EWCE-105

Environmental Chemistry

(Lecture-1)

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Under graduation: EWCE Dept, MIST (2017-2021)

Major : **Civil and Environmental Engineering**

Post graduation: CE Dept, BUET (Ongoing)

Major : **Civil and Environmental Engineering**

Current Job Status: Lecturer, EWCE Dept

COURSE OUTLINE (1.5 Credits)

Topics
• Introduction to Environmental Chemistry
○ Introduction ○ Scope and history of environmental chemistry ○ Environmental chemistry and green chemistry
• Atmospheric Chemistry and Air Pollution
○ Atmosphere ○ Air Pollution ○ Reaction of atmospheric oxygen ○ Chemical and photochemical reactions in the atmosphere ○ Greenhouse effects, climate change and its consequences ○ Monitoring of air quality

References:

1. Manahan, Stanley E., Environmental Chemistry, CRC Press.

2. A. K. De, Environmental Chemistry, New Age International Publishers.

What is Environment?

- The term ‘Environment’ originally comes from French word ***environner*** which means ‘**to encircle or surround**’.

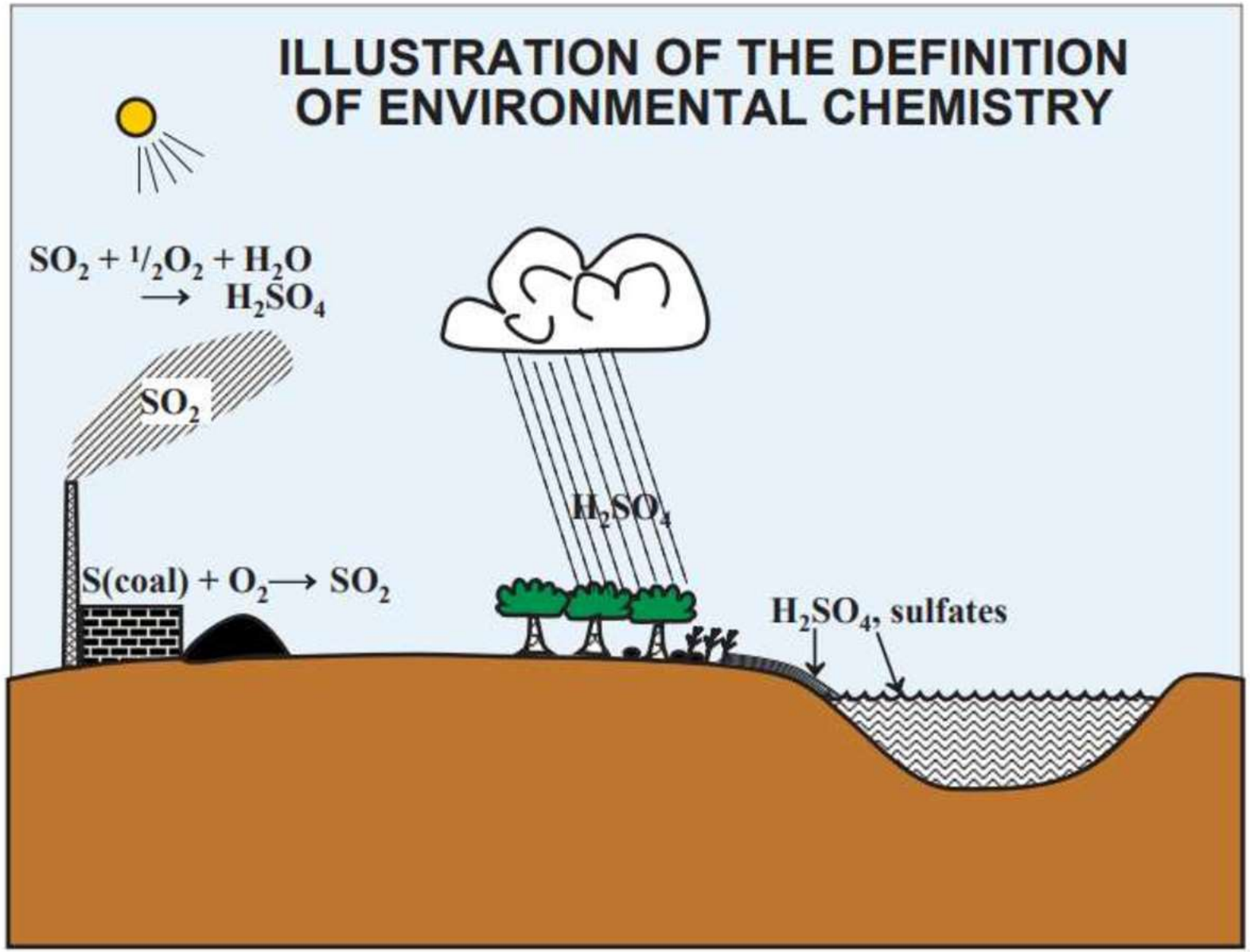
- Environment is our surrounding.

