hemispheres.

Polar Winds

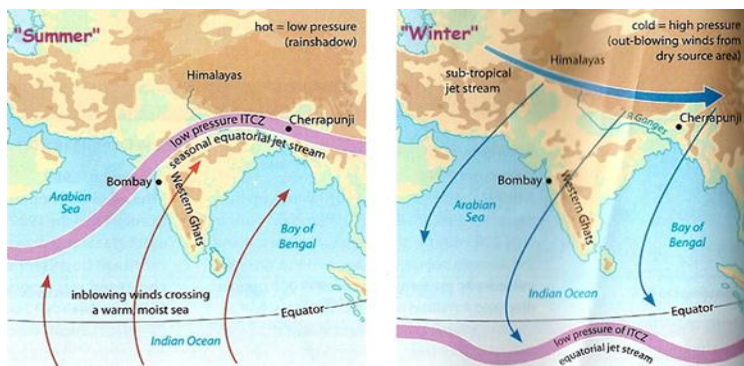
Blow from the polar high pressure to the sub polar low pressure area. In the northern hemisphere, their direction is from the north-east. In the southern hemisphere, they blow from the south-east.

Topic – 94: Seasonal Winds:



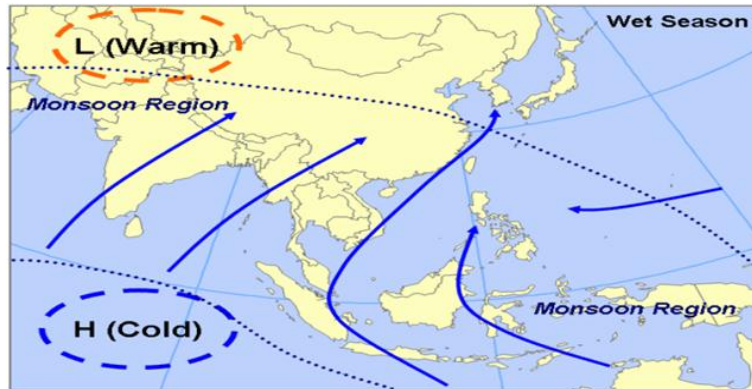
Seasonal winds accompanied by seasonal changes in atmospheric circulation and precipitation associated with the heating of land and sea. During the day, near an ocean, sea or lake, the land heats up faster than the water. The air above the land also gets heated. As warm air

risks, it draws cooler air from over the water to blow towards the land, creating a sea breeze.



At night, the opposite conditions prevail. The land loses heat rapidly while the sea is still warm. The air resting over the land is cold while the air resting over the sea is warm and rises creating a low pressure area. A land breeze thus blows in from the

high pressure over the land towards the water. These land and sea breezes maintain air circulation in the coastal areas and have a moderating effect on the temperatures.



Monsoons are land and sea breezes on a large scale. The word 'monsoon' comes from the Arabic word 'mausim' meaning weather. They change or reverse their directions according to the seasons. Strong contrasts in temperature between summer and winter because great

differences in pressure conditions over the interior parts of the big continents like Asia. Hence winds blow onshore from a sea to the land in summer and from land to the sea in winter. The onshore winds bring moisture and heavy rainfall while the offshore winds are relatively dry. Although the monsoons are associated with south-east USA, Australia, parts of South America and East Africa they are most effective over south-east Asia and India blows from June to September while the winter monsoons prevails from October to December. Major monsoon systems of the world consist of the West African, Asia-Australian monsoons and North and South America.

Topic – 95: Monsoon:

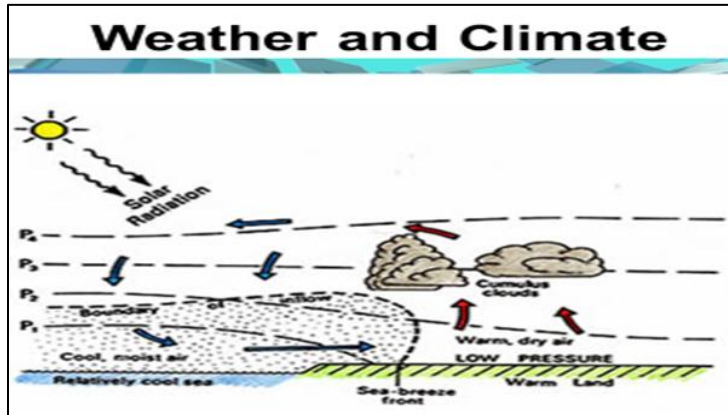


Monsoons are large-scale sea breezes which occur when the temperature on land is significantly warmer or cooler than the temperature of the ocean. In Pakistan 75% of the total area is under irrigation. In India 50 % of the total area is under cultivation. Bangladesh has less than 25% of the area under cultivation. The following is the

view of the Western Ghats in dry season on May 28. Here we can see all slopes are barrel whereas after rain in august all the slopes are covered with vegetation.

Water has a relatively high heat capacity and sun's rays penetrate up to 50 meters. In contrast, rocks have lower heat capacities and can only transmit heat into the earth by conduction.

Topic – 96: Local winds:



Local winds occur on small spatial scale, their horizontal dimension is several tens to few hundreds of kms. There are many winds around the world, some of them cold, warm, some are wet, and dry. On the earth's surface, some local variations of temperature on the land may cause

changes in air pressure. As a result local winds blow. They blow in a particular season and are known by the local names in that region. For instance, the hot dry, dusty winds that blow in the month of May and June over the northern plains in India are called Loo. There are still other types of winds that are irregular and keep changing their direction and blow in an area for a very short time, such as tornadoes, typhoons and cyclones.

Topic – 97: Local winds:



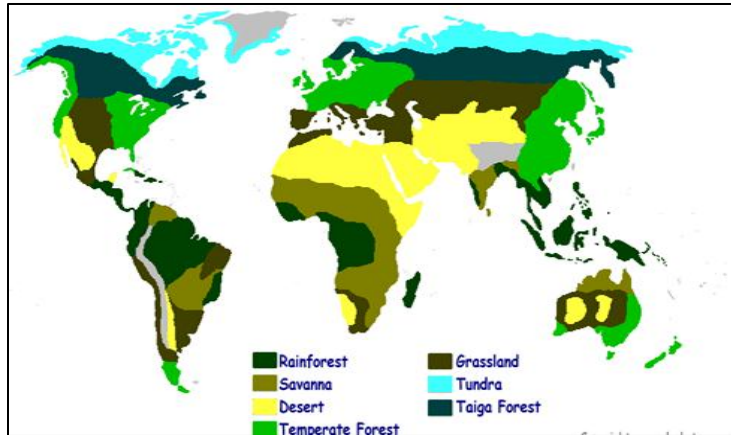
Local winds are controlled by the local environment. Areas which are under the sub polar type of climate are under the cold wind. Following is the example of such wind which is called bora. The bora can reach the speed of 100 km/h. Some other examples of local winds that bring

unusual changes in the temperature of the places are the warm Chinooks that devour the snow on the leeward side of the Rocky mountains of North America, the Foehn in the Swiss Alps and the hot, sand laden Sirocco that blows over Southern Europe from the Sahara and causes 'blood rain'

which is actually desert sand and dust that falls with the rain. When wind moves and there is a barrier on its way such as mountain the wind become warm.

Lesson No. 28

Effect of Weather on Landforms

Topic – 98:

Weather does, affect various landforms on the Earth. Blowing wind can shape rocks by erosion. Storms can change the shape of coastlines. In this way, weather can change the shape of landforms. More importantly, weather affects the biosphere -- the environment that allows life to exist. Changes in the weather can have an impact on what plants and animals can survive in a given place. Seventy-

one percent of the Earth's surface is covered by water. "The Water Cycle" is fuels our weather and determines the various climates and biomes of the planet. Weather affects the inhabitants of Earth more than it affects the planet itself. Whole civilizations have sprung up and died because of the effects of the weather over the millenia.

Topic – 99: Effect of weather on human life:

Climate determines where, how, and why people live what they do. It determines their mode of dress, what type of house they live in, the food they eat, and even the length of their life span. Dry area is not suitable for cultivation. Following is the example of two different inhabitats. One of cause of global warming is deforestation. It is due to extension in agricultural practices. Normally, the carbon dioxide produced by human activities is absorbed by plants. Weather controls human

settlements form on Earth. In areas where the weather makes the climate temperate, people have been able to settle, but places with severe weather are under less populated.

Biomes

Topic – 100:



A biome is a major community of plants and animals, classified according to its predominant vegetation and characterized by the organisms to that particular environment. A grouping of terrestrial ecosystems on a given continent that are similar in vegetation structure, physiography, features of the environment and characteristics of their animal communities. The most widely used systems of classifying biomes

correspond to latitude (or temperature zoning) and humidity. Biodiversity generally increases with humidity and towards the equator. Major ecosystems that spread over a large portion of the earth and share similar abiotic and biotic factors are referred to as biomes.

Topic – 101: Classification of biomes:

A fundamental classification of biomes are based on:

1. Terrestrial biomes which includes grassland, tropical rainforest, temperate and tundra
2. Aquatic biomes (Freshwater, marine)

Climate is a major factor determining the distribution of terrestrial biomes. Among the important factors are:

Latitude: Arctic, boreal, temperate, subtropical, and tropical.

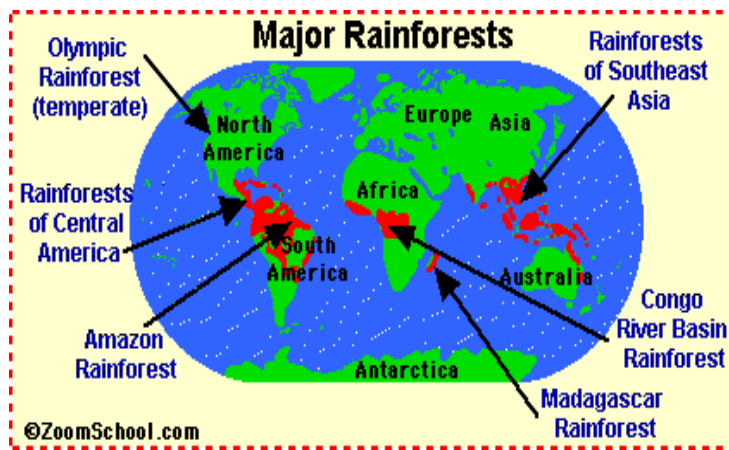
Humidity: Humid, semi-humid, semi-arid, and arid

Elevation: Varying habitat types based on elevation.

Topic – 102: Types of biomes:

Biomes are often known by local names. For example, a temperate grassland is known as steppe in Asia prairie in North America, and pampas in South America. Tropical grasslands are known as savanna in Australia. Moist and lacking temperature seasonality Evergreen Tropical Rain forest

Following is the location of rainforest:



The Rain forest consists of tall and closely spaced trees. The trees are densely shaded by a canopy of tree crowns. The monsoon forest are mid latitude Deciduous forests. It is dominated by tall, broadleaf trees that provide a continuous and dense canopy in summer.

Topic – 103: Sub Tropical Forests and decidius forests:

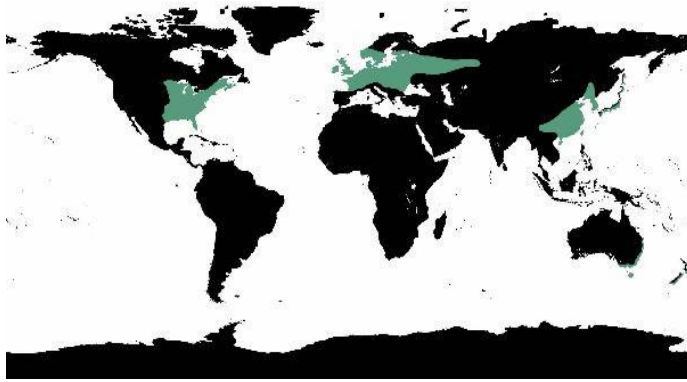
When a community of organisms occupy certain type of environment it is called habitat. The third type which is important in biomes is subtropical ever green forests. These are generally found in the regions of mist sub tropical climate where winters are mild and there is ample rainfall throughout the year. This forest occur in two forms broad leaves and needle like leaves. The sub tropical broad leaves well developed lower layer of vegetation. The sub tropical ever green broad leaves forest is associated with moist sub tropical climate.



The hot and humid conditions make tropical rainforests an ideal environment for bacteria and other microorganisms. Because these organisms remain active throughout the year, they quickly decompose matter on the forest floor. In other biomes, such as the deciduous forest, the decomposition of leaf litter adds

nutrients to the soil. But in the tropical rainforest, plants grow so fast that they rapidly consume the nutrients from the decomposed leaf litter. As a result, most of the nutrients are contained in the trees and other plants rather than in the soil. Most nutrients that are absorbed into the soil are leached out by the abundant rainfall, which leaves the soil infertile and acidic.

The mid-latitude deciduous forest biome is located between the Polar Regions and the tropics. Because of its location, air masses from both the cold polar region and the warm tropical region contribute to the changes of climate in this biome. Deciduous forests can be found in the eastern part of North America, and the middle of Europe. There are many deciduous forests in Asia.



In deciduous forests there are five different zones. The first zone is the Tree Stratum zone. The Tree Stratum zone contains such trees as oak, beech, maple, chestnut hickory, and elm, basswood, linden, walnut, and sweet gum trees. This zone has height ranges between 60 feet and 100 feet. The small tree and sapling

zone is the second zone. This zone has young and short trees. The third zone is called the shrub zone. Some of the shrubs in this zone are rhododendrons, azaleas, mountain laurel, and huckleberries. The Herb zone is the fourth zone. It contains short plants such as herbal plants. The final zone is the Ground zone. It contains lichen, club mosses, and true mosses. The deciduous forest has four distinct seasons, spring, summer, autumn, and winter. In the autumn the leaves change color. During the winter months the trees lose their leaves. The Mid-Latitude Deciduous forest is the native type of eastern North America and Western Europe. Deciduous forests are dominated by tall, broadleaf trees that provide a dense canopy in summer.

Topic – 104: Conifers forests and maditiranian forests:

Temperate coniferous forest is a terrestrial biome found in temperate regions of the world with warm summers and cool winters and adequate rainfall to sustain forest. In most temperate coniferous forests, evergreen conifers predominate, while some are a mix of conifers and broadleaf evergreen trees and/or broadleaf deciduous trees. Temperate evergreen forests are common in the coastal areas of regions that have mild winters and heavy rainfall, or inland in drier climates or mountain areas.

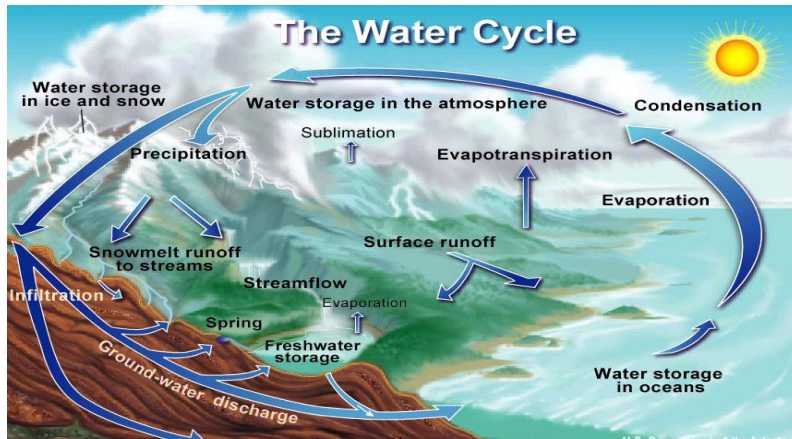


Temperate rain forests occur only in seven regions around the world: the Pacific temperate rain forests of the Pacific Northwest, the forests of southwestern South America, the rain forests of New Zealand and Tasmania, northwest of Ireland, Scotland,

Wales, Iceland, Norway, southern Japan, and the eastern Black Sea-Caspian Sea region of Turkey and Georgia to northern Iran. The moist conditions of temperate rain forests generally support an understory of mosses, ferns and some shrubs. Temperate rain forests can be temperate coniferous forests or temperate. The Mediterranean forests are dominated by low trees with thick leaves that are well adapted to the long summer drought of Mediterranean climate.

Precipitations

Topic – 105:



In meteorology, "precipitation types" can include the forms of the precipitation which is falling to the ground. There are four distinct ways that precipitation can occur.

