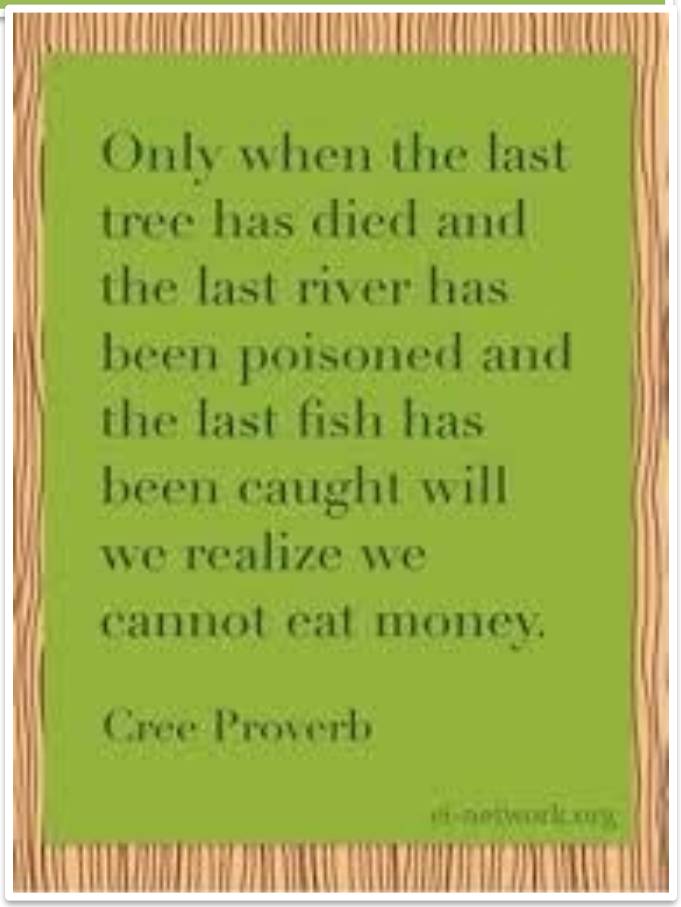
ENVIRONMENTAL STUDIES

UNIT-I

ENVIRONMENT

UNIT-I

- **ENVIRONMENT**
- **ECOLOGY**
- **ECOSYSTEM**
- **INTRODUCTION TO EIA**
- **NATURAL RESOURCES:**
- **MATERIAL CYCLES**
- **IMPORTANCE OF WATER QUALITY**



ENVIRONMENT :

DEFINITION - Environment can be defined as something that surrounds us. Also It is the sum total of all conditions and influences that affect the development and life of all organisms on earth.

Cntd.....

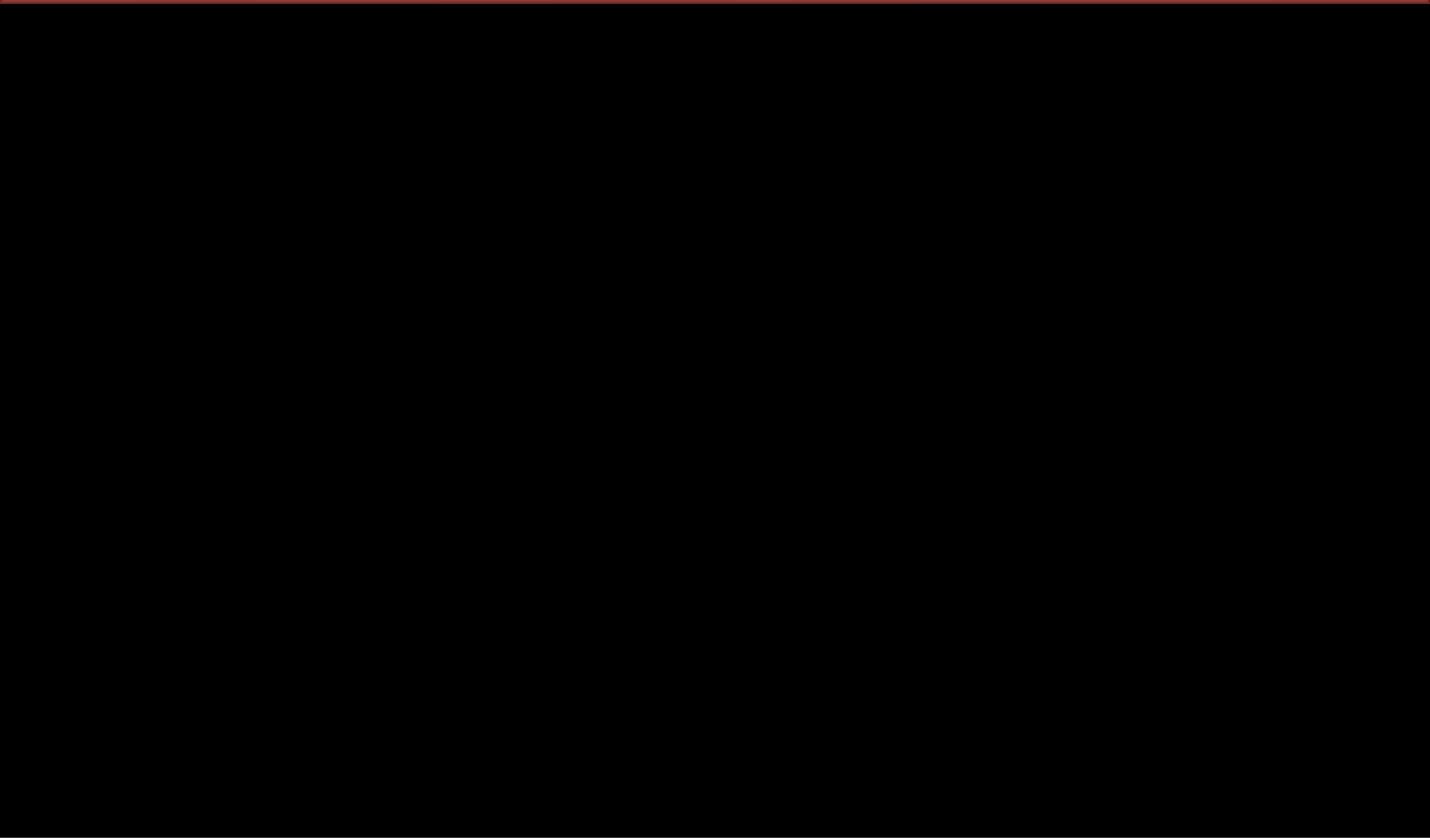
It can also be defined as:

- The sum total of all surroundings of a living organism, including natural forces and other living things, which provide conditions for development and growth as well as of danger and damage.