- This includes living and non-living things around us.

Environmental Chemistry

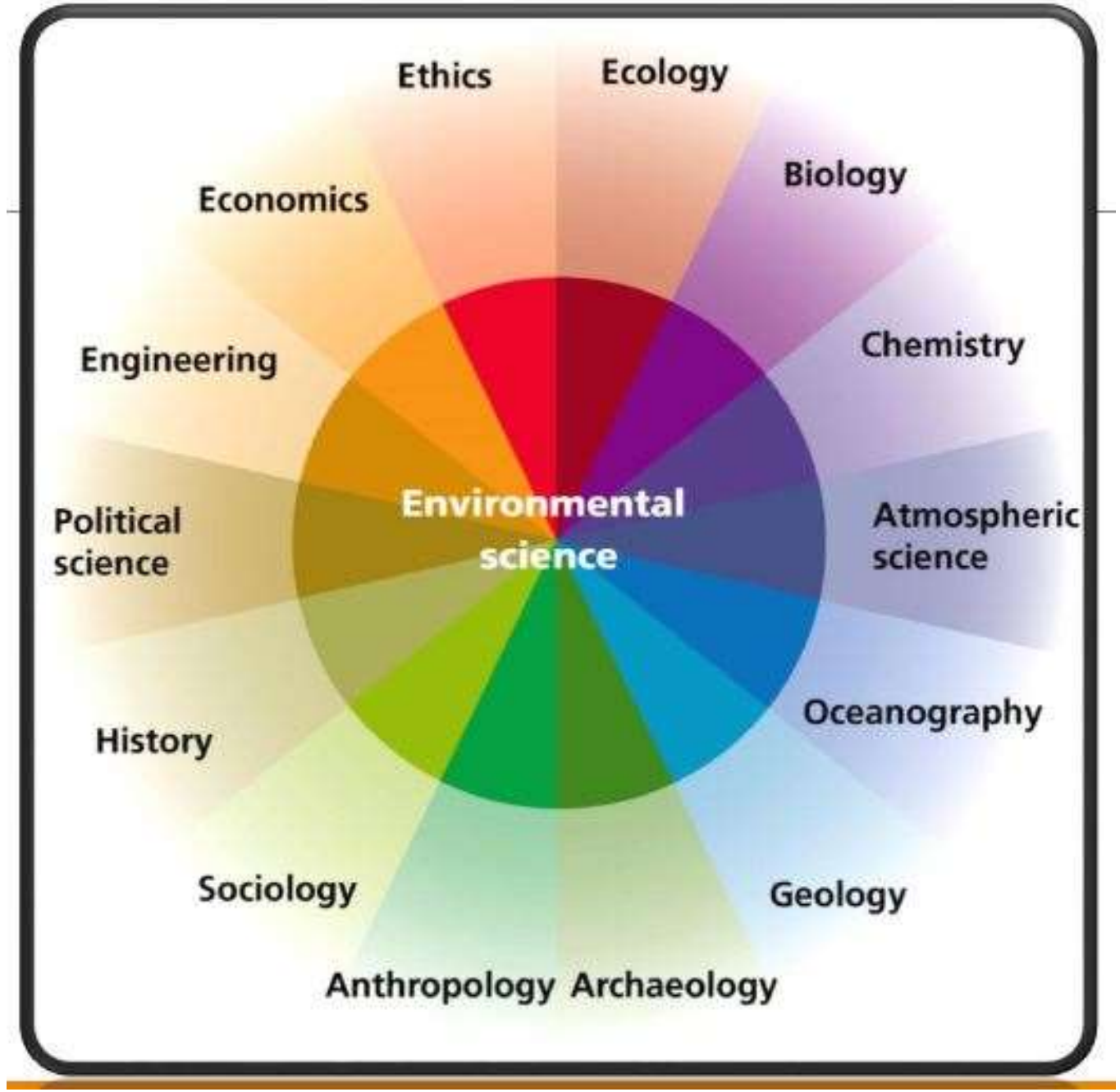
- **It is the science of chemical phenomena in the Environment.**