Precipitation occurs when a portion of the atmosphere

becomes saturated with water vapor, so that the water condenses and "precipitates". Precipitations have three fates:

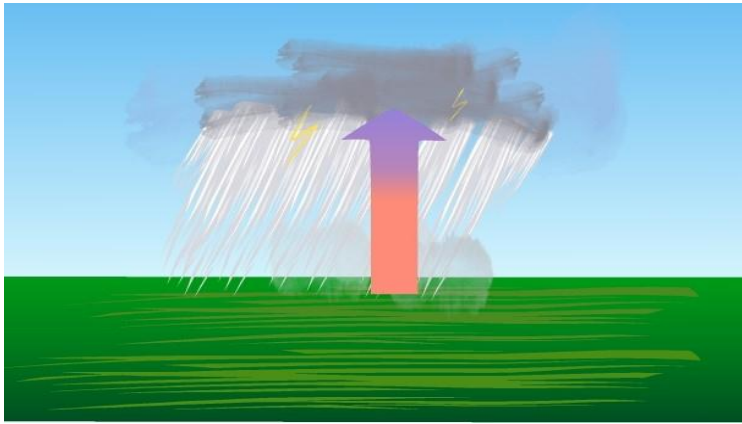
- It can evaporate.
- It can sink into the soil.
- It can run off the land.

Topic – 106: Precipitations:

In precipitations there are different surfaces. Air which is moving upward is chilled by the adiabatic process, which leads eventually, to precipitation. Air can move upward in four ways. Precipitation

1. Convective.
2. Orographic.
3. Frontal.
4. Convergent.

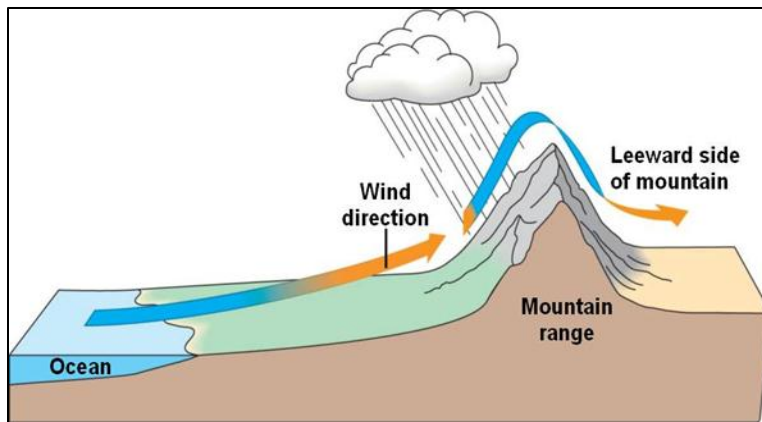
Convective Lifting precipitation is generally more intense, and of shorter duration, than other forms precipitation. Convective clouds, e.g. cumulonimbus and cumulus.



Convection occurs when the Earth's surface with unstable or moist atmosphere, becomes heated more than its surroundings, leading to significant evaporation. Convective precipitation falls over an area for a relatively short time; convective clouds have limited horizontal extent.

Most precipitation in the tropics appears to be convective; caused thunderstorms. Unstable air – Warm, moist, and heated by the surface- can produce abundant convective precipitation.

Topic – 107: Orographic Lifting Precipitation:



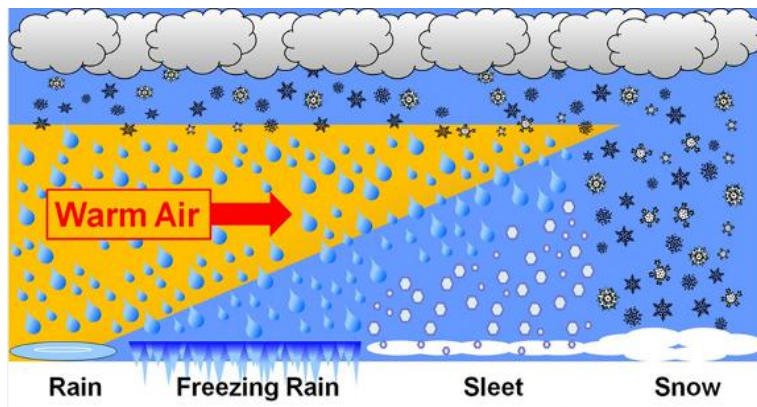
Orographic Lifting Precipitation occurs when moist air is forced upwards over rising terrain, such as a mountain. Orographic rainfall is caused when masses of air forced up the side of large mountain. The lift of the air results in adiabatic cooling, and ultimately condensation and precipitation. As the air rises and

cools, orographic clouds form and serve as the source of the precipitation, most of which falls upwind of the mountain ridge. Some also falls a short distance downwind of the ridge and is sometimes called spillover. On the lee side of the mountain range, rainfall is usually low, and the area is said to be in a rain shadow. Very heavy precipitation typically occurs upwind of a prominent mountain range that is oriented across a prevailing wind from a warm ocean.

Topic – 108: Frontal lifting precipitation:

The air to be forced upward is through the movement of air masses and their interaction with one another. This process is occurs as spiral circulation of air. In Warm fronts, air pushes the cold air

mass. The warm air over rides the cooler air and moves upward. Warm fronts are followed by extended periods of light rain and drizzle.

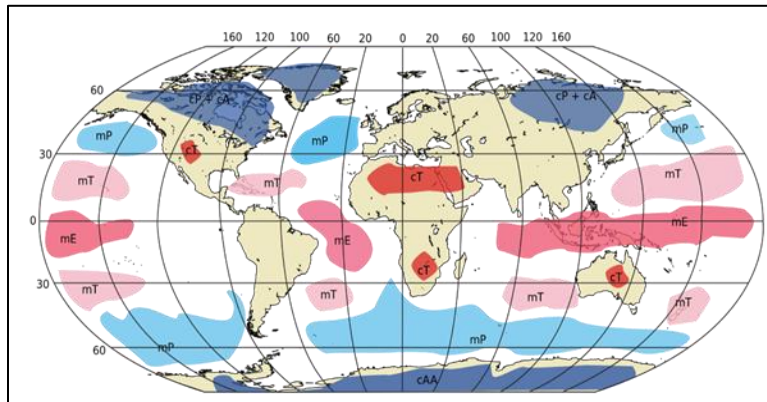


Cold fronts occur when a mass of cooler air capture a mass of warm air, since cold air is more dense than warm air. The rain duration is shorter, and more intense, than that which warm fronts. Convergent Lifting Precipitation is an atmospheric condition that exists

when there is a horizontal net inflow of air into a region. When air converges along the earth's surface, it is forced to rise. Large scale convergence can lift a layer of air hundreds of kilometers across.

Air Masses

Topic – 109:



In meteorology, an air mass is a volume of air defined by its temperature and water vapor content. Air masses cover many hundreds or thousands of square kilometers. An air mass adopts the characteristics of the surface below them. They are classified according

to latitude and their continental or maritime source regions. When masses of air with different density (moisture and temperature) meet, they represent the true characters of the source region.

Types of Air masses:

Air masses are categorized on the basis of their source of origin and are named on the basis of characteristics of local region where they are developed.

1. Continental polar air mass:

Cold and dry air masses that originate over landmass are called continental polar mass and are indicated by CP. The air masses generated in Green land or at Antarctic region are the best examples of CP air mass.

2. Maritime Polar air mass:

Cold and moist air masses that originate over water are called maritime polar mass and are presented by MP. The air mass of Arctic region, pacific and Atlantic Ocean are the best example. An air mass adopts the characteristics of the surface below them. They are classified according to latitude and their continental or maritime source regions.

3. Continental tropical air mass:

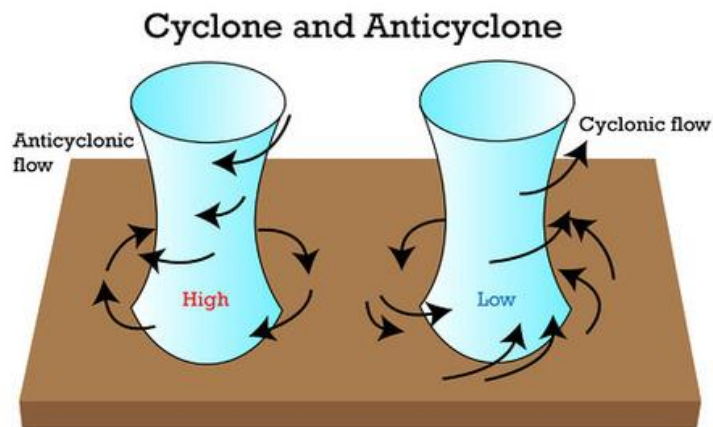
The Warm and dry air mass originating over land mass in tropics. These are represented by CT. for example, the air masses of North America and India.

4. Maritime tropical air mass:

The Warm and humid air mass originating over water in tropical regions and these are indicated by MT. for example, the air masses of Indian Ocean.

Topic – 110: Cyclones:

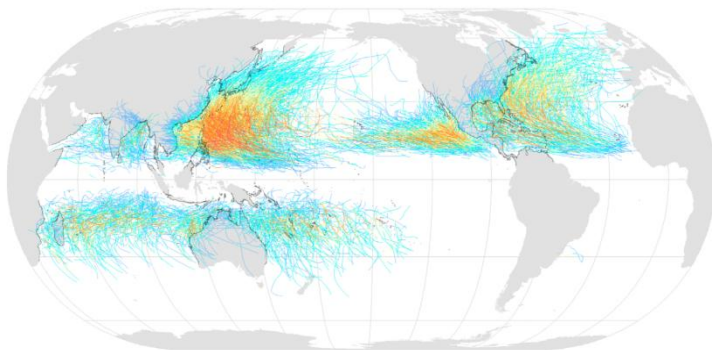
Air masses are set in motion by wind systems-typically masses of air moving in a spiral motion. Air can spiral inward and converge in a cyclone, or spiral outward and diverge in an anticyclone.



pressure in center than surrounding.

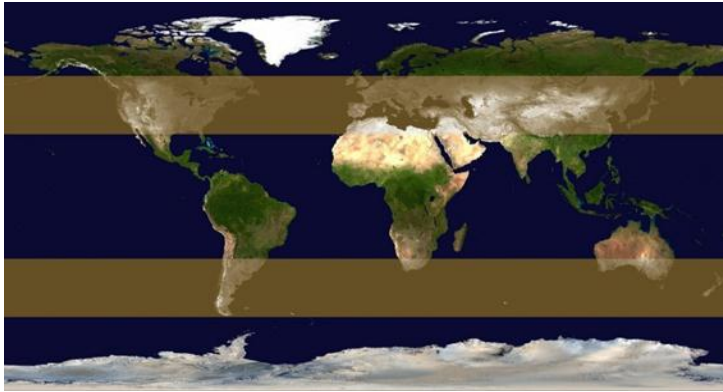
A cyclone is more or less circular area of low atmospheric pressure in which the wind blows counterclockwise in the northern hemisphere. A typical cyclone is a large whirling mass of air ranging 500-100 miles or more in diameter and with a velocity of 300miles/hr. It is the reverse process of cyclones. Air moves away from the center due to the high

Tropical Cyclones, 1945–2006

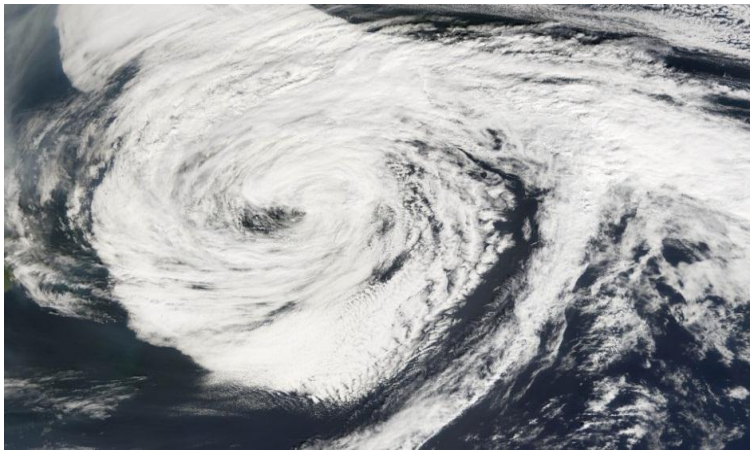


The most serious effect of tropical cyclone is coastal destruction by storm waves and very high tides. The high wind creates damaging surf and push water towards the coast.

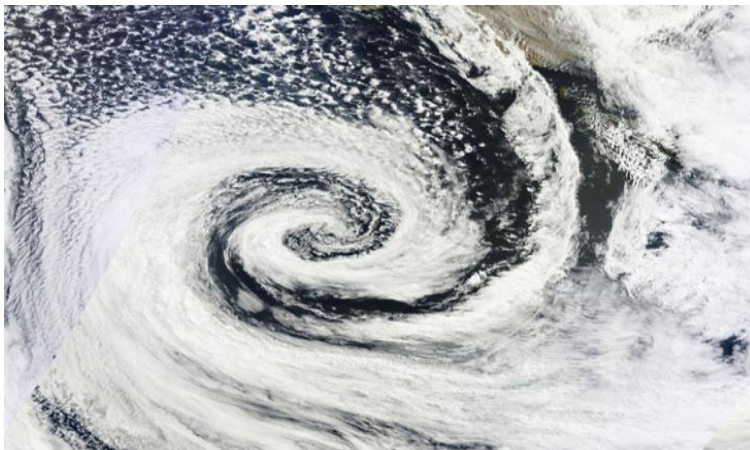
Topic – 111: Extra Tropical Cyclones:



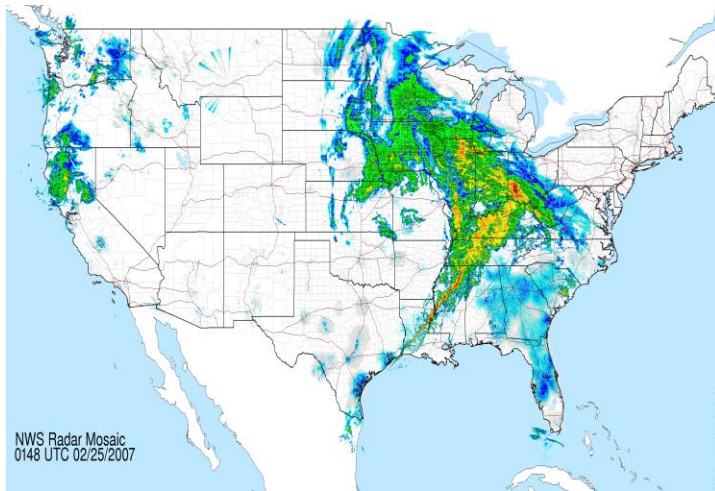
Extra tropical cyclones, mid-latitude cyclone or wave cyclones, phenomenon which drive the weather over much of the Earth. The cloudiness, mild showers to heavy gales and thunderstorm are main characters. Approximate areas of extra tropical cyclone formation worldwide.



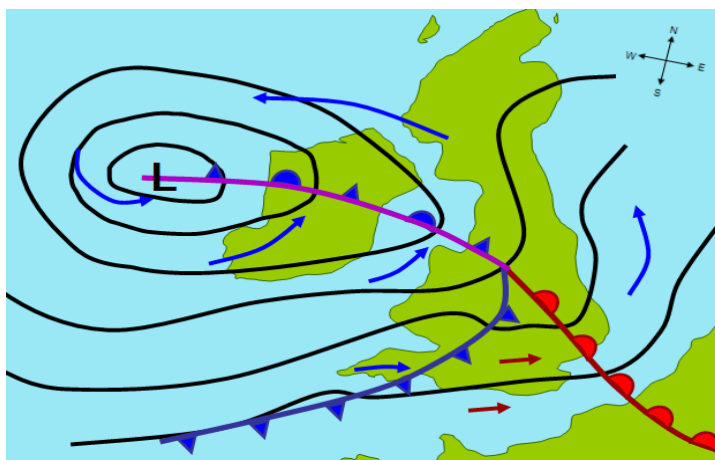
Hurricane Florence in the north Atlantic after completing its transition to an extra tropical cyclone from a hurricane.



A clockwise spinning Extra tropical cyclone off southern Australia, in the southern hemisphere.



A February 24, 2007 radar image of a large extra tropical cyclonic storm system at its peak over the central United States.



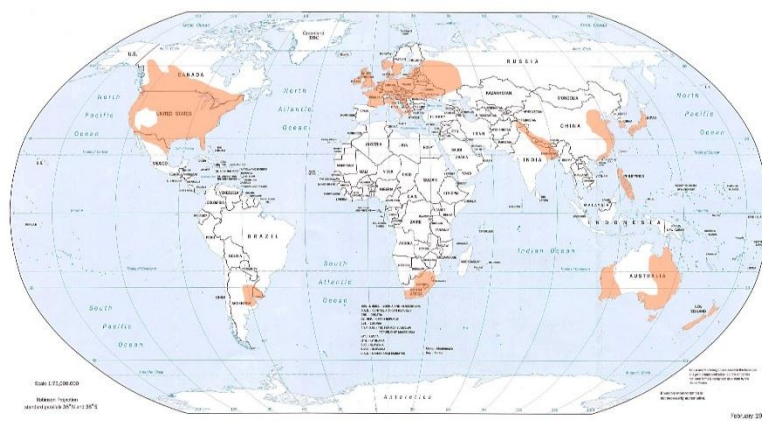
The blue and red arrows between isobars indicate the direction of the wind and its relative temperature, while the "L" symbol denotes the center of the "low". Note the occluded cold and warm frontal.