- Environment literally means surrounding and everything that affect an organism during its lifetime is collectively known as its environment.

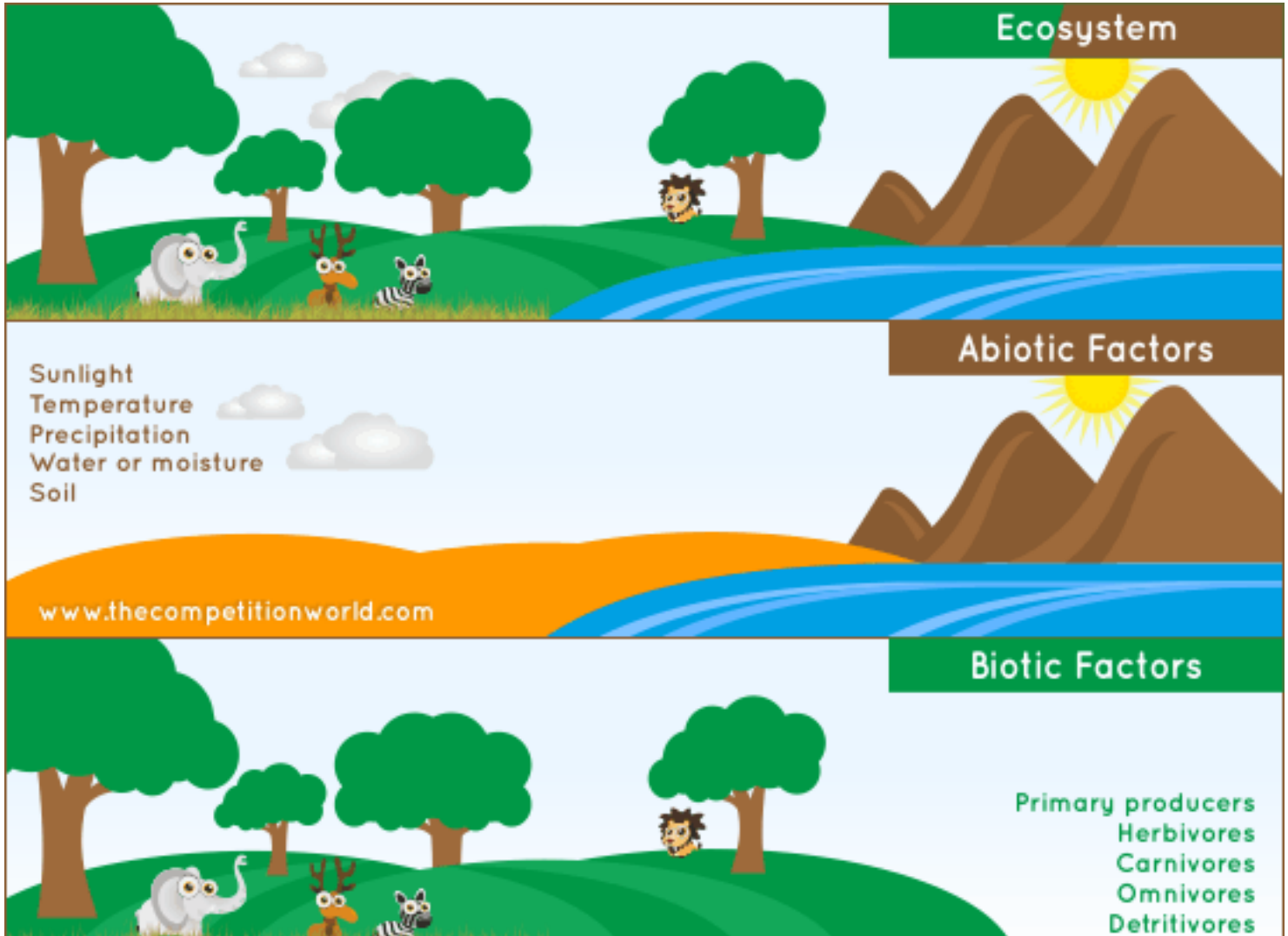
- In another words “Environment is sum total of water, air and land interrelationships among themselves and also with the human being, other living organisms and property”.

What Human is doing with the Environment?



Components of Environment

- **Biotic components**
- **Abiotic components**



Cntd..

- **Biotic components** – Human beings, Plants, Animals and micro organisms.

  - Biotic component consists of producers, consumers, and decomposers/recyclers.

  - Producers – Plants and some bacteria capable of producing their own food photosynthetically or by chemical synthesis.

  - Consumers – animals obtain their energy and protein directly by grazing (feed on grass) , feeding on other animals, or both.