- **The study of the sources, reactions, transport, effects and fates of chemical species in water, soil and air environments and the effect of human activity and technology on them.**


ILLUSTRATION OF THE DEFINITION
OF ENVIRONMENTAL CHEMISTRY
$SO_2 + {}^1/_2O_2 + H_2O \rightarrow H_2SO_4$
SO_2
H_2SO_4
$S(coal) + O_2 \rightarrow SO_2$
H_2SO_4, sulfates

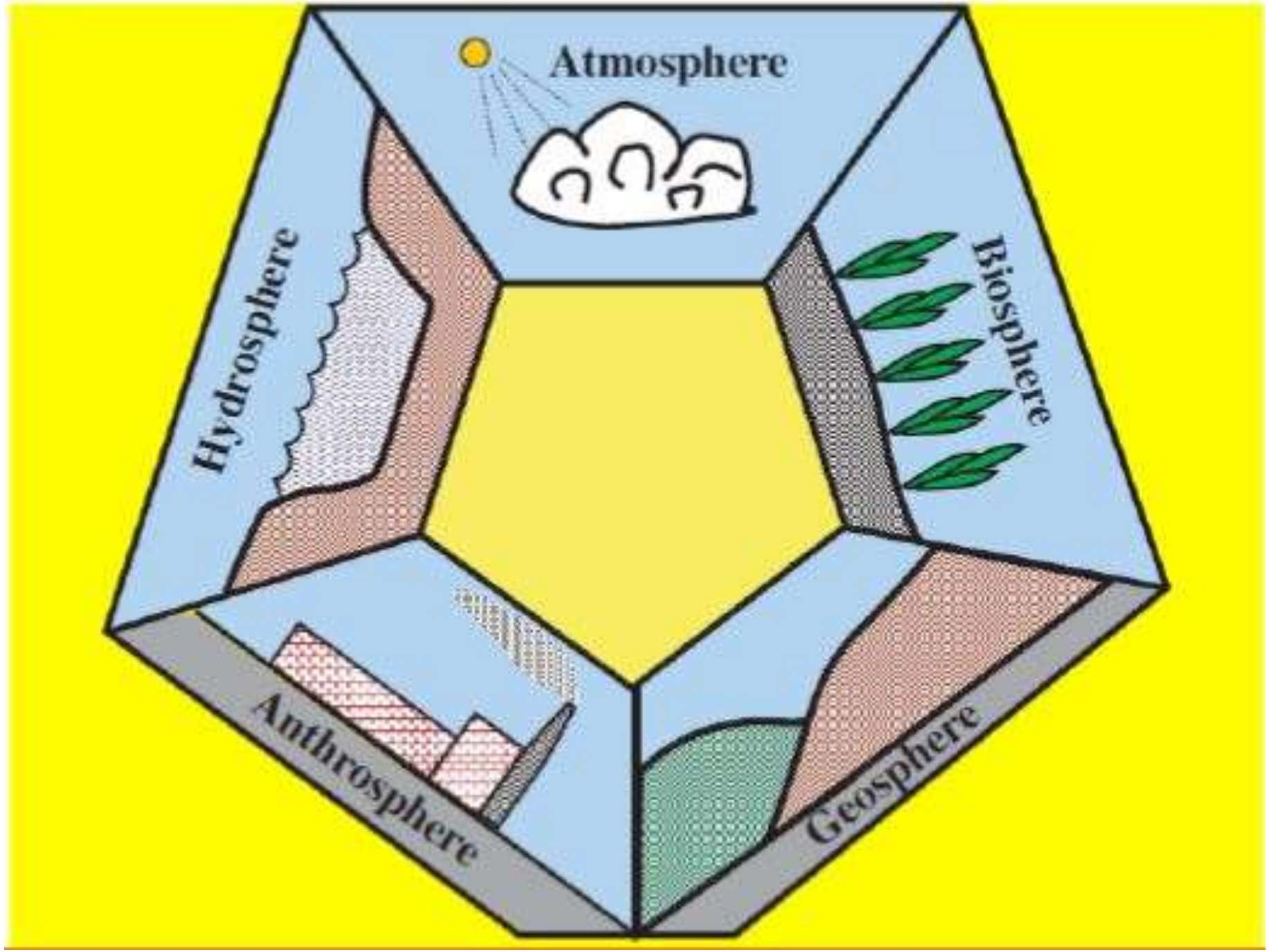
Environmental Science

- It is an interdisciplinary science that uses concepts & information from *natural sciences* such as ecology, biology, chemistry, physics, geology and *social sciences* such as economics, politics, and ethics to help us to understand:
- How the earth works
- How we are affecting the earth's life-support systems (environment), and
- How to deal with the environmental problems we face.


Ethics
Ecology
Economics
Biology
Engineering
Chemistry
Political science
Environmental science
Atmospheric science
History
Oceanography
Sociology
Geology
Anthropology
Archaeology

Environmental Science

- **Traditionally, environmental science has considered four environmental spheres: water, air, living organisms, and earth.**
- **But it is important to consider a fifth environmental sphere, the anthrosphere, which consists of the things that humans make and do.**


Atmosphere
Hydrosphere
Biosphere
Anthrosphere
Geosphere

Classification /Segments of Environment

- **Atmosphere**
- **Hydrosphere**
- **Geosphere**
- **Biosphere**
- **Anthrosphere**

Atmosphere

- The protective cover consisting of gaseous substances (in normal condition) surrounding the earth.
- Approx. area of about 200 sq. miles and extends up to 600 miles.
- Near the earth surface, the density of air is 1.3 kg/m^3 which decreases with altitude.
- Atmospheric pressure at sea level is 14.7 lb./$inch^2$ which also decreases with altitude and by 600 miles altitude, the pressure is zero.