Topic – 112: Tornado:

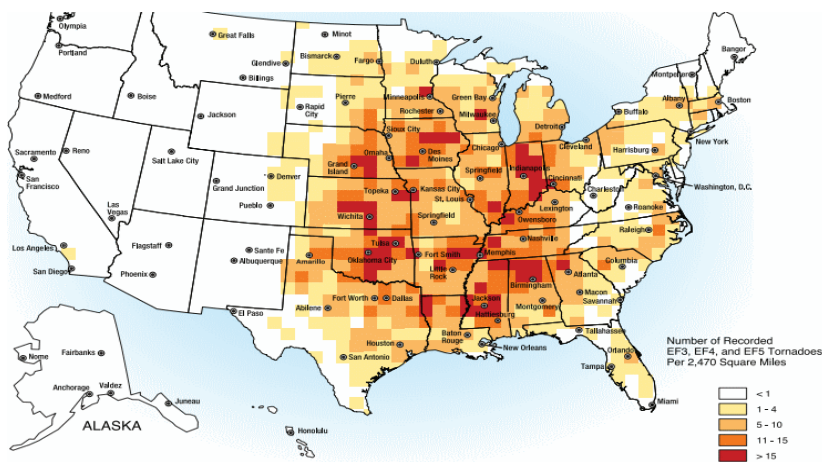
A tornado is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud. They are often referred to as twisters or cyclones. Tornadoes come in many shapes and sizes, but they are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust. Most tornadoes have wind speeds less than 180 km/h, are about 250 feet (80 m) across, and travel several kilometers before dissipating. A tornado near Anadarko, Oklahoma. The funnel is the thin tube reaching from the cloud to the ground. The lower part of this tornado is surrounded by dust cloud.



A waterspout near the Florida in 1969.



Areas worldwide where tornadoes are most likely, indicated by orange shading.



The most extreme tornadoes can attain wind speeds of more than 480 km/h, stretch more than 3 km across, and stay on the ground for more than 100 km.

Lesson No. 32

Savanna

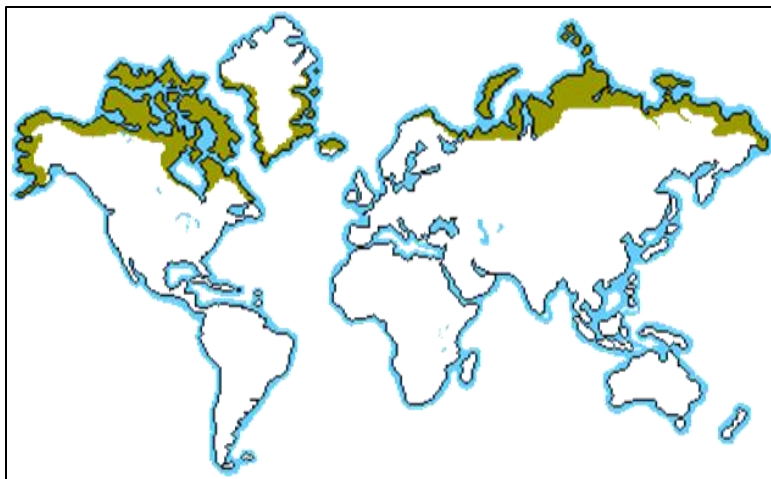
Topic – 113:

A savanna is a grassland scattered with shrubs and isolated trees, which can be found between a tropical rainforest and desert biome. Not enough rain falls on a savanna to support forests.

Savanna biomes cover about 20 percent of the Earth's surface.

Savannas are comprised mostly of

grasses and a few scattered trees. They cover half the surface of Africa, large areas of Australia, South America, and India.



The tundra biome is an ecosystem situated near the North Pole in the Arctic Circle. It is by far the coldest of all biomes. The winters are extremely cold with temperatures typically below -34°C . In Tundra Biomes the summers last only about two months. And the temperatures are still very cold

ranging from 3° to 12°C .

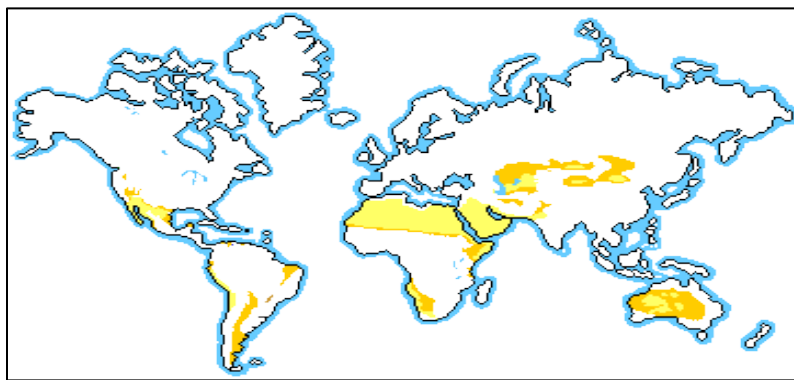
Topic – 114: Steppe Biomes:

In the Steppe Biomes, there isn't much humidity in the air because Steppe is located away from the ocean and close to mountain barriers. The Steppe biome is a dry, cold, grassland that is found in all

of the continents except Australia and Antarctica. It is mostly found in the USA, Mongolia, Siberia, Tibet and China.

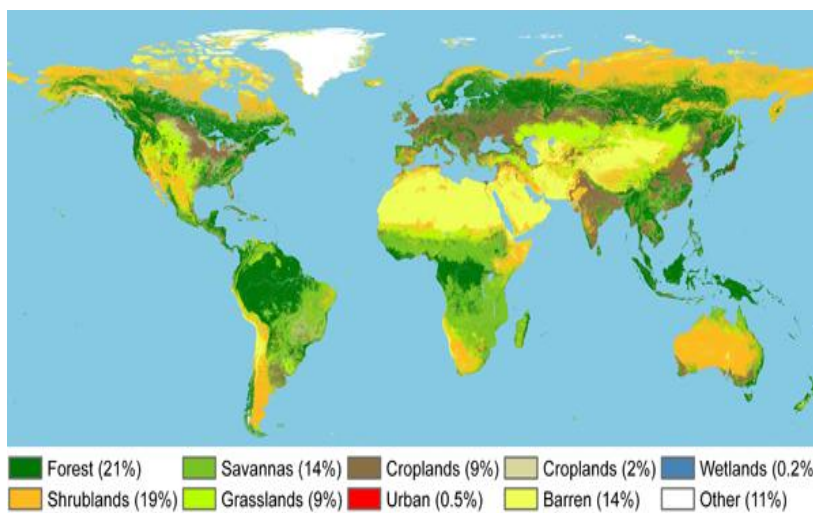


The Desert biome is an ecosystem that forms due to the low level of rainfall it receives each year. Deserts cover about 20% of the Earth.



There are four major types of desert in this biome - hot and dry, semiarid, coastal, and cold. They are all able to characterize by a special kinds of plant and animal life that are able to survive there.

Topic - 115: Classes of vegetation:



In studying the major formation classes of vegetation we must emphasize the importance of climate. As climate changes with latitude or longitude, vegetation will also change. The image shows the areas of the earth that are covered by forests, savannas, croplands, wetlands, shrub lands, grasslands, urban land,

barren, others and their percentages is also shown in the figure. The climates of the earth are remarkably diverse, ranging from the hot, humid wet equatorial climate at the equator to bitterly

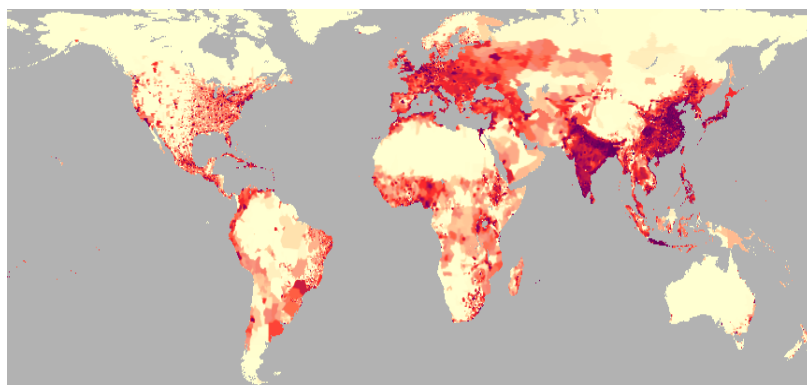
cold and dry ice sheet climate at the poles. Between the extreme climates are the other climates, each with the distinctive features. The principle controlling are temperature, atmospheric moisture, precipitation, global circulation and weather systems. The Climate exerts strong controls on vegetation and soils, especially at the global level. The climate is the controlling factor and it controls everything.

Lesson No. 33

World's Population and Settlements

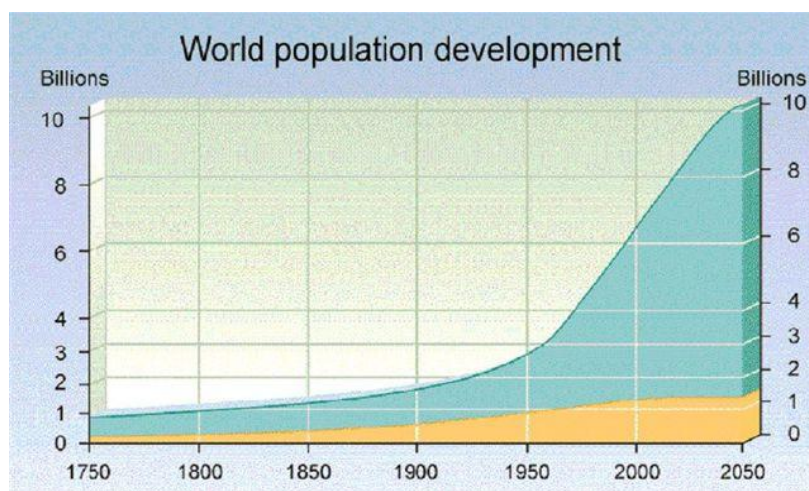
Topic – 116:

A population is a summation of all the organisms of the same group or species, which live in a particular geographical area, and have the capability of interbreeding. In ecology, the population of a certain species in a certain area is estimated using the Lincoln Index. Human population has grown very slowly for most of its existence on earth. Scientists currently estimate that modern human beings (*Homo sapiens*) evolved roughly 130,000 to 160,000 years ago. Many threats, from diseases to climate fluctuations, kept life expectancy short and death rates high in pre-industrial society, so it took until 1804 for the human population to reach one billion. From that point forward, however, population growth accelerated very quickly. The Earth's Human population at the beginning of the twentieth century stood at about 1.5 billion. By the end of that century, it exceeded 6 billion. The following figure shows the distribution of human population on the earth.



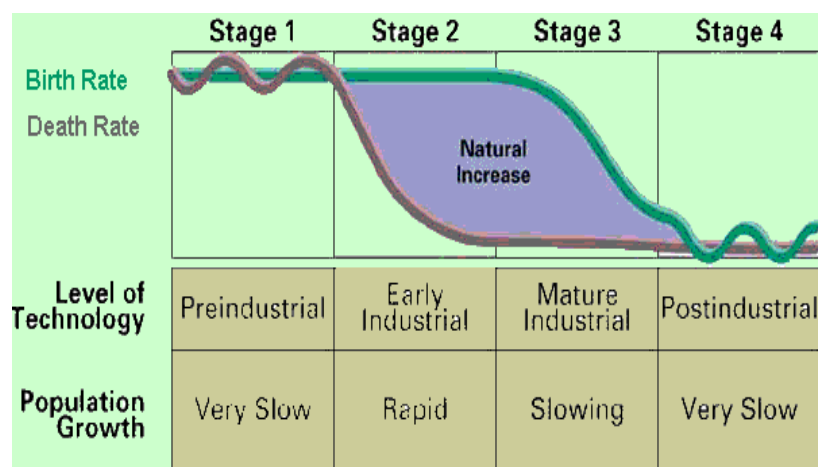
As of 2013, the human population is around 7 billion people, and it has taken many years for the population to grow to this size. Over this long amount of time, some periods have had slow growth while others have had more rapid

growth. Due to these fluctuations and how large the human population has become, scientists have begun to investigate the growth of the human population.



Demography is the study of the size, density and distribution of the human population in a specific region with respect to spatial and temporal variation. This area of study takes into account birth rates, death rates, age distribution and any other factors that influence the size and growth of a population.

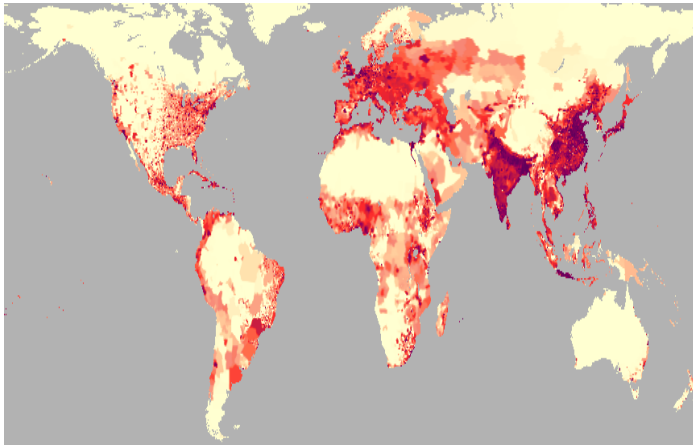
Demographers have identified three distinct periods of human population growth that help explained the history of how our population has changed.



The focus of the study of the population geography is on the spatial aspects of demography. Demographic issues and problems vary not only region to region but country to country.

Topic – 117: Human Population:

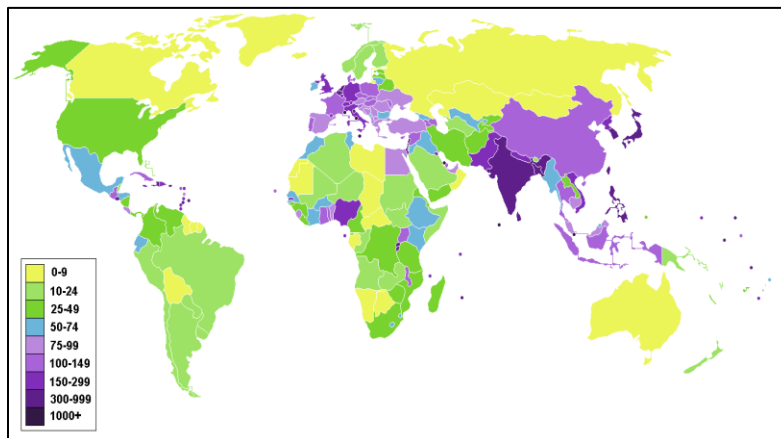
In northern hemisphere one-third of the total land is covered with water and on southern hemisphere two-third of the total is covered with water. That is the reason that population is more in the northern hemisphere. The world's largest concentrations of human population are all found on the same land mass: Eurasia. The overwhelming majority of the world's population inhabits the northern hemisphere.



The Japan, a small island country, has a population of over 127 million. Its population concentrated as China and India, farmlands are limited because of its mountainous character.

Topic – 118: Density of the population:

The density of population is the measurement of the number of people per square kilometer. Population density (people per sq. km) in South Asia was last measured at 350.18 in 2013. It varies from one region to other and mainly is controlled by the available natural resources and the personal skills and technological development of a region. The extent of urbanization and the population explosion can be investigated on the basis of density of population. In developed places most of the people are living in urban areas while in developing places most of the people are in rural areas.



Types of population density:

Population density can be categorized in to following classes:

Arithmetic Density:

It is the actual density of population. It is actual piece of land where human habitation

exists. When one discuss about this kind of density then the water body is excluded.

Agriculture density:

It is type of physiological density. When we discuss about this type of density then it describes the available cultivable land of a country and is divided by the total number of farmers. The available

statistical data shows that India has agriculture density than all over the world. The barren land and the desert land are excluded when this type of density is calculated.

Economic Density:

In this type of density, all the economically fertile land is discussed. It includes all the type of productive land like, plain areas, water channel through which trade is possible and the mountainous areas are also discussed because these provide the essential minerals which play a significant role in the production of a country.