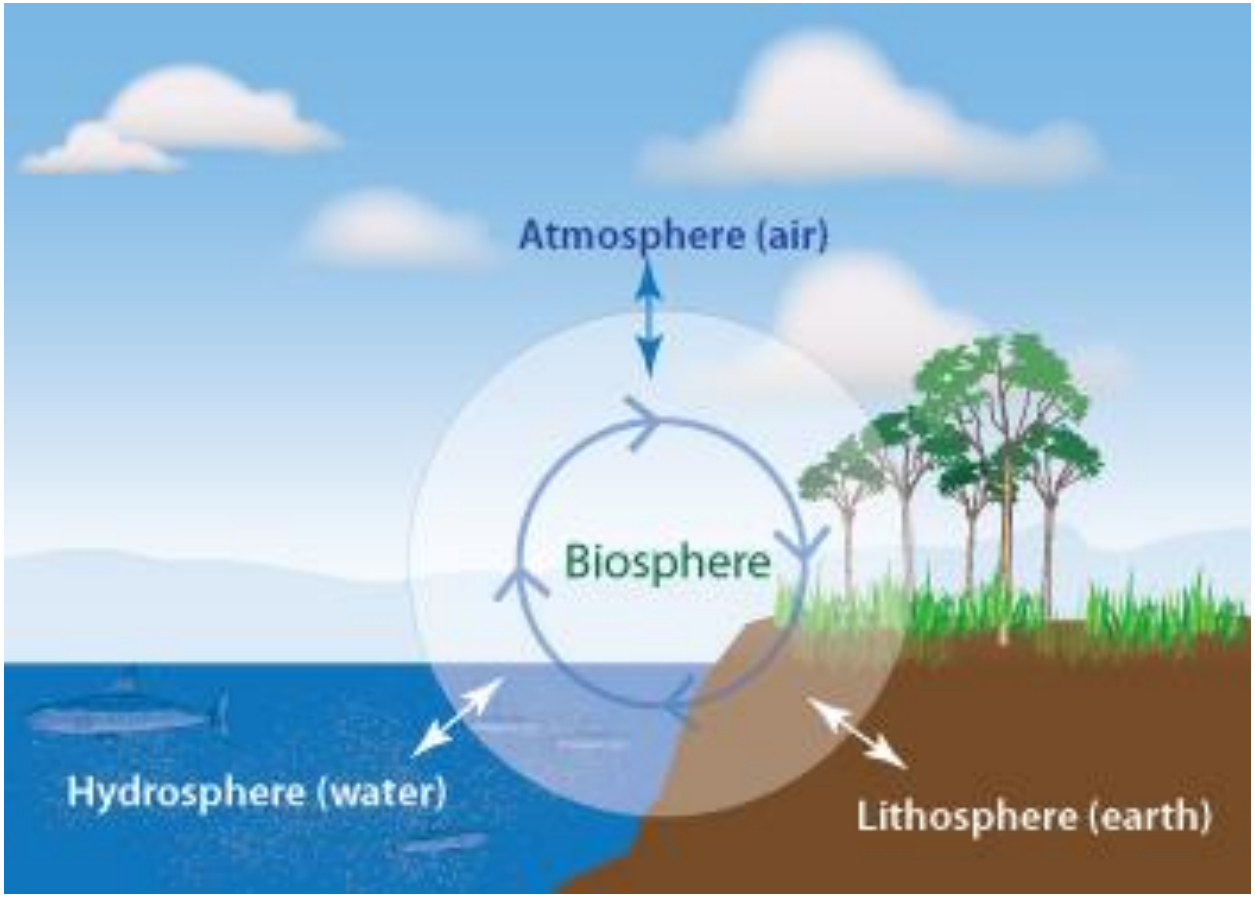
  - Decomposers/recyclers – are Fungi and Bacteria that decompose the organic matter of producers and consumers into inorganic substances that can be reused as food by the producer.

Thus “Decomposers” are the “recyclers of Biosphere”.

Cntd..

Abiotic components – Water, Air, Soil, Rocks etc….

It consists of Hydrosphere, Atmosphere, Biosphere and Lithosphere.



Cntd..

- **Hydrosphere –** All the water on the earth's surface, such as lakes and Seas, Oceans and sometimes including water over the earth's surface , such as clouds.

- **Atmosphere –** defined as the area of air and gases enveloping objects in space, like stars and planets, or the air arround any location. Mixture of air and gasses around the earth.

- **Biosphere –** the regions of the surface, atmosphere, and hydrosphere of the earth occupied by living organisms. It is the part of the earth's crust, waters, and atmosphere that supports life Part of earth's environment where life exists.

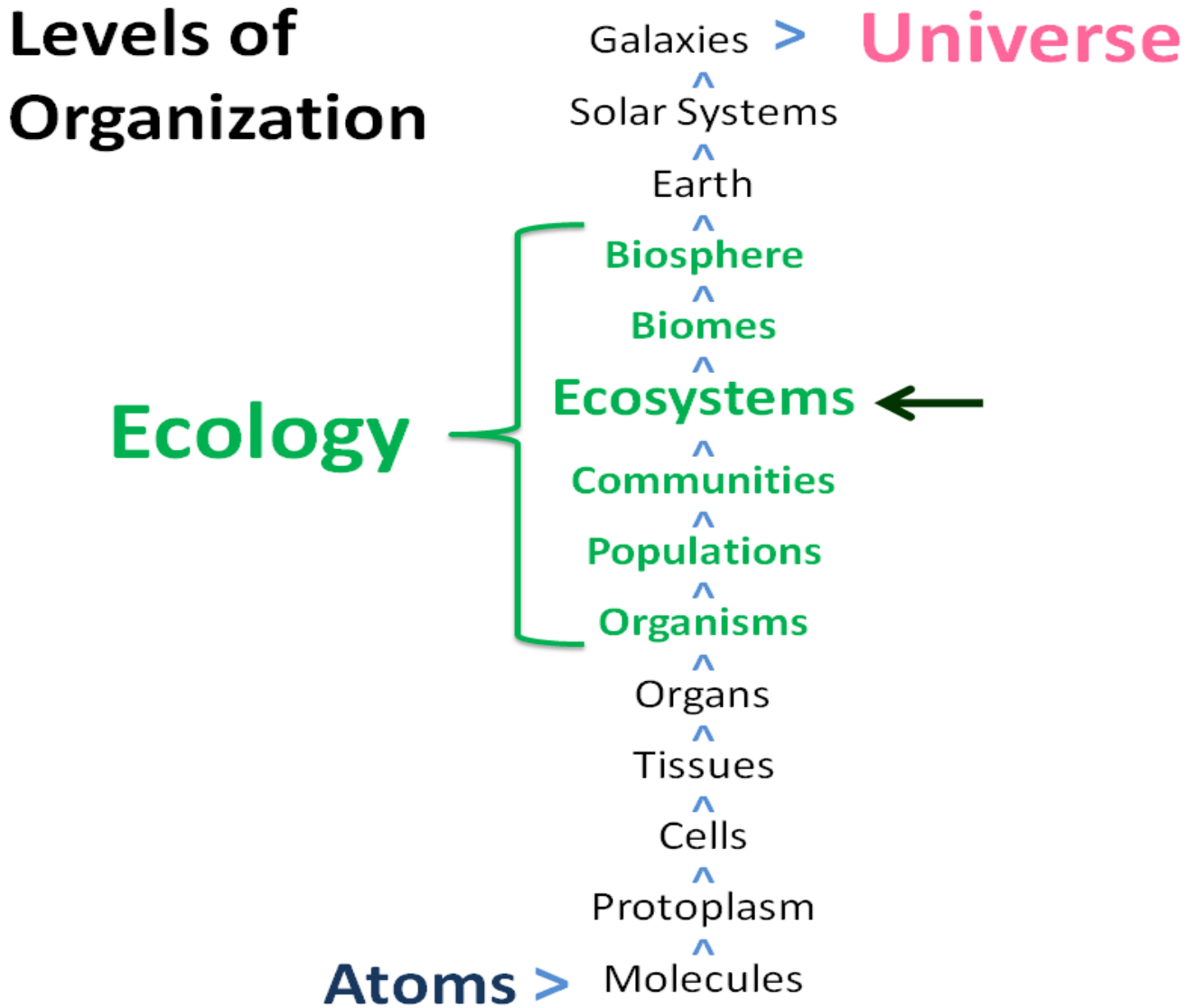
- **Lithosphere –** is the solid, outer part of the earth. The earth mainly consists three layers namely, the Core(inner layer) ; the Mantle (in the middle); and the crust (upper) which includes continents and Oceans floor.