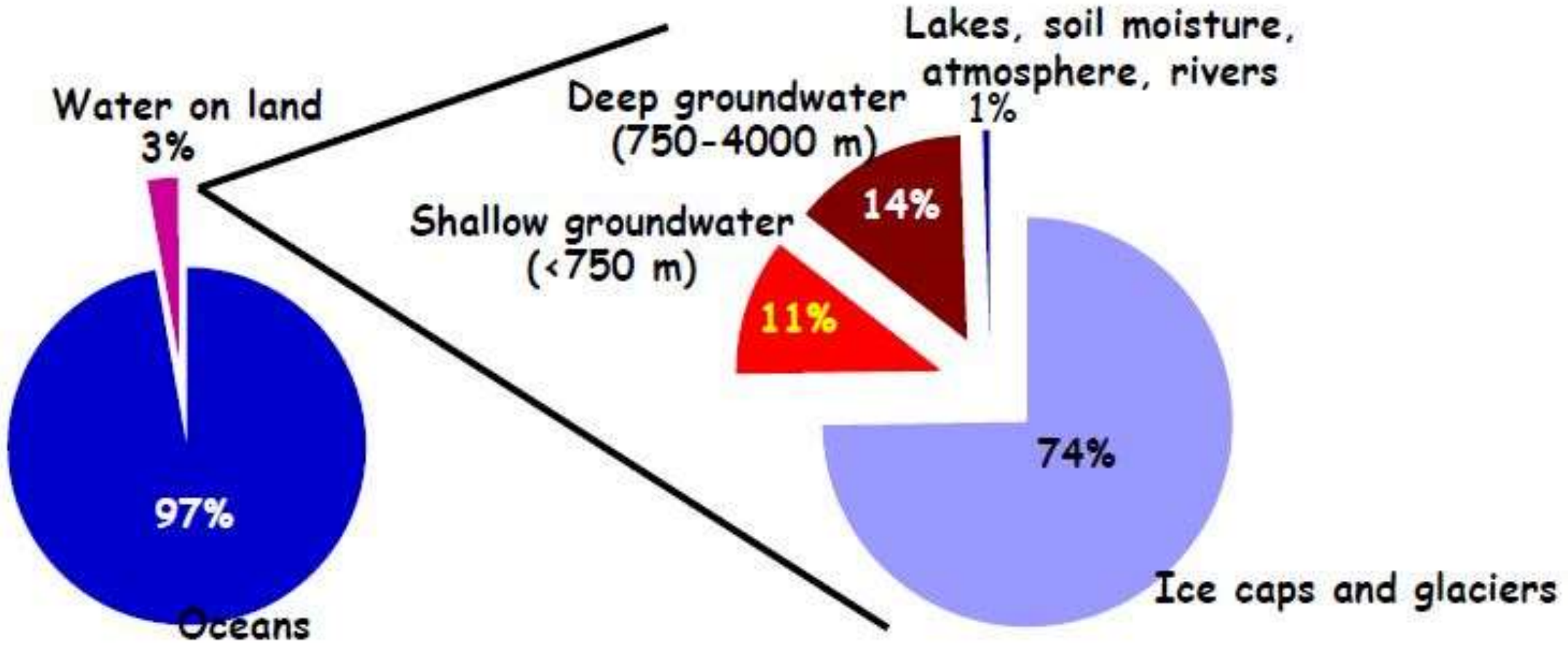
Role of atmosphere

- Supports life on earth by supplying O_2, CO_2, N_2.
- Saves lives from unfriendly environment of outer space (*i.e.* by absorbing harmful radiation).
- Maintains the heat balance of the earth.
- Carries water from sea to land through hydrological cycle.

Hydrosphere

- Includes all water resources; oceans, seas, rivers, lakes, ponds, streams, glaciers, polar ice caps, groundwater.
- Covers more than 75% of the earth’s surface.
- About 97% of the earth’s water is found in oceans.
- About 2% of the earth’s water is found in polar ice caps and glaciers.
- Only 1% of water is found as fresh (surface and ground water).
- World water reserves: 1401x1018 L.
- Consumption: Irrigation~ 30%, Power plant~50%, Domestic~7%, Industry~13%.

Inventory of Water on Earth

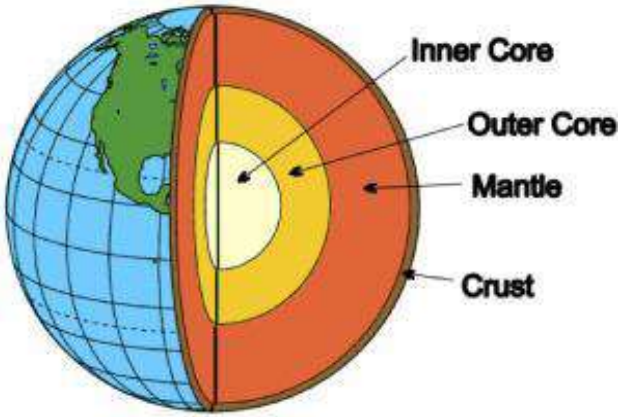


Role of Hydrosphere

- Habitat for aquatic life
- Man and animal cannot survive
- Approx. 60% of plant body mass is water
- 65% of human blood is water
- We cannot run industry without water
- In irrigation
- *We can not survive without water*
- *So, water is life!!*