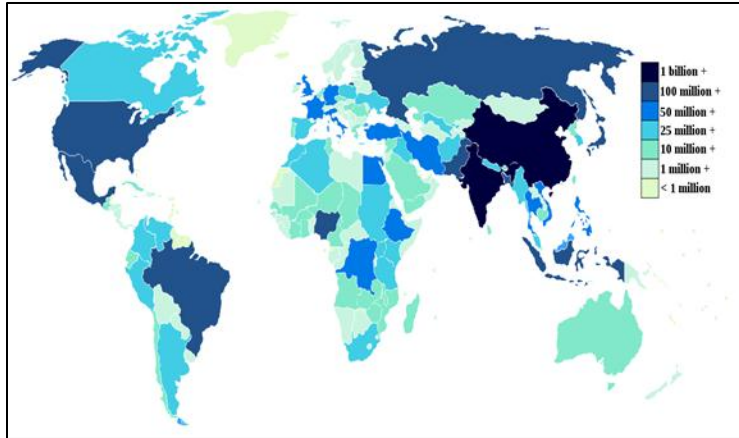
Physiological Density:

It is similar to the agricultural density but there is a little difference between both of these densities. When we discuss physiological density then all the arable land is discussed but in the context of agricultural density only the crop cultivated area is discussed.

Pakistan ranks number 6 in the list of countries by population. The population density in Pakistan is 233 people per Km². 37% of the population is urban. The most densely populated areas of Pakistan are Punjab and Sindh.

Lesson No. 34

World Population

Topic – 119:

In 1820 the total population of the world was 1 billion. In 1930 it was 2 billion. In 1970,s it becomes 3 billion. In 1999 it was 6 billion. So the most increase in population was in 20th century. World population refers to the total number of living humans on Earth. According to the estimate by the United Nations

Population Fund, the world population reached 7 billion on October 31, 2011.

#	Top ten most populous countries	1990	2008	2025*
1	China	1,141	1,333	1,458
2	India	849	1,140	1,398
3	United States	250	304	352
4	Indonesia	178	228	273
5	Brazil	150	192	223
6	Pakistan	108	166	226
7	Bangladesh	116	160	198
8	Nigeria	94	151	208
9	Russia	149	143	137
10	Japan	124	128	126

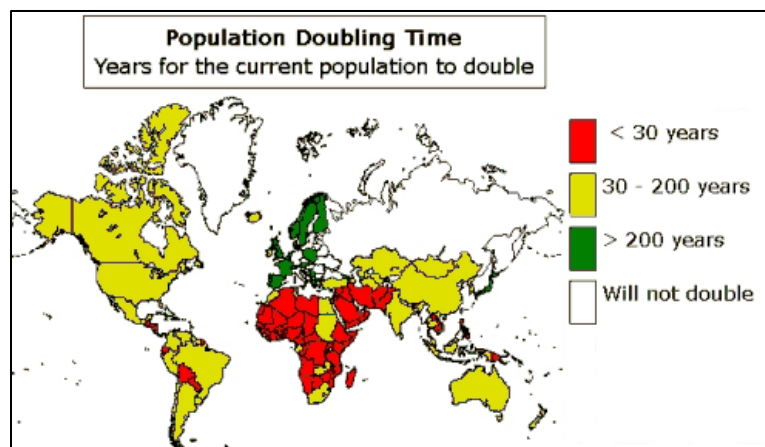
The following figure shows the top ten populous countries in millions. And most of these belong to Asia and most of them are under develop countries. The highest growth rates – global population increases above 1.8% per year – in 1950s. The global growth rate peaked at 2.2% in 1963, and has declined to 1.1% as of 2012.

Topic – 120: Population Growth:

Population growth is the increase in the number of individuals in a population. The population growth rate is the rate at which the number of individuals in a population increases in a given time. It is controlled by the density of the growth. The last 100 years have seen a rapid increase in population due to medical advances and massive increase in agricultural productivity made possible by the Green Revolution. The pre-agricultural period is the first period of human population

growth. This period is considered anything before 10,000 years ago. During the pre-agricultural period, human population growth was very slow, and it took tens of thousands of years for the human population to double. The agricultural period is the second period of human population growth. This period ranges from 10,000 years ago to about 1,000 years ago. During this time period, the human population started to grow more rapidly due to advances in agriculture. It was during this time that plants and animals were domesticated for farming. There were also advances in irrigation and plowing techniques that increased overall crop yield. As a result of increased food availability and more nutritious food, the human population grew faster than ever. The industrial period was the third period of human population growth. This period is from 1,000 years ago to current day and is characterized by advances in technology. Although there were advances in technology during the early part of this period, it wasn't until the Industrial Revolution in the 1800s that the advances in technology started to have a profound influence on the human population. The majority of world population growth today is occurring in less developed countries.

Topic – 121: Population Growth rate:



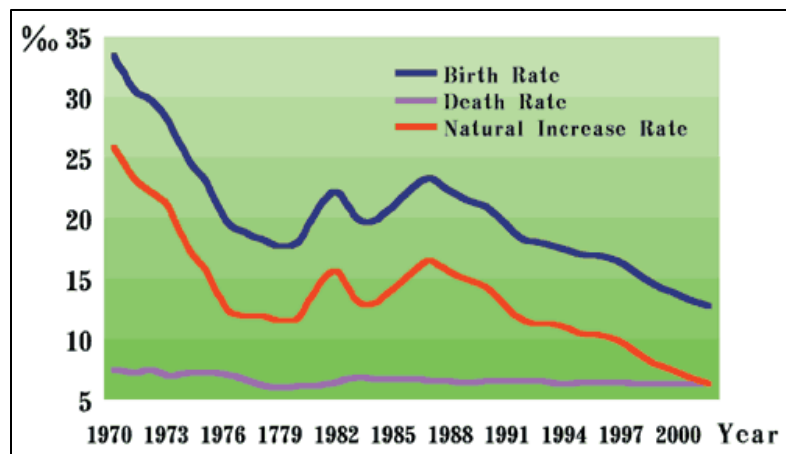
In population growth two areas are very important linear growth rate and the exponential growth rate. In linear growth rate there is a uniform growth rate but in exponential growth rate profit is also included and the world's growth rate is in exponential.

The time required for a population of a country or region to become double is called the doubling time of that country.

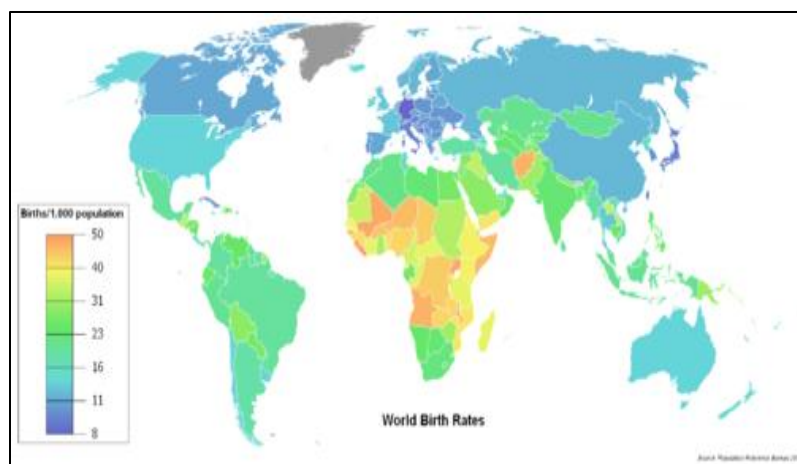
Topic – 122: Demographic characteristics of population:

Total annual births were highest in the late 1980s at about 139 million, and are now expected to remain essentially constant at their 2011 level of 135 million in the world population. The CIA World Fact book gives the world annual birth rate as 1.89%, mortality rate as 0.79 and growth rate

as 1.096%. In the world population the deaths number 56 million per year, and are expected to increase in the world human population is 80 million per year.

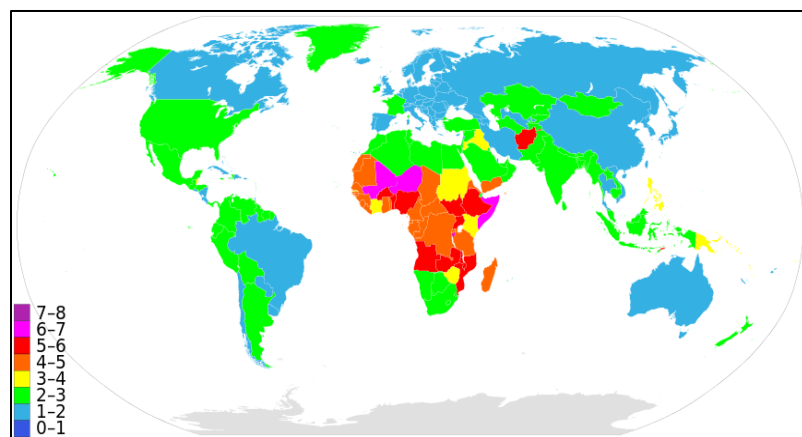


Crude birth rate defines the number of birth of a region and is discussed in the context of total number of births and is divided by total population is multiplied by 1000. It is called crude birth because there is no differentiation is made between the born child either he is boy or she is girl.



The total fertility rate (TFR), sometimes also called the fertility rate, period total fertility rate (PTFR) or total period fertility rate (TPFR) of a population is the average number of children that would be born to a woman over her lifetime during the age of 15_49. A world map showing

global variations in fertility rate per woman, according to the CIA World Fact book's 2013 data.

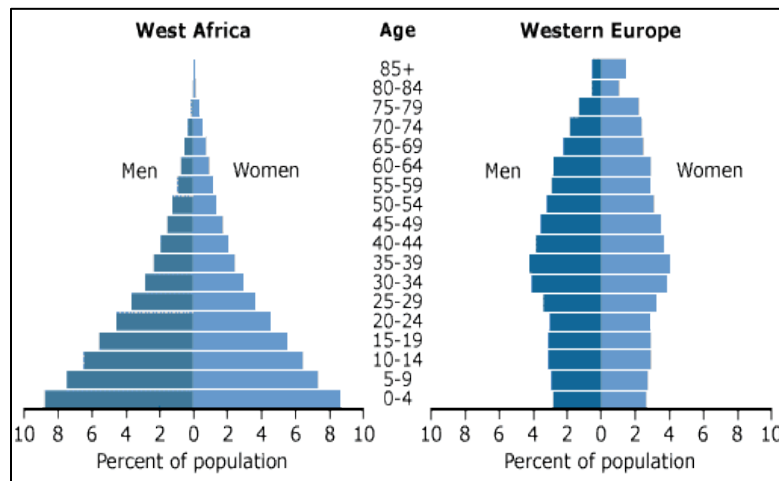


The infant mortality rate (IMR) is the number of deaths of infants under one year old per 1,000 live births. This rate is often used as an indicator of the level of health in a country. The infant mortality rate of the world is 49.4 according to the United Nations and 42.09 according to the CIA World Fact

book. It is also high in the less developed countries as compared to the developed countries of the

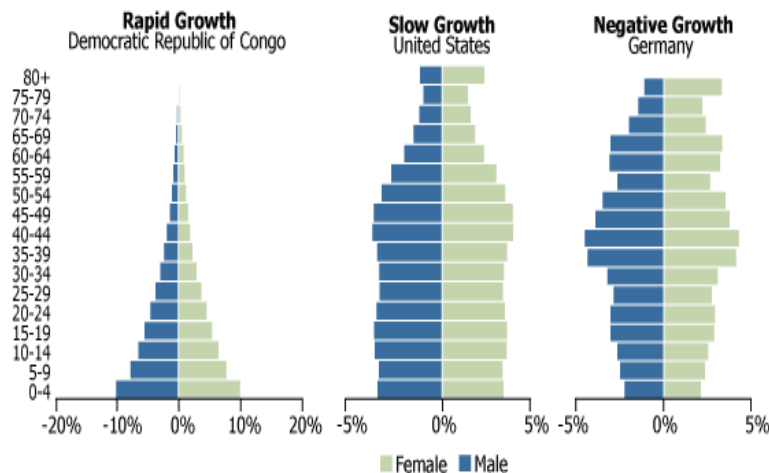
world. Many children die before reaching their first birth day, so high Crude Death Rates tend to reflect high Infant Mortality Rate.

Topic – 123: Population Structure:



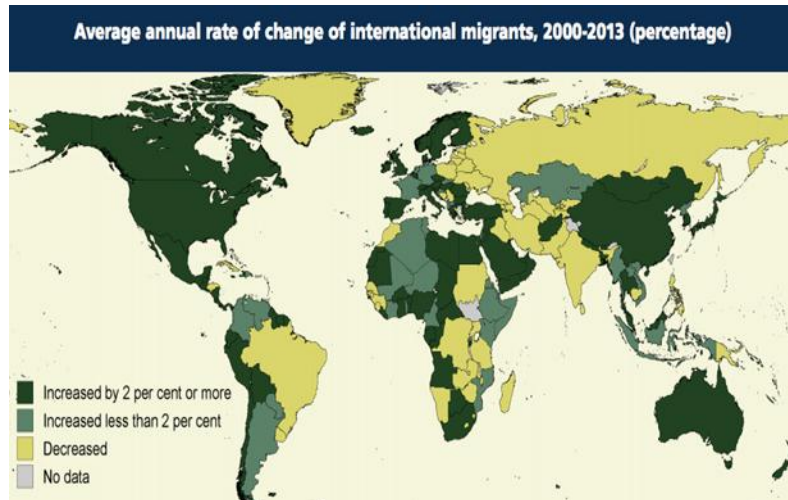
The composition or structure of a population is its makeup in terms of age, male-female ratio, and other properties as marital status and education. The following figure shows the example of the population structure

Now let us see the difference between the population structure of the developed and developing countries.



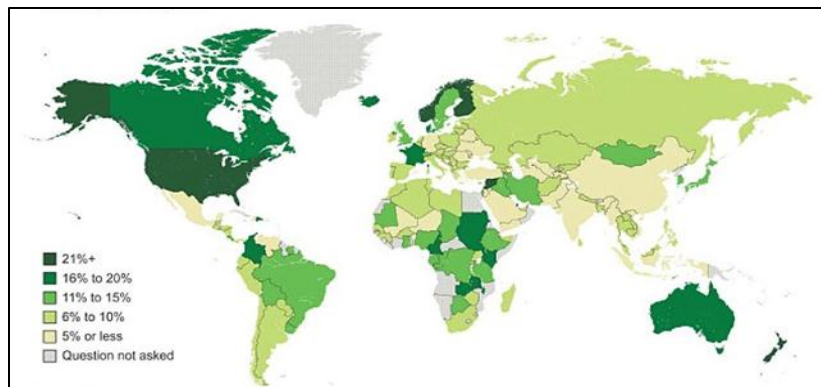
Migration

Topic – 124:



Migration is one of the factors behind the change of population. Migration (human) is the movement of people from one place in the world to another for the purpose of taking up permanent or semi-permanent residence, usually across a political boundary. It may be permanent, temporary, seasonal, periodic and

cyclic in nature. It is not necessary to shift out of the political boundaries of the state. Population growth involves not only natural increase but also the immigration of outsiders. In some countries beside negative population growth, these immigrants create positive balance.



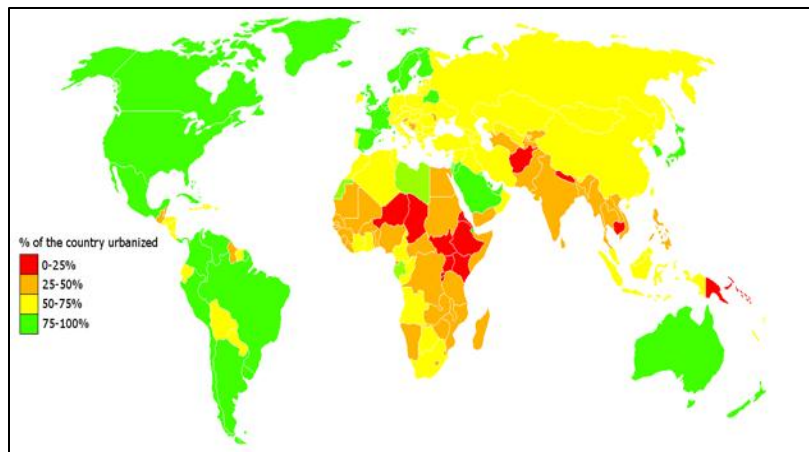
Internal migration include the mobility of the people from the place of their residence to the other place for the purpose of better living standard but the migrants do not cross the geographical boundaries. Rural-

urban and urban-urban migration is the best example.

External migration is the mobility of people out of the political border. While migration on the basis of will are, forced migration and voluntary migration. In forced migration the migrants are forced either by the severe weather condition or political disturbance or the violent activities, these factors

compel them to leave their home land. While in voluntary migration people leave their place of origin according to their own wills for the purpose of better life opportunities.

Topic – 125: Urbanization:



Urbanization is a population shift from rural to urban areas, "the gradual increase in the proportion of people living in urban areas", and the ways in which each society adapts to the change. Global urbanization map showing the percentage of urbanization per country in

2012. Green color shows 90% of the total population of the urbanization, yellow shows second highest, red shows below 25%.