ECO-SYSTEM

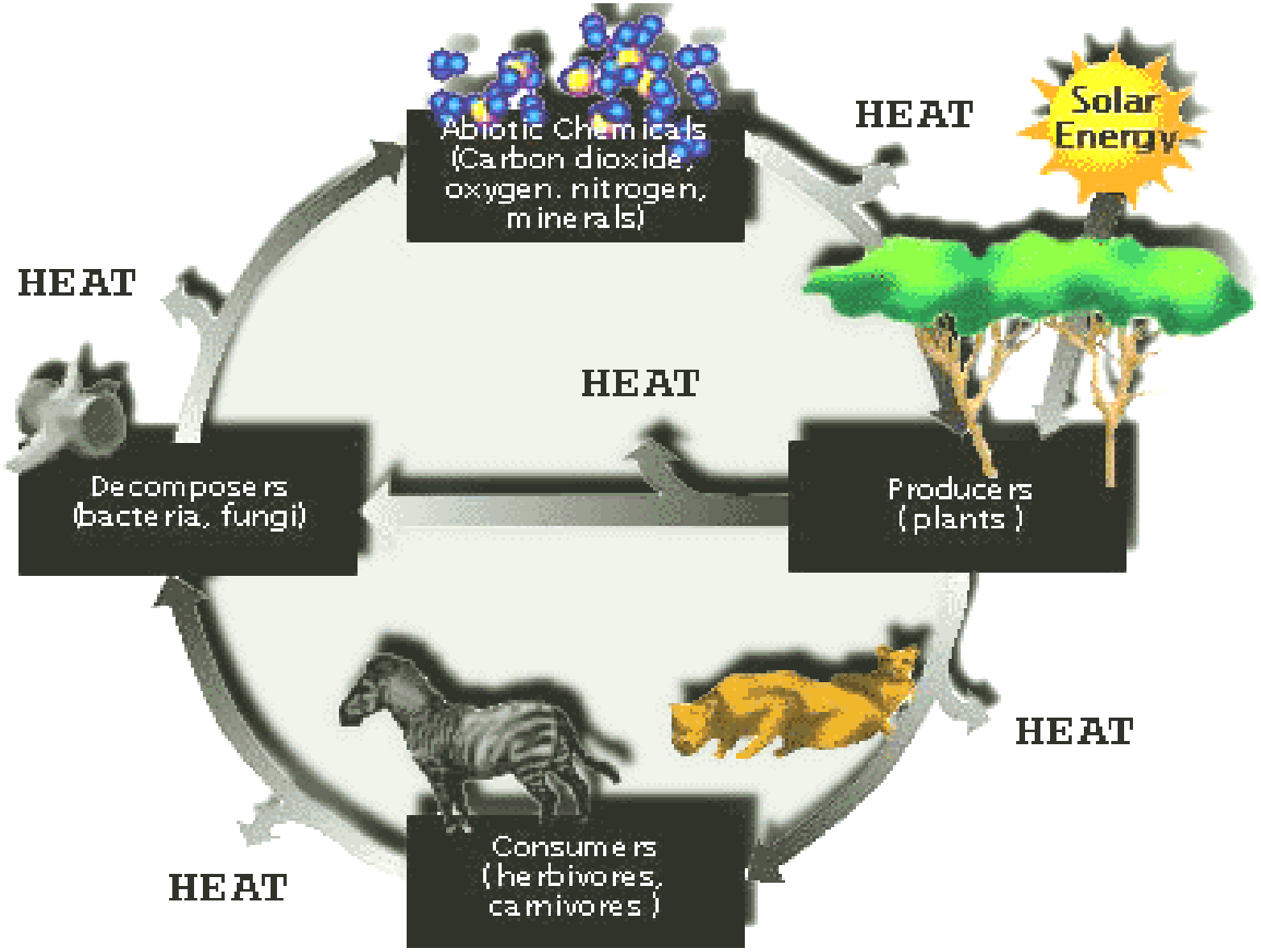
- Ecosystem is a community of living and non living things that work together.
- Ecosystems have no particular size.
- It can be as large as a desert or a lake or as tree or puddle (a small pool of liquid on ground, especially from rain).

If you have a terrarium, that is an artificial ecosystem. The water, water temperatute, plants, animals, air, light and soil all work together.

LEVELS OF ORGANIZATION



PROCESSES OF ECOSYSTEMS



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- If there isn’t enough light or water or if the soil doesn't have the right nutrients, the plants will die. If the plants die, animals that depends on them will die. If the animals that depends on plants die, any animals that depends on those animals will die.
- Ecosystem in nature work the same.
- All the parts work together to make a balanced system

Eco-system is a biotic assemblage of plants, animals, and microbes, taken together with their physico-chemical environment.

Or

Any “bio-system” that includes all organisms which function together as a community called biotic community in a given area or surrounding where they interact with the physical environment called abiotic community is known as “eco-system”.

Ecosystem consists of:

- ✓ biotic community
- ✓ abiotic community- essential for maintenance of all life processes

ECO-SYSTEM….contd.

Continuous interaction between the biotic and abiotic environment is established through:

- ✓ energy flow (solar energy) in the system
- ✓ Cycling of the materials

  natural cycles such as

  carbon cycle

  nitrogen cycle

  hydrological cycle

  sulphur cycle

Constituents of Eco-system:

1. Inorganic substances (carbon, nitrogen, carbon dioxide, water etc.) involved in natural cycles
2. Organic compounds (proteins, carbohydrates etc.)
3. Air, water, substrate environment (climatic regime, other physical factors)
4. Producers- autotrophic (i.e. self sustaining organisms, green plants that can manufacture food from simple inorganic substances)

Constituents of Eco-system Cntd….