Geosphere

- **Geosphere is considered that portion of the Earth system that includes Earth's interior, rocks and minerals, landforms and the processes that shapes the Earth's surface.**
- **The Earth has 4 layers: solid crust on the outside, the mantle and the core split between inner core and outer core.**



Role of Geosphere

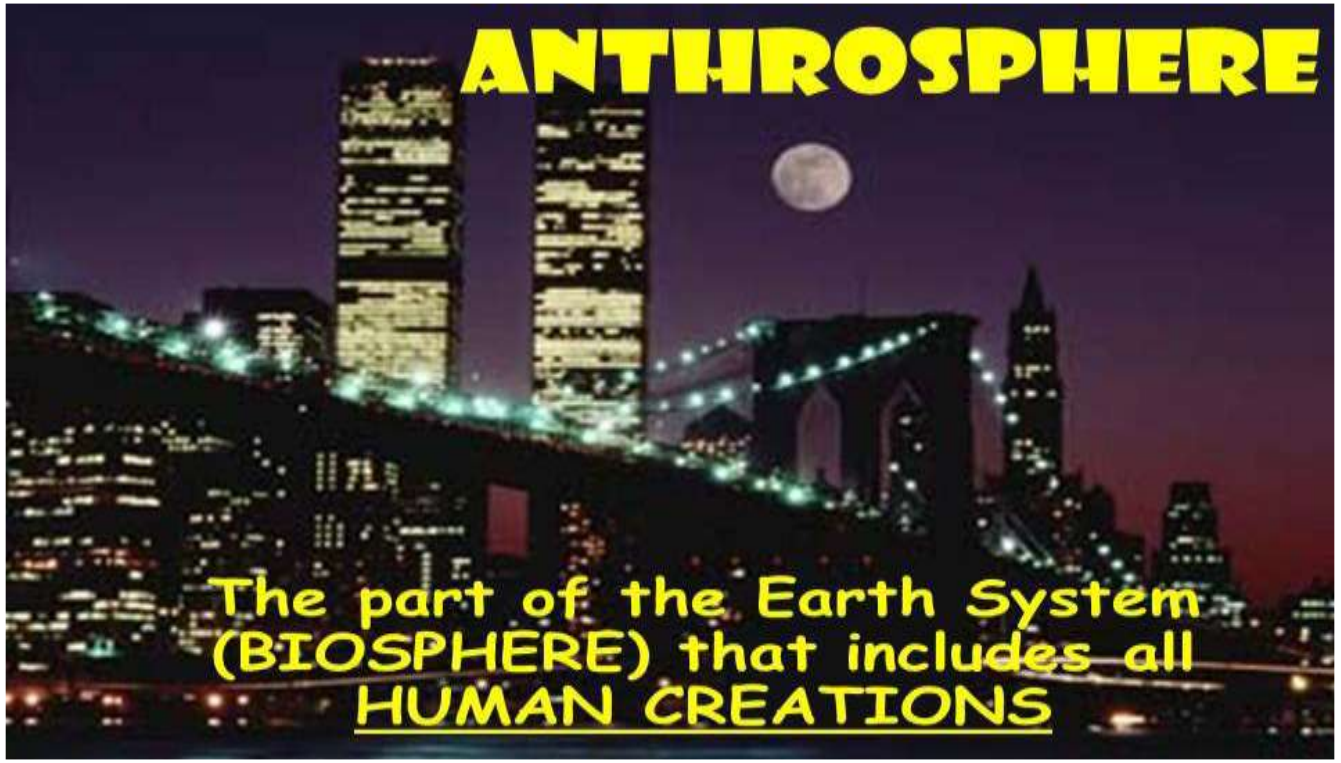
- Grows plants, food….
- Living space…
- Ground water
- Shapes the lands and impacts human…
- Full of resources (fuel, minerals, gold)