Guangzhou, a city of 12.7 million people, is one of the 8 adjacent metropolises located in the largest single agglomeration on earth. 3% of the world's population lived in cities in 1800; proportion had risen to 47% by 2000, and reached 50.5% by 2010. By 2050, proportion may reach 70%. It is predominantly the process by which towns and cities are formed and become larger as more people begin living and working in central areas.

Lesson No. 36

Human Settlements

Topics - 126:

A settlement, locality or populated place is a community in which people live. A settlement can range in size from a small number of dwellings to the largest of cities with surrounding urbanized areas. Settlements may include hamlets, villages, towns and cities.

Hamlets are tiny settlements - they are just a collection of houses, perhaps centered around a few farms and maybe without even a shop.



Villages are small settlements - several hundred people live in them and they have: a few shops, a place of worship and maybe a school too; Towns are medium-sized settlements - thousands of people live in them and they have a shopping Centre and factories;

Topic – 127: Types of the settlement:

In geography, statistics and archaeology, a settlement is a locality or populated place or a community in which people live. Cities are large settlements –they usually have lots of services and sometimes a cathedral too (megacities have over 10 million people).



A megacity is usually defined as a metropolitan area with a total population in excess of ten million people. A megacity can be a single metropolitan area or two or more metropolitan areas. Here we have more cities as compared to the city life. In 2015, there are 35 megacities, Chennai being the

latest. The largest of these are the metropolitan areas of Tokyo and Jakarta the conurbation each of these having a population of over 30 million inhabitants. Tokyo is the largest metropolitan area, while Shanghai is the largest city proper. Following is the diagram of Mount Fuji as seen Civic Center, Tokyo.



A conurbation is a region comprising a number of cities, large towns, and other urban areas that, through population growth and physical expansion, have merged to form one continuous urban and industrially developed area. In most cases, a conurbation is a polycentric urban

agglomeration, in which transportation has developed to link areas to create a single urban labor market or travel to work area.

Topic – 128: Types of settlements:

Sometimes human settlements are controlled by type of their formation. There are various types and let us discuss them.

Dispersed Settlement:

If the number of villages is less than half the number of hamlets, the settlement is regarded as dispersed. The inhabitants of dispersed settlements live in isolated dwellings scattered in the

cultivated fields. Individualism, sentiments of living freely, custom of marriage relations are conducive to such settlements.

Nucleated Settlement:



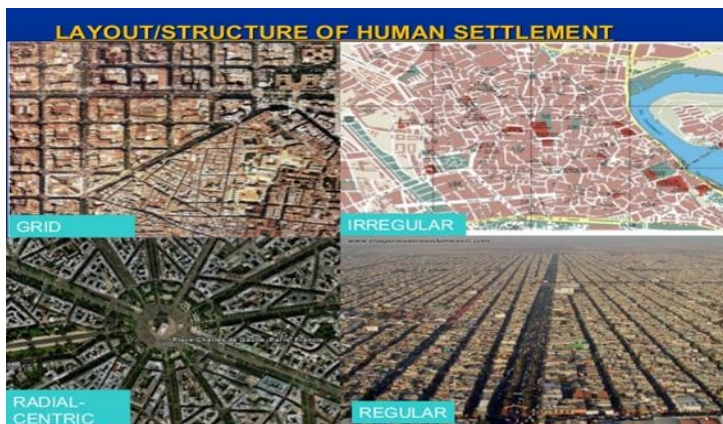
In this type of settlement the houses, even most farmhouses within the entire associated area of land, such as a parish, cluster around a central church which is close to the village green. Other focal points can be substituted depending on cultures and location, such as a commercial square, circus, crescent, a railway station, park or a sports stadium.

Linear Settlement:



Linear settlement is a (normally small to medium-sized) settlement or group of buildings that is formed in a long line. Many follow a transport route, such as a road, river, or canal, though some form due to physical restrictions, such as coastlines, mountains, hills or valleys.

The grid plan or grid street plan is a type of city plan in which streets run at right angles to each other, forming a grid. It is a method of land measurement.



Unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing)

A formal settlement is a located area for housing which has amenities such as electricity and sanitation added to it.

Lesson No. 37

Urbanization – 1

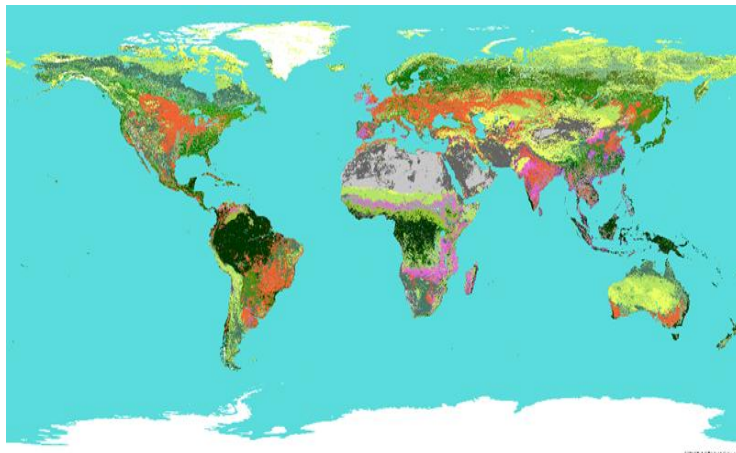
Topic – 129:

Urbanization is a population shift from rural to urban areas, "the slow but sure increase in the percentage of people living in urban areas", and the ways in which each civilization adapts to the change. Urbanization has different functions in developed and in developing countries as countries are controlled by either: Commercialization, Industrial production or Trade centers.

It reflects that cities functions can be different due to difference or change in economy. City development and development of various areas within the city depend on the major function of the city. Within city, there are different areas marked for multiple activities i.e. some areas are marked as residential areas, whereas some are labeled as commercial areas. At times there are certain areas marked for social activities. In short land actions are depended upon human activities and requirements. The dominant function in different cities varies. Major function of the cities changes with time. For example: London is known for its functions as financial centers, Lahore is attempting to be a services city or New Castle was famous for coal mines but now have heavy industries.

Land Use and Land Cover

“Land cover indicates the physical land type such as forest or open water whereas land use documents how people are using the land”. Continental surface changes with time as well. This is at times due to expansion of land use. Land use refers to nature controlled areas.



In the above diagram, different colors represent various forms of land cover land use. Yellow represents agriculture area whereas green and dark green represents pastures and forests. All these are nature controlled areas and called land covers. On the other hand, due to certain human activities these areas are changed into

land covers by making housing schemes, industries, sub urban areas etc. Land use is due to human

controlled activities and functions. For example, Malaysia planned to have development as per international standards till 2020. Instead of affecting their agriculture areas, they worked on the development of barren land and bring it in use by the establishment of residential areas, hospitals, industries etc.

Topic – 130: Urbanization – 2:

City Functions

City functions are different in developed and developing countries due to their functionalities. Developed countries usually focus on services whereas developing countries are either production based on Anglo-based activities. Some of the city functions are as follows which influence urbanization:

- Selling goods and services
- Providing jobs
- Administration
- Entertainment centers
- Cultural centers
- Religious centers
- Transport hub
- Residential areas
- Special public services

CBD: Central Business Districts. Central area of the city, form where city originally started it usually has a lot of services and is:

- Most accessible area
- Centrally located with easy access to motor way etc.
- Metro routes

Topic – 131: Urbanization – 3:

Urban places / areas are usually densely populated areas. They can be small or big or at times called hyper city controlled by urban activities.

Open Space

- There are large areas of open spaces included the parks and lakes and large playing areas.
- Scattered around the city to give service to the population of various residential area.

City Suburbs

- Expensive residential housing areas, comprises of semidetached and detached housing where people can afford more land for gardens and bigger houses.
- It has better facilities and away from the crowd.
- Less pollution (noise etc.)

Terraced Housing

- Just outside of the inner city, tends to be another area of low cost residential area.
- They have very small houses with no gardens.
- This area belongs to worker class who tend to stay close to their work place.

Inner City

- This area is outside CBD.
- This is the mixture of old industrial housing and industry.
- This is the second circle of the city belongs to CBD.

CBD

- centrally located
- origin of the city
- Crowded and land is usually expensive.

Topic – 132: Urbanization – 4:

Factors behind movement of the people within country and between countries are the same for developed and developing world. In the developed world 90% of the population belongs to urban area and 10% belong to the rural area which reflects that the migration percentage is low. Whereas, in developing countries, migration within the country is high from rural to urban area. For example, in Pakistan 37% population belongs to urban area and the remaining is from rural area.

Major reasons behind this movement are:



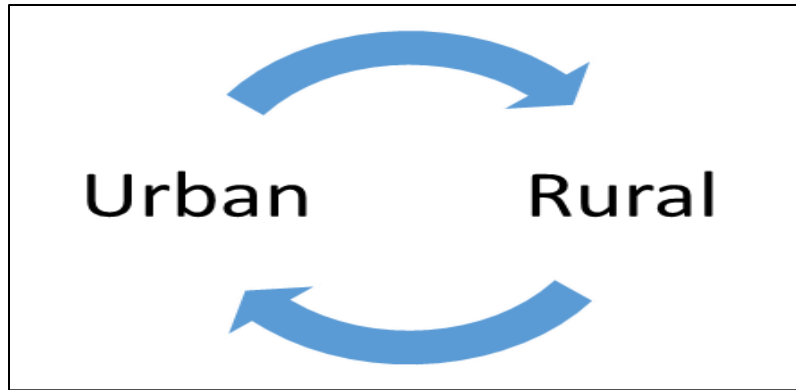
Or

Major factors influence this movement from one place to another are:

- Education
- Entertainment
- Parks
- Information flow
- Employment
- Economic condition

Lesson No. 38

Urbanization – 5

Topic – 133: Urbanization – 5:

Movements of people are as follows:

In developed countries people move from urban to open space to avoid crowd, over populated areas, noise pollution etc. This type of movement is called de-urbanization. Majority of movement is from rural to urban

areas and is known as urbanization. There are issues and problems of the urbanization.

- Traffic flow
- Air pollution
- Smog
- Water pollution
- Urban diseases
- Urban crime

Topic – 134: Urbanization –6:

In the urban society most of the population belongs to the education. The main is that people from neighboring cities or countries come for the purpose of education. Secondly the most important dominant area is employment. So in both the areas ratio of young people is more as compared to others. The growth rate of Pakistan is 1.8 but if we see the growth rate of Karachi or Lahore it is 4 more than the countries growth rate.

Traffic flow

The increase in the traffic flow is due to people migrating from neighboring areas. The service areas of the city have increased traffic flow day by day. This results in small hazards such as traffic accidents which kill 1.2 million people per year. Pedestrian and vehicle movement networks in cities are a

central concern of urban areas.

Urban Air pollutants



When we are dealing with the traffic flow and the industrial establishment in the urban areas pollutants are developed due to these two sources. Pollutants are in the form of nocks, cocks and socks meaning sulphur dioxide, carbon dioxide, carbon monoxide and nitrogen oxide. These are actually the greenhouse gases find in the air which results in the rise of

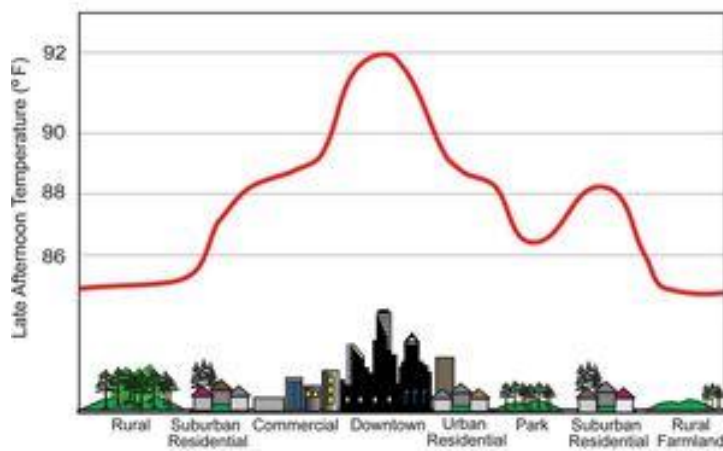
temperature in these areas. High concentrations of suspended particulates adversely affect human health, provoking a wide range of respiratory diseases and exacerbating heart disease and other conditions

Urban Dust Dome



The dome-shaped formation of stagnant and polluted air above a city is known as a dust dome. The urban heat island which causes a city to heat up, caps the dust and other particulates at a low level in the atmosphere. If there is not a strong enough wind, then this dome that is created remains intact and causes that heated up air within the urban heat island. Though if the wind does blow strong enough, then

this dome is blown downwind causing it to move out of the city. Industrial machinery and furnaces, manufacturing complexes, cars, and even air conditioners heat up the city's air; building materials such as concrete, asphalt, and brick retain and radiate that heat well into the night. The large number of windows and other reflective surfaces serve to trap heat, and the lack of areas of open water sustains it.



Temperature Inversion

Temperature inversion is the condition in which the temperature of the atmosphere increases with altitude in contrast to the normal decrease with altitude. When temperature inversion occurs, cold air underlies warmer air at higher altitudes.

Topic – 135: Urbanization –7:

Today world is facing the phenomena of climate change, it is a process of where we have the change of climatic condition of the globe and recent trend is call the global warming trend, this is the part of change in climate.

Climate change



Climate change, also called global warming, refers to the rise in average surface temperatures on Earth. An overwhelming scientific consensus maintains that climate change is due primarily to the human use of fossil fuels, which releases carbon dioxide and other greenhouse gases into the air. Climate change is a global phenomenon, but a deeply local issue.

Urban areas contribute to climate change through resources use in urban activities.

Industrial water pollution

Industrial water pollution is caused by the discharge of harmful chemicals and compounds into water, which makes it unsuitable for drinking and other purposes. Although 70% of the Earth is covered by water, only water bodies like lakes, ponds, rivers, reservoirs, and streams provide us with fresh water, and so, keeping them clean is an issue of survival not only for humans but for all other forms of life.



The above figure shows the max areas having industrial water pollution and these are the regions where we have developed or manufacturing areas. Much of the manufacturing belongs to middle latitude because of moderate temperature and more working hours in these areas. These areas are

producing maximum amount of the liquid and solid waste because of industry present.

Most industries in the country are located in or around major cities and are recognized as key sources of increasing pollution in natural streams, rivers, as well as the Arabian Sea through discharging toxic water. The contamination of shallow groundwater near industrial plants has been an area of concern as groundwater pollution is often permanent and it may take 100s or even 1000s of years for pollutants such as toxic metals from the tanneries to be flushed out of a contaminated aquifer.

In Pakistan, only 1% of wastewater is treated before being discharged directly into rivers and drains. For example in NWFP, 80,000 m³ of industrial effluents containing a very high level of pollutants are discharged every day into the river Kabul causing observable incident of skin diseases, decrease in agricultural productivity and decrease in fish population.

Urban Solid and liquid wastes

Greater the society population and material wealth, the greater the amount and variety of its garbage and solid waste will be. So developed country of the late 20 century are increasingly discovering that their material wealth and technological achievements are submerging them in a volume and variety of waste solid and liquid harmful and toxic. In north America it produces rubbish and garbage at a state of 200 million tons per year or about 1.6 kilogram per person per day. So this is actually a tragedy of the developed world and also the tragedy of the developing world where industrial establishment is more with the passage of time.

Urban diseases due to water pollution



When water polluted from various sources is accumulated at a certain place, many mosquitoes, flies and insects are produced which cause malaria, Philaria, dengue, yellow fever, encephalitis and many other infectious diseases.

Ocean Dumping



Ocean dumping is the most toxic waste material dumped into the oceans includes dredging material, industrial waste, sewage sludge and radioactive waste. Over the past 150 years, all types of wastes have been ocean dumped. These include sewage (treated and untreated), industrial waste, military wastes (munitions and chemicals), entire ships, trash,

garbage, dredged material, construction debris, and radioactive wastes (both high- and low-level). It is important to note that significant amount of wastes enter the ocean through river, atmospheric, and pipeline discharge; construction; offshore mining; oil and gas exploration; and shipboard waste disposal. Unfortunately, the ocean has become the ultimate dumping ground for civilization.

Topic – 136: Urbanization –8:



In many urban centers across the world, high crime and violence rates are undermining growth, threatening human welfare and curtailing social development. Like in Pakistan, Karachi and the neighboring cities are facing high rate of violence because of certain things which belong to the society. It is also found in the

developing countries too. Urban crime and violence constitute a serious impediment to economic and social development globally.

Environmental challenges



The most important environment concern now is the climate change; millions of people could suffer hunger, water shortages and coastal flooding as the world warms. Poorest countries and the people who are most vulnerable to threat will suffer the most. Current forms of urbanization are pushing the lowest-

income people into locations that are prone to natural hazards. In developing countries, four out of

every ten non-permanent houses are now located in areas threatened by urban floods, urban fire, landslides and other natural disasters. A second environmental concern is long-term increase in the use of fossil fuels. The global use of oil as an energy source has promoted urbanization. The planet has been affected in current times with the greenhouse gasses which are detrimental to maintaining life and sustainable environment on earth. Pakistan is a very small contributor in greenhouse effect; Pakistan contributes only 0.2 % greenhouse gases of the whole world. We are growing at the rate of more than 8 percent in GDP and creating lots of economic opportunities, this is also growing stress and implications on environment. The constant growth in population is another massive challenge.