5. Heterotrophic (that depend on others for nourishment) organisms, mainly bacteria, fungi and animals
6. Micro consumers, decomposers, mainly bacteria, fungi which obtain their energy by breaking down dead tissues.

Common feature of all ecosystems is the interactions between autotrophic and Heterotrophic components.

Constituents of Eco-system Cntd….

- Major autotrophic metabolism takes place in the upper green belt stratum where solar energy is available.

- Intense heterotrophic metabolism occurs in the lower brown belt where organic matter is available in soils and sediments.

CLASSIFICATION OF ECOSYSTEM

Ecosystems are broadly classified as :

Terrestrial Ecosystems – which encompass the activities that take place on land, and

Aquatic ecosystems - the system that exists in water bodies

These ecosystems can be further subdivided as :

Terrestrial ecosystem :

- Forest ecosystem,
- Mountain ecosystem
- Desert ecosystem
- Grassland ecosystem
- Urban ecosystem

Aquatic ecosystem -

Marine ecosystem
Fresh water ecosystem
Esturine ecosystem

Engineered ecosystem : An ecosystem which is fully designed and controlled by man is called 'Engineered ecosystem'. A paddy field or a fish pond can be quoted as an example for this ecosystem.

CLASSIFICATION OF ECOSYSTEM Cntd…

❖Land based ecosystem

- Land (terrestrial) ecosystem - depends on climate and soil
- About 30% of earth's surface is land
- Higher plants and animals – seed plants, insects, worm-blooded vertebrates and micro organisms
- Consist of herbaceous plants, shrubs, grass, woody trees, arthropods (joint legged animals), birds, etc.

CLASSIFICATION OF ECOSYSTEM Cntd…

❖Marine ecosystem

- About 70% of earth's surface is covered by ocean.
- Offer habitat to numerous plants (algae), animals like zooplankton (heterotrope), shrimps & oysters (edible shell fish), fishes, birds, mammals (whales/seals)
- Serve as large basin for run-off and waste from land
- High salt content @ 3.5%
- Poor fertility

CLASSIFICATION OF ECOSYSTEM Cntd…

❖Fresh water ecosystem

- Fresh water bodies –
  - Ponds and lakes - lentic - water is stagnant
  - Rivers and springs – lotic – water is flowing
- Rich in nutrients (nitrates and phosphates)
- Good habitat for phytoplankton (autotrophy), zooplankton (heterotrophy), aquatic plants, fishes

CLASSIFICATION OF ECOSYSTEM Cntd…

❖Wet land ecosystem

- Transitional lands between terrestrial and aquatic ecosystem
- Water stands at 2.5 – 300cm
- Include natural ecosystem with a wide variety of plants, animals, fishes, micro-organisms
- Presently facing danger due to increasing urbanization

BIOMES

Ecosystems that are spread over large geographical areas having similar climatic conditions/features constitute a "BIOME".

The term "Biome" is used to describe a large land community where plant species are more or less uniform.

B I O M E S….contd.

Biomes are broadly classified into:

- ❖Terrestrial biomes
- ❖Aquatic biomes
  - ✓Plankton (organisms floating on water)
  - ✓Necton (swimming at middle level of water bodies)
  - ✓Benthos (swimming deep inside the water bodies)

B I O M E S….contd.

Main Biomes of the world

1. Tundra Biome:

Occurs in the polar region

Characterized by:

- absence of trees
- only dwarf plants
- wet, spongy, rough upper ground surface

Main Biomes of the world….contd.

2. Temperate coniferous forest biome:

   occurs in the cold regions

   high rainfall

   long winters and short summers

3. Temperate deciduous forest biome:

   high altitude regions(3000-4000m above msl)

   rainfall (100-125cm/yr)

   trees like pines, fir, junifer, oak, sal etc.

   ex: Himalayas

Main Biomes of the world….contd.

4. Temperate Greenland biome:

25-75 cm rainfall per yr

found as tall and short grass prairies (large open area of grass land) of north and South America

5. Tropical Savanna biome:

tropical grass land with scattered drought resistant trees

found in Eastern Africa, Australia and south america

Main Biomes of the world….contd.

6. Desert biome:

found in very dry environment

temperature varies from very hot to very cold

7. Tropical Rainforest biome:

occur near the equator

fairly high temp. with humidity

200-225 cm rainfall

dense vegetation- tall trees

herbs, shrubs

habitat to numerous vertebrate and invertebrate animals

SUSTAINABLE ECOSYSTEM

For economic growth and better living,

Developing countries continue to give priority for agricultural and industrial sectors at the cost of environment and forest.

Leads to depletion of resource base.

such continuous degradation finally weakens the economy.

Population explosion adds to the misery.

SUSTAINABLE ECOSYSTEM...contd.

Therefore

the policy should be such that

the ecosystem is

SUSTAINABLE.

i.e.

It contains an element of

RENEWABILITY.

SUSTAINABLE ECOSYSTEM...contd.

SUSTAINABLE DEVELOPMENT

means

"meeting the needs of the present without compromising the ability of the future generations to meet their needs"

SUSTAINABLE ECOSYSTEM...contd.