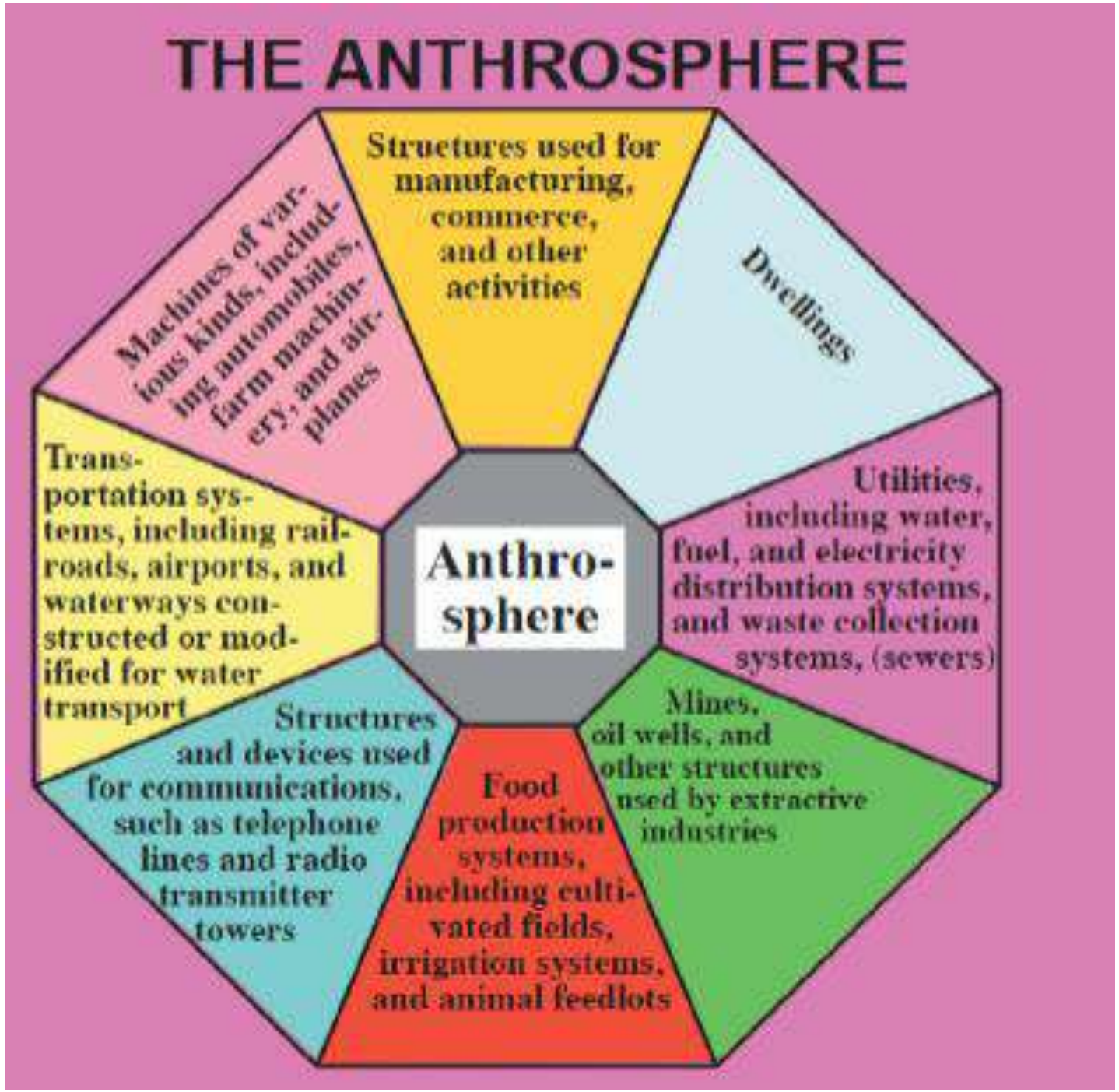
Biosphere

- Biosphere is made up of the part of Earth where life exists. Extending from a few km into the atmosphere to the deep sea vents of the ocean.
- The biosphere is a global ecosystem composed of the living organisms (biotic) and the abiotic (non-living) factors from which they derive energy and nutrients.
- Living organisms and the portions relating to them are called BIOTIC
- Non living portions are known as ABIOTIC

Anthrosphere

- The anthrosphere may be defined as that part of the environment made or modified by humans and used for their activities.