As we grow economically, we have to decide at this point in time that we ensure better quality of life. At the end of the day, when we have more money but our quality of life suffers and we can't breathe and drink pure water; then it is not worth it. The poor cannot deal with the impacts of a degraded environment. The migrants usually are poor and are

forced to live in urban slums. Out of the total population 45 percent of the people in Sindh and 50 percent in Punjab live in one-room houses. They often are not linked to water supplies and sanitation. The reason is their lack of financial resources and the administration does not provide these because that might give them legal status. Their habitats are environmentally vulnerable and they do not have access to many facilities. As a result they are prone to diseases because they live in low-income houses usually in industrial areas and have little choice in the quality of their nutritional intake. This increases their vulnerability to diseases, which they do not have the capacity to treat. They have minimum access to health services and spend long hours in polluted work places (factories) or work as unskilled labor.

Topic – 137: Urbanization –9:

Economic challenges

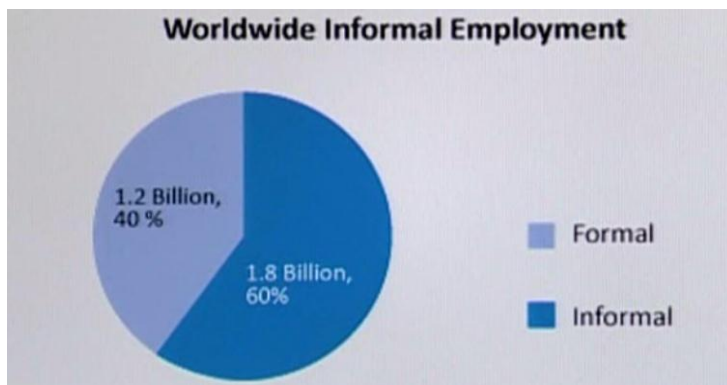
Four out of every five new jobs are in the informal sector, which currently employs 57 percent of the workers. The main problem is that most of these poor lives in urban cities and towns and they have less opportunities as compared with country side poor. They are dealing with economic problems like economic loss due to war on terrorism, energy crisis, poorly managed tax system, low export and high import, inflation etc. In Mexico City, 60 percent of residents work in the informal sector, and the number of street vendors increased by 40 percent. The informal economy in Pakistan is large where workers have limited access to labor welfare services. The Labor Force Survey 2008-09 states that the informal sector accounts for more than 73.3 per cent of the employment in main jobs outside agriculture, more in rural than in urban areas. The informal sector has shown increase in its employment from the previous year.

Informal workers



participate in the informal economy are typically classified as employed. Like street venders in Colombia, waste picker in Indonesia and street vendors in India

The informal sector is largely characterized by several qualities: easy entry, meaning anyone who wishes to join the sector can find some sort of work which will result in cash earnings, a lack of stable employer-employee relationships, a small scale of operations, and skills gained outside of a formal education. Workers who



The figure above shows a difference between the formal and informal employment around the globe. The ratio of informal employment 60 % is more than that of formal employment 40% which is 1.8 billion and 1.2 billion. About 0.2 million, new urban dwellers are added to the world's urban population each day mostly in the developing countries.

Rapid urbanization, urban poverty and the growth of slums have also refocused attention. 17% of the cities in the developing world are experiencing annual growth rate of 4 percent or more. The bulk these urbanities are poor and therefore will not be able to meet their accommodation and services need through formal mechanisms.

Topic – 138: Urbanization –10:

Green Agenda



The green agenda a natural system, global, regional and local, used as services by cities. Green Agenda is a participatory method for developing and implementing local sustainable development strategies and plans with active involvement of the different sectors in the local community where the process is conducted.

Eco system: that provides green open space used by the city for biodiversity protection and recreation.

2. **Water system:** that cities use to tap the natural flow for water supply and waste disposal.
3. **Climate and air systems:** that provides cities with the requirements for health life.
4. **Other ecological services:** including agricultural and forestry systems providing food and fiber for cities.

Brown agenda

Human systems required to make cities healthy and live able, which are part of the city. To put it simply, the brown agenda is about pollution. It is about toxic waste contaminating the environment and poisoning people. It is about rapid, loosely regulated industrialization and the legacy of toxic waste left behind, even from factories, mines and other facilities that have been shut down because of excessive pollution.

1. **Waste systems:** to recycle and remove wastes from the cities, including solid, liquid and air waste.
2. **Energy systems:** to provide power, heating, cooling and lightening for all cities functions.
3. **Transport system:** to enable mobility in the city, including fuel.
4. **Building materials and systems:** that provides the physical basis of life in cities.

The brown agenda depend upon how the metabolism of the city is managed. This is through the material we are using, energy consumption and transport, induction use of material and the creation of efficient build environment. These system are always provided in the cities using and increasing geological footprints in other words brown agenda has always tended to assume the green agenda to consume and dominate it.

Sustainable city

Cities are hubs for ideas, commerce, culture, science, productivity, social, human and economic development. Urban planning, transport systems, water, sanitation, waste management, disaster risk reduction, access to information, education and capacity-building are all relevant issues to sustainable urban development. A sustainable city creates an enduring way of life across the four domains of ecology, economics, politics and culture. However, minimally a sustainable city should firstly be able to feed itself with a sustainable reliance on the surrounding countryside. Secondly, it should be able to power itself with renewable sources of energy. The crux of this is to create the smallest possible ecological footprint, and to produce the lowest quantity of pollution possible, to efficiently use land; compost used materials, recycle it or convert waste-to-energy, and thus the city's overall contribution to climate change will be minimal, if such practices are adhered to.

Lesson No. 39

Energy Resources– 01

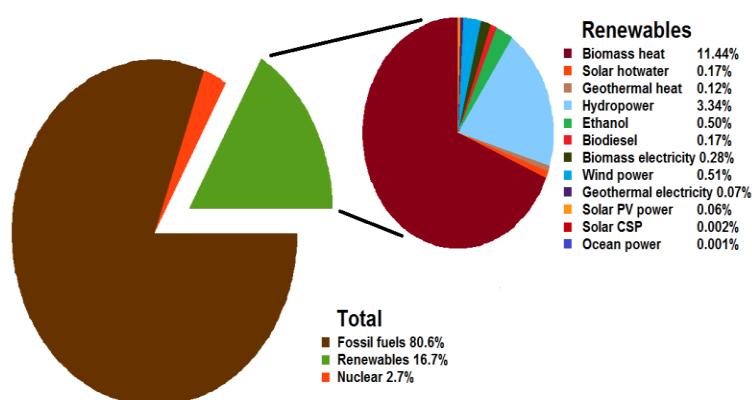
Topic – 139:

"Energy Resources" is about ways of getting energy so we can generate electrical power. The world energy resources can be divided into non-renewable and renewable resources. A nonrenewable resource is a natural resource that cannot be re-made or re-grown at a scale comparable to its consumption like nuclear resources, coal, petroleum and natural gas. Renewable resources are natural resources that can be replenished in a short period of time like solar, geothermal, wind and biomass.

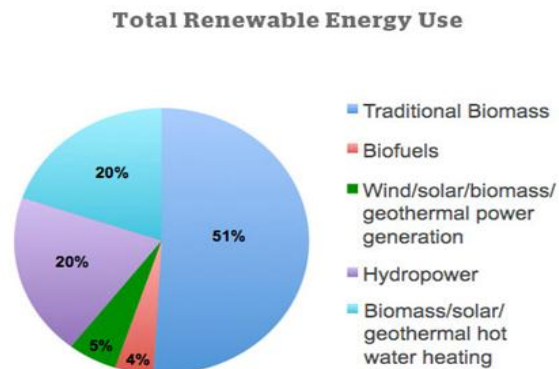
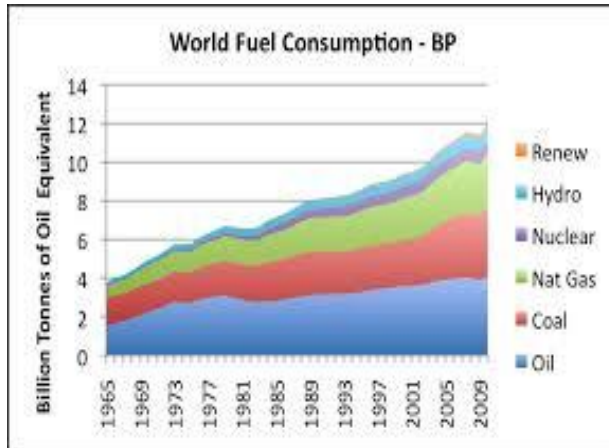
Fossil fuels

Fossil fuels are formed by natural processes as decomposition of buried dead organisms. The age of the organisms and their resulting fossil fuels is millions of years, sometimes exceed 650 mya. Fossil fuel is a general term for buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and

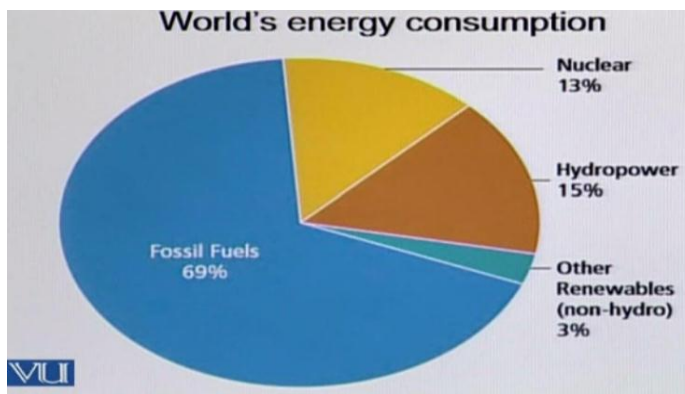
pressure in the earth's crust over hundreds of millions of years. Fossil fuel energy consumption (% of total) in Pakistan was last measured at 60.89 in 2011.

Comparison of Non- renewable and Renewable Resources

World fuel consumption and Total renewable energy use

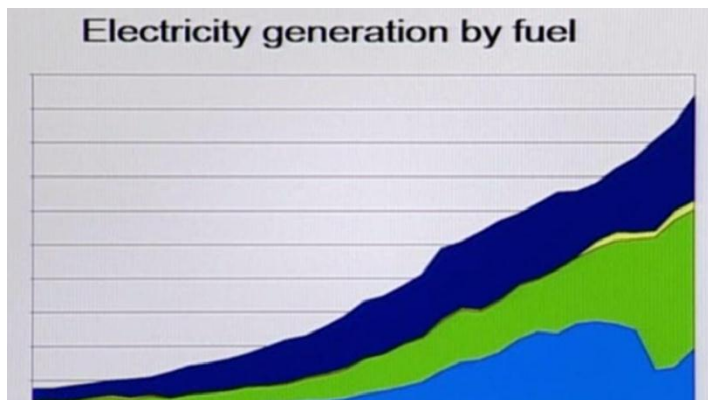


World energy consumption



Topic – 140: Energy Resources-02:

The consumption of fuel in the developing countries are less as compared to the developed countries. In developed countries the consumption of fuel is more like Canada and America is on one number which uses the maximum quantity of fuel. When we compare these countries with India, China and Pakistan, there is a big difference here; the per capita consumption is much less.



The above graph shows the certain rise in different colors with the passage of time, the flow is rising gradually. The blue shows coal, green shows oil and gas, and light blue shows water. So in electricity generation, these three fuels are being used worldwide, and the yellow color is controlled by nuclear power. Nuclear power in electricity generation is playing a minor role. With the passage of time,

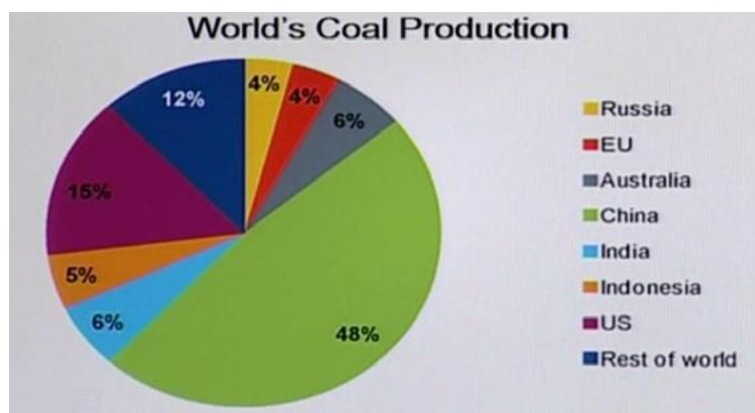
rise among the consumption of fuel is increasing. Farmers in developing countries rely on their own physical energy or energy of animals to plough or tend the field. In contrast the developed agriculture countries are consuming more fuel energy through use of tractors, automatic loaders and combine harvesters. Additional energy is required to develop fertilizers and pesticides widely used in industrialized agriculture. World energy consumption has increased every year since 1989 from 2004 to onwards. For example energy consumption increased worldwide by about 3.4 %, the increase is not however evenly distributed around the world. China has nearly doubled its energy consumption in the past decade. Similarly India has increased its consumption 50% more than it did in last 1990s by contrast USA use about 6% more energy as before and Japan use only 2.5% more. Pakistan is one of the richest countries of the world in terms of natural resources with gigantic reserves of coal, gas, gemstones, copper and gold.

Energy Resources-02

Topic – 141:

Non-renewable resources

Non-renewable resources is a resource that does not renew itself at a sufficient rate for sustainable economy. An example is carbon-based, organically-derived fuel. The original organic material, with the aid of heat and pressure becomes a fuel such as fossil fuels (coal, petroleum, natural gas) are all non-renewable resources. It is extracted by humans only where geological processes such as heat, pressure, organic activity, weathering and other processes are existed enough to become economically viable to extract. These processes generally take from tens of thousand millions of the years through tectonic plates, tectonic subsidence and crustal recycling.



Coal is the most abundant fossil fuel that launched the industrial revolution and has continued to grow in use; coal is the fastest growing fossil fuel. fossil fuel energy consumption (% of total) in Pakistan was last measured at 60.89 in 2011, its highest value over the past 40 years was 63.39 in 2007, while its lowest value was 35.29 in 1972, according to the world bank.

fossil fuel comprises coal, oil, petroleum, and natural gas products.

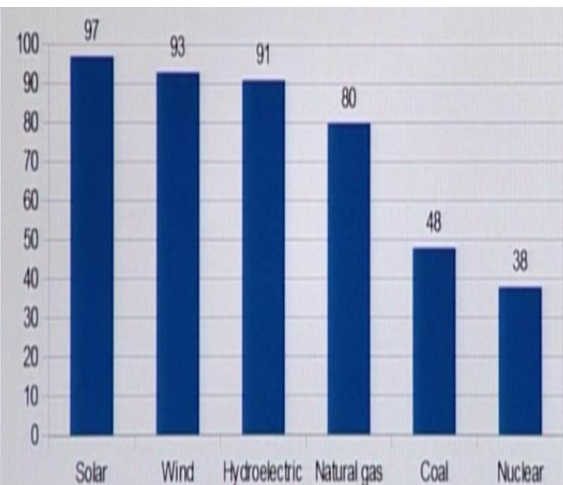
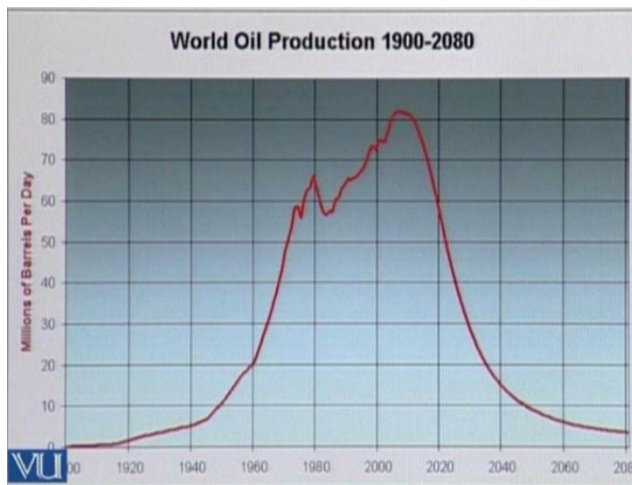
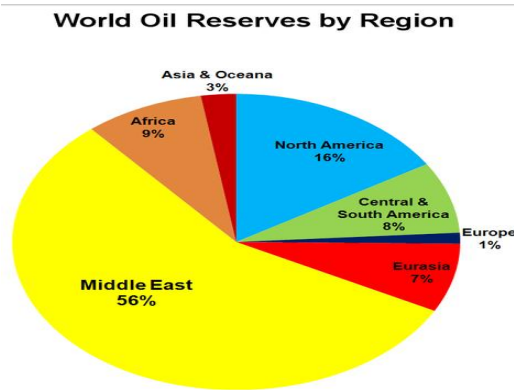
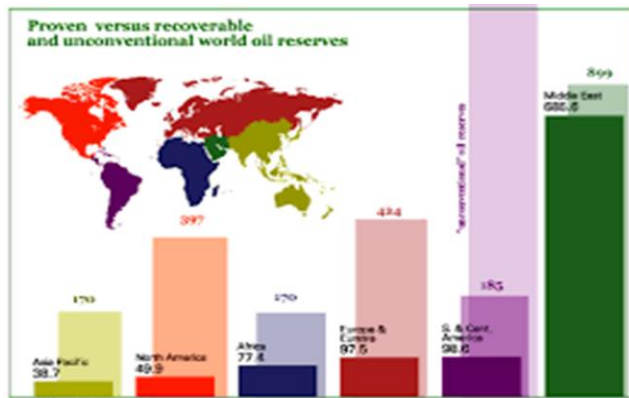
Extraction of coal

Surface mining and deep underground mining are the two basic methods of mining. The choice of mining method depends primarily on depth of burial, density of the overburden and thickness of the coal seam. Seams relatively close to the surface, at depths less than approximately 180 ft (50 m), are usually surface mined.