COMPONENTS OF SUSTAINABLE DEVELOPMENT

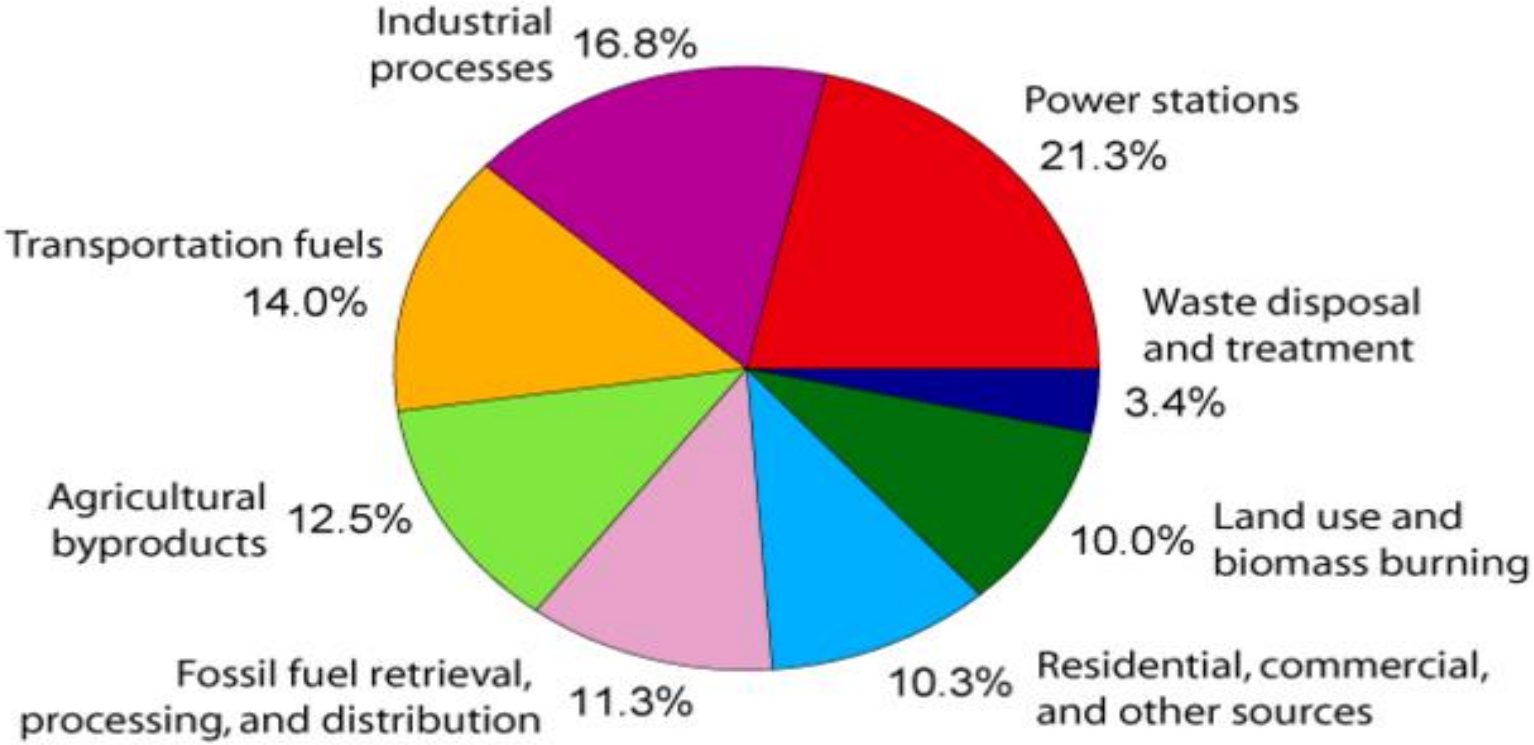
- ✓Population stabilization
- ✓Integrated land use planning
- ✓Conservation of bio-diversity
- ✓Air and water pollution control
- ✓Renewable energy resources
- ✓Recycling of wastes and residues
- ✓Environmental education and awareness

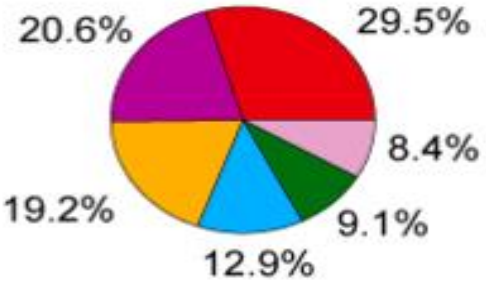
ENVIRONMENTAL IMPACT ASSESSMENT

Definition: The exercise of visualizing or assessing the effects of a project on the environment before taking it up is called as 'Environmental Impact Assessment (EIA)'.

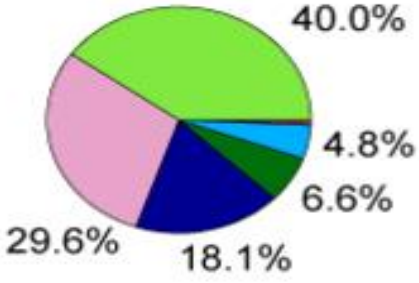
- EIA makes it possible to integrate the environmental aspects into the developmental activities during initiation of the project.
- It prevents the environmental and economic liabilities that may arise in future.
- A proposed project can be shelved in the beginning itself if it is found to be detrimental to the environment.

Annual Greenhouse Gas Emissions by Sector

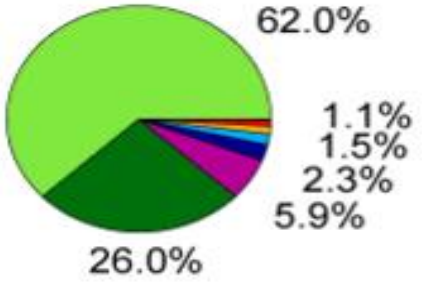




Carbon Dioxide
(72% of total)



Methane
(18% of total)



Nitrous Oxide
(9% of total)

ENVIRONMENTAL IMPACT ASSESSMENT Cntd..…

Development shall include:

economic

political

social and

cultural aspects of life.

"Always, there is conflict of interest between the development and environment."

Environmental Management Plan (EMP) attempts to strike balance between the development and environment through Environmental Impact Assessment (EIA).

ENVIRONMENTAL IMPACT ASSESSMENT…contd

- Objective of EIA

  To identify, predict and evaluate:

  The probable economic, environmental and social impacts of development activities and take necessary steps as remedial measures.

  Any major industrial projects must obtain EIA clearance from Ministry of Environment. EIA is conducted by a team of experts in the field (environment), appointed by Ministry of Environment, GOI.

NATURAL RESOURCES

Life support materials or resources provided by the Nature for sustenance of life on earth for plants, animals and man are known as Natural Resources.

Ex: water, air, soil, forests, minerals, crops etc.

Categories of Natural Resources:

1. Renewable Resources:

These can be recycled and regenerated within a given span of time.

Ex: forests, wind energy, solar energy, hydropower

etc.

NATURAL RESOURCES

2. Non-renewable Resources:

- ✓ These cannot be regenerated.
- ✓ With increase in consumption, these will get exhausted in due course of time.