THE ANTHROSPHERE
Structures used for manufacturing, commerce, and other activities
Dwellings
Machines of various kinds, including automobiles, farm machinery, and airplanes
Transportation systems, including railroads, airports, and waterways constructed or modified for water transport
Utilities, including water, fuel, and electricity distribution systems, and waste collection systems, (sewers)
Anthrosphere
Structures and devices used for communications, such as telephone lines and radio transmitter towers
Food production systems, including cultivated fields, irrigation systems, and animal feedlots
Mines, oil wells, and other structures used by extractive industries

Components of Anthrosphere

- Structures used for dwellings.
- Structures used for manufacturing, commerce, education, and other activities.
- Utilities, including water, fuel, and electricity distribution systems, and waste distribution systems, such as sewers.
- Structures used for transportation, including roads, railroads, airports, and waterways constructed or modified for water transport.

Components of Anthrosphere

- Structures and other parts of the environment modified for food production, such as fields used for growing crops and water systems used to irrigate the fields.
- Machines of various kinds, including automobiles, farm machinery, and airplanes.
- Structures and devices used for communications, such as telephone lines or radio transmitter towers.
- Structures, such as mines or oil wells, associated with extractive industries.

Anthrosphere and Human Activities

- Pollution arises from human activities!!!
- POLLUTION: Introduction of waste matter into the environment by man which causes damage or deterioration to living systems and for the environment
- POLLUTANT: A substance that is present than its natural concentration as a result of human activities and has a detrimental effect on the environment or hazardous to man (or poses a threat to health and safety or the quality of life).

Anthrosphere and Human Activities

A contaminant is a substance that is present in greater concentration than its natural concentration as a result of human activities (causes deviation from normal composition of an environment)

- It is not a pollutant unless has some detrimental effect
- The toxic or harmful effects from contamination may become apparent at a later date
- The medium (soil, fish etc) affected by pollutant or contaminant is called a receptor while the chemical medium or species that retains or interacts with it is known as sink.

Technology and Anthrosphere

- Technology: Use of automation and machines.
- Positive and negative effects of technology on the environment.

Role of Environmental Science / Environmental Engineering

- To minimize damage to environment by allowing technology to serve environment positively (i.e. safety of environment for inhabitants).
- Environmental Engineers augment the natural process and minimize adverse effects on the environment.

Impact of Technology on the Environment

Production of pollutants (solids, liquids or gases) can arise from:

- Industry: Activities involved in the production of large quantities of industrial products.
- Agriculture: Intensive use of land cultivation, drainage of wetland, irrigation of arid land, application of fertilizers, herbicides, pesticides etc.
- Oil spillage, Mining.
- Extraction and production of mineral and other raw materials.
- Transportation (scarring of road surfaces, emission of air pollutants.

Impact of Technology on the Environment

- Intelligent technological applications is a way to solve environmental problems.
- Redesign of basic manufacturing processes (reduces raw material consumption, energy use and waste production).
- Use of computerized control for optimum energy efficiency, maximum utilization of raw materials which allows minimum production of pollutants.

Interactions between the segments of Environment:

All the Spheres are closely connected.

How to Biosphere interact with Atmosphere?

How to Hydrosphere interact with Atmosphere?

How to Hydrosphere interact with Geosphere?

and vice versa…

Lecture Summary

- Introduction of Environment
- Concept of Environmental Science (Chemistry)
- Anthrosphere and Human Activities