China which already has many of the world's most polluted cities, was in 2007 building two coal fired plants every week. Coal triggered global warming concerns and other pollutants. According to the international energy agency the proven reserves of coal are around 909 billion tonnes, which could sustain the current production rate for 155 years.

Topic – 142: Energy Resources-04:

Sustainability environmental concerns related to global warming and sustainability are expected to move the world's energy consumption away from fossil fuels.



The economic pressure through less carbon emissions and green taxation, some countries are taking action as a result of the Kyoto protocol and further steps in this direction are proposed. The European commission has proposed that the energy policy of the European union set abiding target of increasing the level of renewable energy in the EU's from 7% in 2007 to 20% by 2020.

Topic – 143: Energy Resources-05:

Renewable resources

Renewable resources unlike non-renewable resources, which are eventually depleted, a simple comparison is a coal mine which once has been exhausted is gone. Renewable energy is generally defined as energy that comes from resources which are naturally available such as sunlight, wind, rain, tides, waves and geothermal heat.

Wind power is extraction from the air flow using wind turbines to produce mechanical or electrical power. Windmills are used for their mechanical power. Wind power as an alternative to fossil fuels. Wind power is a renewable, widely distributed, clean, no greenhouse gas emissions during operation and uses little land. Far less problematic than those of non-renewable power sources.

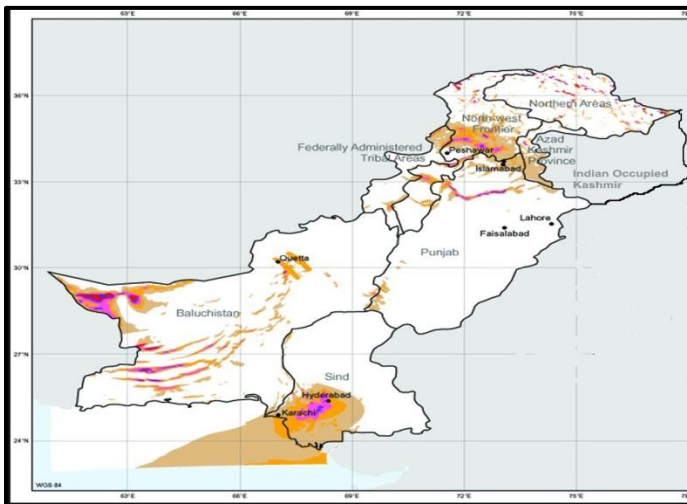


The Gansu wind farm in China is a group of large wind farms under construction in western Gansu province in China. It is scheduled to have the highest power output in the world.



Wind power in Pakistan

In Pakistan where three regions are very important in wind power the southern part of Sindh where the wind comes during the summer from the southern side of Sindh. The second most regions is in Baluchistan winds come from the western side of Baluchistan and the third important region is the northern side of Pakistan which includes area of Khyber pakhtun khan, the Punjab and gilgit baldistan.



Hydroelectricity is the term referring to electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water. It is the most widely used form of renewable energy, accounting for 16 % of global electricity generation production in 2010. Hydro power is produced in 150 countries, with the Asia Pacific region generating 32 % of global hydropower in 2010. In the budget 2013-14: RS 57.840 billion was allocated for water resources development

in Pakistan.

Renewable energy replaces conventional fuels in four district areas: electricity generation, air and water heating/cooling, motor fuels and rural energy services.

Topic – 144: Energy Resources-06:

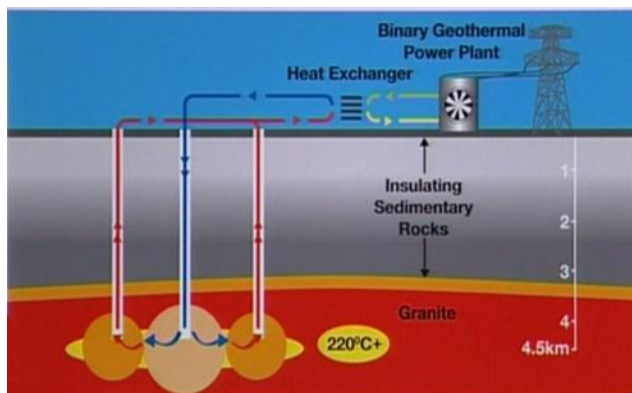
Biomass

Biomass is a biological material derived from living organisms. In context of biomass as a resource for making energy, it refers to plants or plant-based materials. As an energy source, biomass can either be used indirectly to produce heat or indirectly after converting it to various forms of biofuels. Wood remain the largest biomass energy source include forest residues and even municipal solid waste. Industrial biomass can be grown from numerous types of plants, including corn, poplar, willow, sorghum, sugarcane, bamboo and a variety of tree species, ranging from eucalyptus to palm oil. Biomass is the oldest fuel known to humans consists of such material as fast growing plants and crop waste and wood chips, animal waste and wood. Biomass contains chemical energy which comes from sun radiant energy which photosynthesis organism use to form organic molecule. Biomass is renewable form of energy when use no faster than it is produce. Deforestation and desertification can result when biomass is over used. Biomass cannot replace fossil fuel. The entire photosynthesis production of the continual amount to only half of our current energy use and that mean devoting it no other use include paper food or construction material. Biomass fuel which can be solid liquid gas is burned to release energy. Solid biomass such as wood is burn directly to obtain energy.

Biomass energy can be used in those areas where we have sugarcane production. Mostly in south Asia and Second area is Brazil where sugarcane is found. The biomass used for electricity generation varies by region. Agricultural waste is common in Mauritius (sugar cane residue) and Southeast Asia (rice husks). Conversion of biomass to biofuel can be achieved by different methods which are broadly classified into: thermal, chemical and biochemical methods

Topic – 145: Energy Resources-07:

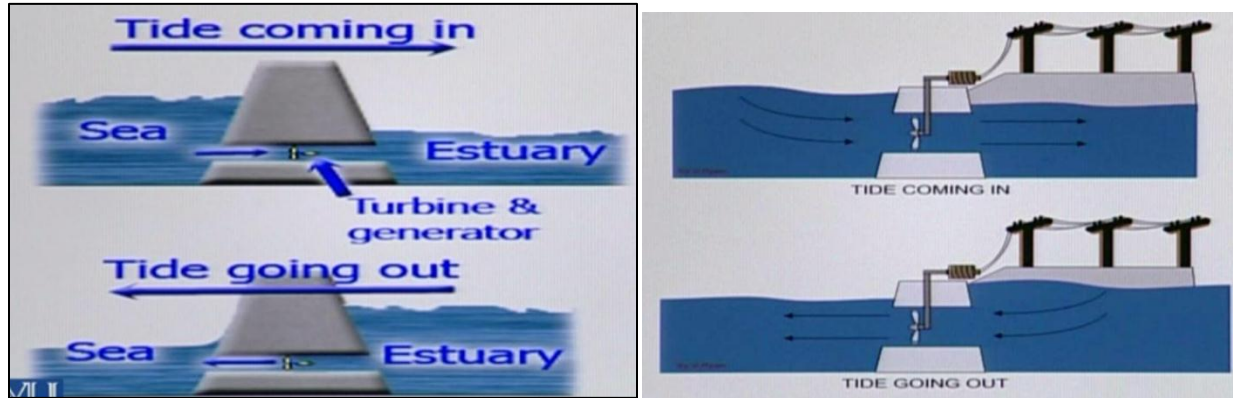
Geothermal energy



Geothermal energy is the heat from the Earth. Its clean and sustainable resources of geothermal energy range from the shallow ground to hot water. Hot rock found a few miles beneath the earth's surface and down even deeper to the extremely high temperatures of molten rock called magma.

Natural heat within the earth arises from the ancient heat within the earth core, friction where the continental plates collide with one another and from the decay of radioactive elements. The amount of geothermal energy is enormous.

Special turbines and other technologies can capture the power of waves and tides and convert it into clean, pollution-free electricity. Water turbines were developed in the 19th century and were widely used for industrial power prior to electrical grids. Now they are mostly used for electric power generation. Water turbines are mostly found in dams to generate electric power from water kinetic energy.



Like other renewable resources both wave and tidal energy are variable in nature. Waves are produced by winds blowing across the surface of the ocean.

Lesson No. 41

Energy Resources– 03

Topic – 146:

Conservation is the protection, preservation, management or restoration of wildlife and of natural resources such as forests, soil and water. A green vehicle is a road motor vehicle that produces less harmful impacts to the environment than comparable conventional vehicles running on gasoline or diesel. Solar vehicles: vehicle pollutants have been linked to human ill health including the incidence of

respiratory, cardio disease and lung cancer. A report estimated that 24,000 people die prematurely each year in the UK.



Human powered transport includes walking, bicycles, boats and other environmental friendly ways

A green hybrid vehicle: Hybrid taxi fleet operators in New York have also reported that reduced fuel consumption saves them thousands of dollars per year. Energy conservation also refers to reuse and recycle of energy available in the

given environment, as gray water can be used for kitchen garden and watering of plants.

Topic – 147: Energy Resources-09

Energy conservation



Energy conservation refers to reducing consumption through using less of an energy services. Energy conservation differs from efficient energy use, which refers to using less energy for constant services. For example driving less, turning your thermostat down a degree or two in the wintertime and unplugging your computer or home appliances when

they are not in use. In all of these examples, you are reducing the amount of energy you use by doing without or making due with less fuel or electricity. While energy conservation might cut down on your comfort level and make things a bit less convenient, it can help reduce monthly heating and electricity bills and save money at the gas pump. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy efficiency is defined as saving energy, but keeping the same level of service. For example, if you turn off the lights when you leave a room, you are practicing energy conservation. If you replace an inefficient incandescent light bulb with a more efficient compact fluorescent bulb, you are practicing energy efficiency. Energy conservation and efficiency are both energy reduction techniques. Energy conservation is sometimes known as sufficiency.



Automobile efficiency has been improved dramatically since 1970s as a result of lighter material and design that reduce air drag. The USA average fuel efficiency of new passenger car double between mid-1970s and 1980s, although it has decline since then a trend that has reduce the energy efficiency is the popularity of the mini vans or light trucks all of which have

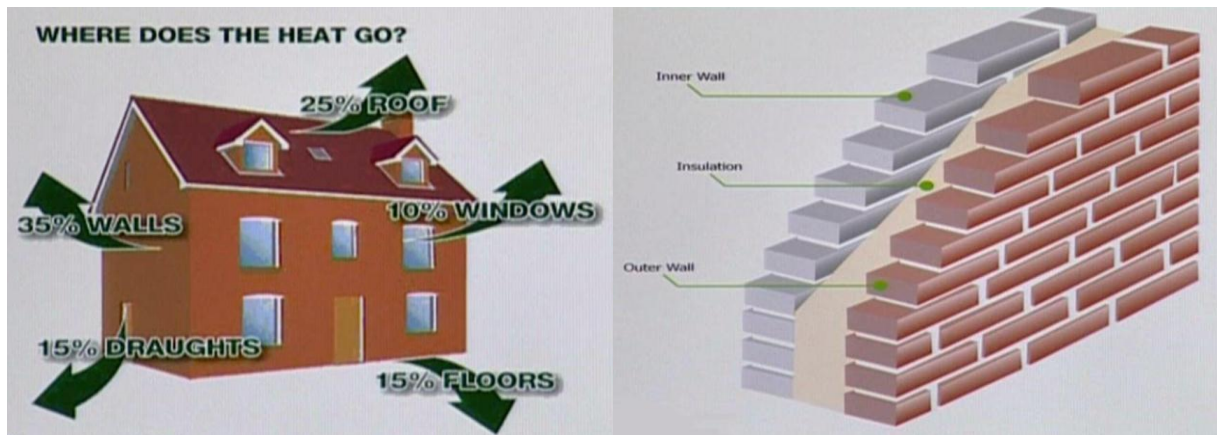
higher average gas mileage. Energy conservation and energy efficiency are both energy reduction techniques.

Topic – 148: Energy Resources- 10



Energy conservation reduces energy services; it can result in increased environmental quality, national security, personal financial security and higher savings. Energy conservation is at the top of the sustainable energy hierarchy. It also lowers energy costs by preventing future resource depletion. Efficient energy use, sometimes simply called energy

efficiency is the goal to reduce the amount of energy required to provide products and services. Insulating (thermal insulation is the reduction of heat transfer) a home to use less heating and cooling energy to achieve and maintain a comfortable temperature. A super isolated office building in Toronto Canada has south-facing windows with insulating glass. The building is so well isolated that it uses no furnace.



Improvements in efficiency are generally achieved by adopting a more efficient technology or production processes or by application of commonly accepted methods to reduce energy losses.

Lesson No. 42

Environmental hazards and disasters– 01**Topic – 149:****Environmental Hazards**

Environmental hazard is the state of events which has the potential to threaten the surrounding natural environment and adversely affect people's health. Hazards is natural or man-induced processes or event that cause potential losses to human lives, property damage, disruption to normal activities and essential functions of the community and damage to the environment. Once a hazard becomes "active", it can create an emergency situation. A hazard situation that has come to pass is called an incident. The environment provides resources (water, air, mineral and wood), i.e. opportunity, to human beings. However, when the disequilibrium of the nature exceeds the threshold of its natural fluctuation, it can trigger the occurrence of extreme environmental events, hazards or disasters.

Disaster

A disaster is serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses. The impact of disaster exceeds the ability of the affected community or society to cope using its own resources. In contemporary academia, disasters are seen as the consequence of inappropriately managed risk. These risks are the products of a

combination of both hazards and vulnerability. Hazards that strike in areas with low vulnerability will never become disasters, as is the case in uninhabited regions.

The losses due to natural hazards are 20 times greater (as a percentage of GDP) in developing countries than in industrialized countries.

Topic – 150: Environmental Hazards and disasters-02:**Natural hazards**

Hazards encompass geological and meteorological phenomena such as earthquakes, coastal erosion, volcanic eruption, cyclonic storms and drought. Natural events, those originating from extreme and/or common physical processes, are referred to as natural hazards. Earthquakes, volcanic eruptions, floods, hurricanes, tsunamis, blizzards, and tornadoes that originate in the lithosphere, hydrosphere, or atmosphere are some examples of natural hazards. Natural hazards can be further

categorized into hydro-meteorological or atmospheric hazards (typically weather-related) such as floods, droughts, forest fires, and tornadoes, and geophysical or geologic hazards such as earthquakes, tsunamis, and volcanic eruptions.