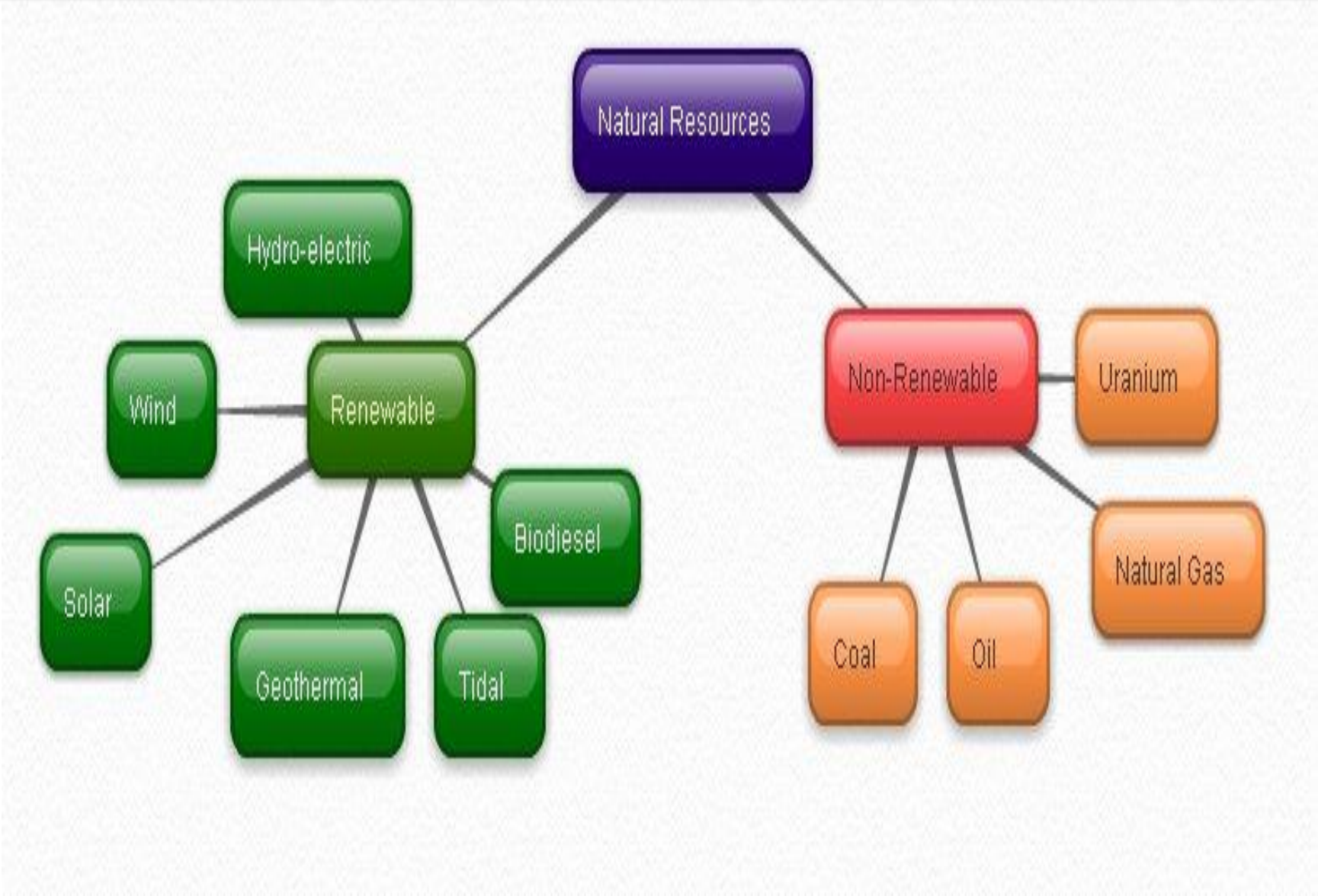
Ex: Fossil fuels such as coal, petroleum, minerals

etc.

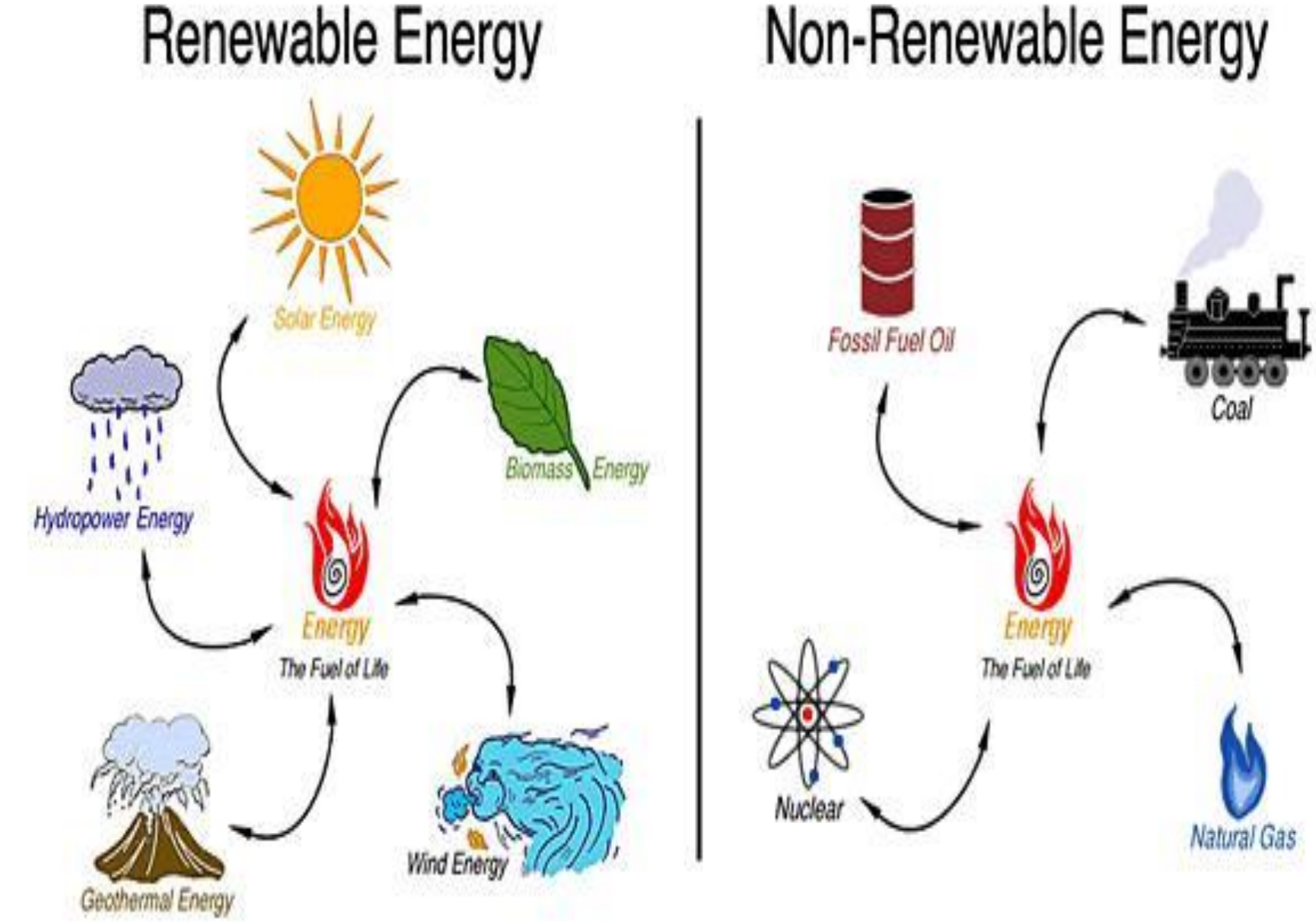
Note: Even renewable resources are liable for extinction if exploitation continues unabated.