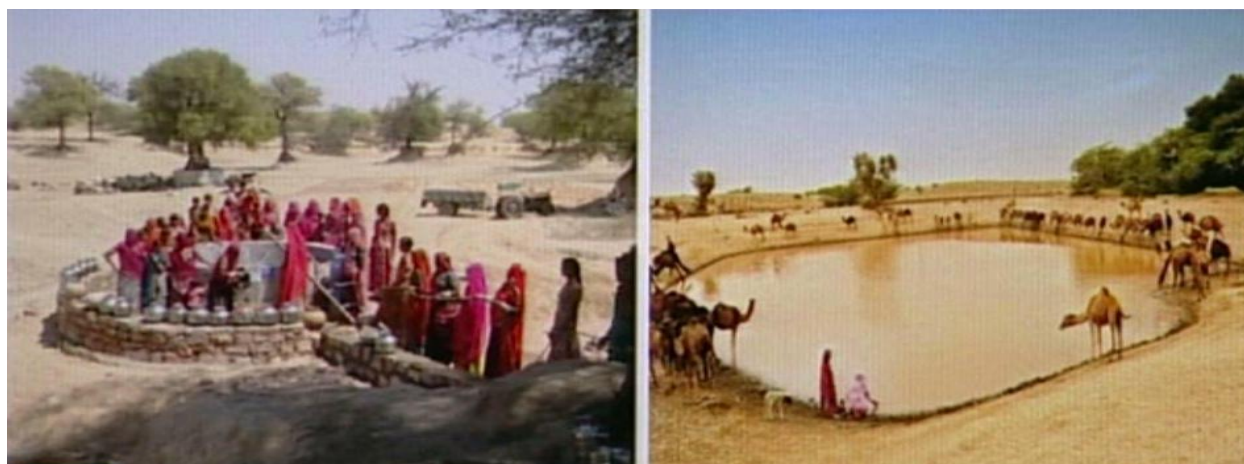
Biological hazards

Biological hazards can refer to a diverse array of disease and infestation. Hazards that originate for biological reasons (e.g., epidemics) are called biological hazards or biohazards. Sources of biological hazards include bacteria, viruses, medical wastes, insects, plants, birds, animals, and humans. These sources can cause a variety of health effects ranging from skin irritation, allergies, and infections (e.g., AIDS and tuberculosis) to deaths. Biological hazards are often divided into two categories: pathogens and toxins. Pathogens are organisms that spread disease and may include anthrax, smallpox, influenza, plague, hemorrhagic fever, and rickettsia, while toxins are poisons created by plants and animals. While pathogens could kill many people, toxins are not likely to do so. For example, the 1918 Spanish influenza pandemic killed more people in the United States than had died in combat in World War I. In recent years, public health officials have been very much concerned with several diseases (e.g., foot-and-mouth disease, HIV/AIDS, the hantaviruses, severe acute respiratory syndrome (SARS), the West Nile virus, dengue fever and the Avian “bird” flu) associated with biological hazards.

Other natural hazards such as floods and wild fires can result from a combination of geological, hydrological and climatic factors. The global climate risk index 1993-2012 has ranked Pakistan as the 12th most affected by extreme weather events. The temperature increase will result in more heat waves and will also affect the country’s water demand.

Topic – 151: Environmental Hazards and disasters-03:

Pakistan has witnessed a 0.76 C rise in temperature during the last 40 years, but more disturbing is that the mountainous areas of Gilgit- Baltistan and Chitral have increase of 1.5 C during the same time period. More than 40% of the population in Pakistan is at risk of natural disasters such as droughts, floods and cyclones.



In Pakistan 40 % of total area is covered with plains and deserts. Deserts are 9 to 10 of total area of Pakistan it includes cholistan, thar- parkar and thal. The main issue of this type of land is water. Lack of clean water, due to which human as well as animals suffers.



An avalanche (also called a snow slide or snow slip) is a rapid flow of snow down a sloping surface. Avalanches are typically triggered in a starting zone from a mechanical failure in the snowpack (slab avalanche) when the forces on the snow exceed its strength but sometimes only with gradually widening (loose snow avalanche). Avalanches to rise in temperatures in the northern area and warned that the late spell of snowfall coupled with increased

temperatures might increase the chance of avalanches in northern Pakistan. While avalanches are sudden, the warning signs are almost always numerous before they let loose. Yet in 90 percent of avalanche incidents, the snow slides are triggered by the victim or someone in the victim's party. Avalanches kill more than 150 people worldwide each year. Most are snowmobilers, skiers, and snowboarder.

Topic – 152: Environmental Hazards and disasters-04:

Flood



A flood is an overflow of water that submerges land which is usually dry. Flooding may occur as an overflow of water from water bodies such as a river or lake. Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to homes and businesses. Some floods as flash floods can develop in just a few minutes and

without a visible signs of rain. Additionally, floods can be local impacting a neighborhood or community, or very large, affecting entire river basins. In 2003, Sindh province was badly affected when above normal monsoon rainfall caused flooding in the province; urban flooding also hit Karachi where two days of rainfall of 284.5 mm occurred. In September 2014, due to massive rain in the northern areas as well as Azad Kashmir and in Punjab constituted flood situation in river Chenab and river Jhelum. An estimated 0.75 million people in Pakistan are badly affected by floods each year resulting an annual loss of almost 15 to the country's GDP, which is US\$ 2.7 billion.



A hurricane is a huge storm! It can be up to 600 miles across and have strong winds spiraling inward and upward at speeds of 75 to 200 mph. Each hurricane usually lasts for over a week, moving 10-20 miles per hour over the open ocean. Hurricanes gather heat and energy through contact with warm ocean waters. Evaporation from the seawater increases their power.

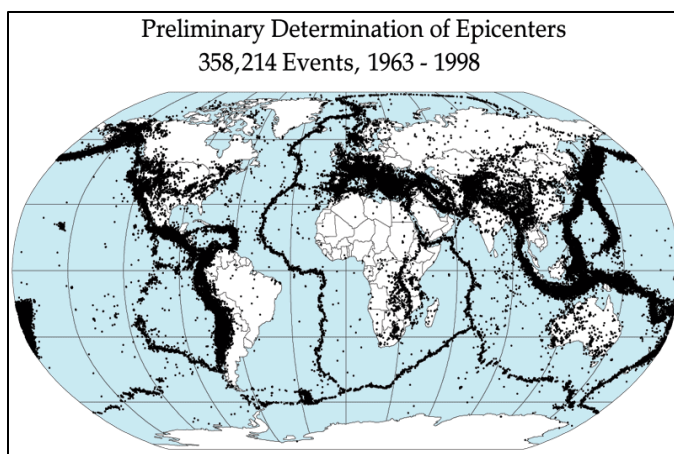
Hurricanes rotate in a counter-clockwise direction around an "eye" in the Northern Hemisphere and clockwise direction in the Southern Hemisphere. The center of the storm or "eye" is the calmest part. It has only light winds and fair weather.

Tropical Cyclones are low pressure systems that form over warm tropical waters and have gale force winds (sustained winds of 63 km/h or greater and gusts in excess of 90 km/h) near the centre. Technically they are defined as a non-frontal low pressure system of synoptic scale developing over warm waters having organised convection and a maximum mean wind speed of 34 knots or greater extending more than half-way around near the centre and persisting for at least six hours.

Earthquake

Topic – 153:

An earthquake is the perceptible shaking of the surface of the Earth, which can be violent enough to destroy major buildings and kill thousands of people. The severity of the shaking can range from barely felt too violent. Earthquakes have destroyed whole cities. They result from the sudden release of energy in the earth's crust that creates seismic waves. Earthquakes can be violent enough to toss people around and destroy whole cities. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.



Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter magnitude scale. These two

scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly imperceptible or weak and magnitude 7 and over potentially causes serious damage over larger areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal. At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides, and occasionally volcanic activity.

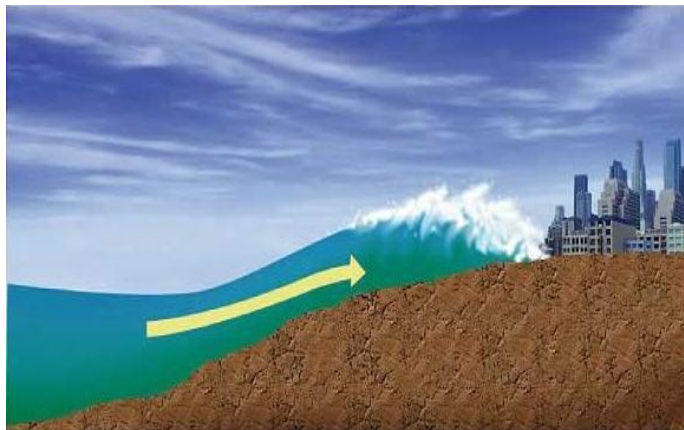
Pakistan is situated at the north western side of the Indian subcontinent and overlaps both with the Indian and the Eurasian tectonic plates. Its Sindh and Punjab provinces lie on the northwestern corner of the Indian plate while Balochistan and most of the Khyber-Pakhtunkhwa lie within the Eurasian plate which mainly comprises the Iranian plateau, some parts of the Middle East and Central Asia. Therefore, it has a history of earthquakes. The Northern Areas and Azad Kashmir lie mainly in Central Asia along the edge of the Indian plate and hence are prone to violent earthquakes

where the two tectonic plates collide. The 2005 Kashmir earthquake occurred at 8:50 am in Pakistan on 8th October in the Azad Kashmir Region. It was near the city of Muzaffarabad.

Topic – 154: Environmental hazards and disasters– 06:

Tsunami

A Tsunami is from Japanese word “harbor wave”, also known as a seismic sea wave or as a tidal wave; Tsunami waves do not resemble normal sea waves because their wavelength is far longer. Rather than appearing as a breaking wave, a tsunami may instead initially resemble a rapidly rising tide, and for this reason they are often referred to as tidal waves, although this usage is not favored by the scientific community because tsunamis are not tidal in nature.



Tsunamis cause damage by two mechanisms: the smashing force of a wall of water travelling at high speed, and the destructive power of a large volume of water draining off the land and carrying a large amount of debris with it, even with waves that do not appear to be large. As the tsunami approaches the coast and the waters become shallow, wave shoaling compresses the wave and its speed decreases below. Its wavelength

diminishes and its amplitude grows enormously. Since the wave still has the same very long period, the tsunami may take minutes to reach full height. Except for the very largest tsunamis, the approaching wave does not break, but rather appears like a fast-moving tidal bore.



An undersea earthquake in the Indian Ocean on 26th December 2004 produced a tsunami that caused one of the biggest natural disasters in modern history. Over 200,000 people are known to have lost their lives. The waves devastated the shores of parts of Indonesia, Sri Lanka, India, Thailand and other countries with waves reported up to 15 m high, reaching as far as Somalia on the east coast of

Africa, 4500 km west of the epicenter. Refraction and diffraction of the waves meant that the impact of the tsunami was noticed around the world and sea-level monitoring stations in places such as Brazil and Queensland also felt the effect of the tsunami.

Drought

Topic – 155:

Drought is a period of below-average precipitation in a given region, resulting in prolonged shortages in its water supply, whether atmospheric, surface or ground water. A drought can last for years. It can have a substantial impact on the ecosystem and agriculture of the affected region. Droughts can persist for several years; even a short, intense drought can cause significant damage and harm the economy.



Meteorological Drought

A meteorological drought is brought about when there is a prolonged time with less than average precipitation. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. Meteorological drought must be considered as region specific since the atmospheric conditions that result in

deficiencies of precipitation are highly variable from region to region. Meteorological drought usually precedes the other kinds of drought.



Agricultural Drought

Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth. Agricultural droughts affect crop production or the ecology of the range. This condition can

also arise change in precipitation levels. The soil conditions and erosion triggered by poorly planned agricultural endeavors cause a shortfall in water available to the crops.



Hydrological Drought:

Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale.

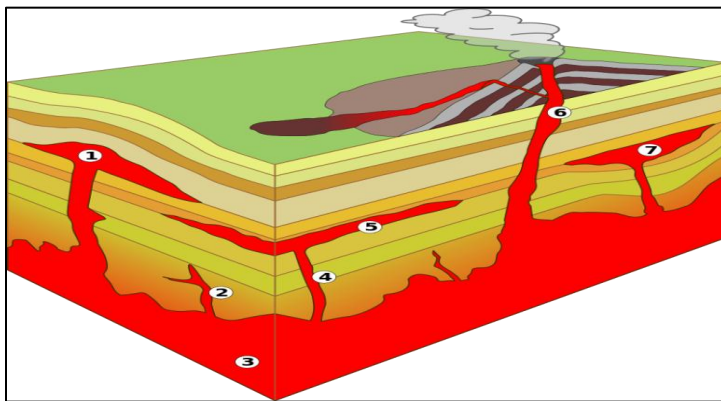
Although all droughts originate with a

deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system.

Topic – 156: Environmental hazards and disasters-08

Volcanism

Volcanism is the phenomenon of eruption of molten rock (magma) onto the surface of the earth where lava, pyroclastic and volcanic gases erupt through a break in the surface called a vent. Magma from the mantle or lower crust rises through its crust to the surface. If magma reaches the surface, its behavior depends on the viscosity of the molten constituent rock. Viscous (thick) magma produces volcanoes characterized by explosive eruptions, while non-viscous (runny) magma produce volcanoes characterized by effusive eruptions pouring large amounts of lava onto the surface. Volcanic eruptions are one of the earth's most dramatic and violent agents of change. Not only can powerful explosive eruptions drastically alter land and water for tens of kilometers around a volcano.



Volcanoes are places where magma reaches the earth's surface. The type of volcano depends on the location of the eruption and the consistency of the magma. When the magma cools it solidifies and forms rocks, the type of rock formed depends on the chemical composition of the magma and how rapidly the magma cools. Magma that reaches the surface to become lava

cools rapidly resulting in rocks with small crystals such as basalt. In the figure the red color shows the magma within the earth and interior of earth.

Volcanism also emit tiny liquid droplets of sulfuric acid erupted into the stratosphere can change our planet's climate temporarily. Eruptions often force people living near volcanoes to leave their land.

Sometimes result in complete destruction, cities and towns, crops, industrial plants, transportation systems and electrical grids can be damaged by tephra, ash, lahars, and flooding,

Volcanoes exhibits pre disaster warnings and analyzed in time allows communities at risk to be forewarned with reliable information in sufficient time to implement response plans and mitigation measure.

Lesson No. 45

Landslide

Topic – 157:

The term landslide describes a wide variety of processes that result in the downward and outward



movement of slope-forming materials including rock, soil, artificial fill or a combination of these. A landslide is the movement of rock, debris or earth down a slope. They result from the failure of the materials which make up the hill slope and are driven by the force of gravity. Landslides are known also as landslips, slumps or slope failure.

Slope saturation by water is a primary cause of landslides. This effect can occur in the form of intense rainfall, snowmelt, changes in ground water levels and water level changes along earth dams, lakes, reservoirs and rivers. Landslides occur when the slope changes from a stable to an unstable condition. A change in the stability of a slope can be caused by a number of factors, acting together or alone. Natural causes of landslides include:

- Groundwater (pore water) pressure acting to destabilize the slope
- Loss or absence of vertical vegetative structure, soil nutrients, and soil structure (e.g. after a wildfire - a fire in forests lasting for 3–4 days)
- Erosion of the toe of a slope by rivers or ocean waves
- Weakening of a slope through saturation by snow melt, glaciers melting, or heavy rains
- Earthquakes adding loads to barely stable slope
- Earthquake-caused liquefaction destabilizing slopes
- volcanic eruptions

Landslides are aggravated by human activities, such as

- Deforestation, cultivation and construction, which destabilize the already fragile slopes.
- Vibrations from machinery or traffic
- Blasting
- Earthwork which alters the shape of a slope, or which imposes new loads on an existing slope
- In shallow soils, the removal of deep-rooted vegetation that binds colluvium to bedrock
- Construction, agricultural or forestry activities (logging) which change the amount of water infiltrating the soil.

Many mountainous areas that are vulnerable to landslides have also experienced at least moderate rates of earthquakes. The occurrence of earthquakes in steep landslide-prone areas are vulnerability to landslide hazards is a function of location, type of human activity, use and frequency of landslide events.

Local governments can reduce landslide effects through land use policies and regulations. Individuals can reduce their exposure to hazards by educating themselves on the past hazard history. The planning and engineering departments of local governments can also obtain the professional services of engineer, geographer, geotechnical engineer or a civil engineer.

Measures to be taken to prevent landslide:

1. Covering the landslide with an impermeable material
2. Directing surface water away from the landslide
3. Draining groundwater away from the landslide
4. Minimizing surface irrigation

Topic – 158: Environmental hazards and disasters-10:

Air Pollution

Air pollution is a mixture of solid particles and gases in the air. Air pollution is a major environmental risk to health. By reducing air pollution levels, countries can reduce the burden of disease from stroke, heart disease, lung cancer and both chronic and acute respiratory diseases.

The “WHO Air quality guidelines” provides an assessment of health effects of air pollution and thresholds for health-harmful pollution levels. Ambient (outdoor air pollution) in both cities and rural areas was estimated to cause 3.7 million premature deaths worldwide in 2012. Some 88% of those premature deaths occurred in the low and middle income countries and the greatest number in the WHO western pacific and south East Asia regions. Policies and investments supporting cleaner transport, energy-efficient housing, power generation, industry and better municipal waste management would reduce key sources of urban outdoor air pollution.

Reducing outdoor emissions from household coal and biomass energy systems, agricultural waste incineration forest fires and other activities would reduce key rural and peri-urban air pollution sources in developing regions. Reducing outdoor air pollution also reduces emissions of CO₂ and short-lived climate pollutant such as black carbon particles and methane contributing to the near and long term mitigation of climate change. In addition to outdoor air pollution, indoor smoke is a serious health risk for some 3 billion people who cook and heat their homes with biomass fuel and coals.