Ex: forests.

NATURAL RESOURCES



NATURAL RESOURCES



NATURAL RESOURCES

The major natural resources are:

(i) Forest resources

(ii) Water resources

(iii) Mineral resources

(iv) Food resources

(v) Energy resources

(vi) Land resources.

Material Cycles

- **BIO-GEO-CHEMICAL CYCLE:** There are about 40 chemical elements considered to be essential for living organisms. Materials are in limited quantity in the earth's system and to keep the system going continuously the only possibility is to regenerate the materials. The unique method evolved in nature is recycling materials continuously is by linking them in cyclic changes

- The macro-nutrients are C, H, O, P, K, I, N, S, Mg, Ca, etc., which have cycles with atmosphere while micro-nutrients like Cu, Fe, Co, etc., are soil based form edophic cycles.
- The bio-geo-chemical cycles are of two varieties – ***sedimentary cycles*** and ***gaseous cycles.***

Material Cycles Cntd…

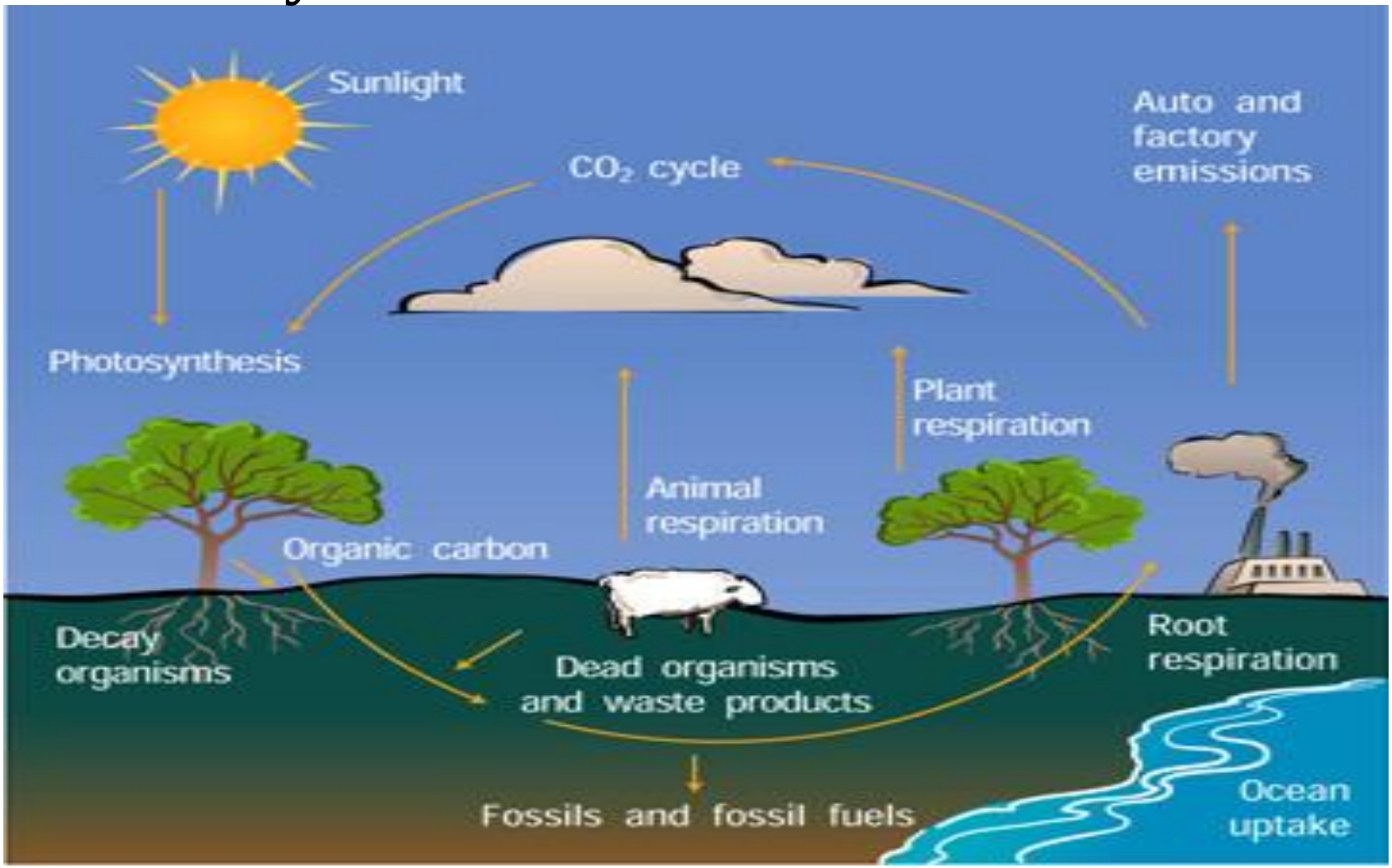
- In sedimentary cycles the main reservoir is the soil, the sedimentary and other types of rocks of earth's crust.
- The gaseous cycles have their main reservoir of nutrients in the atmosphere and oceans. Examples are the oxygen, carbon, nitrogen, sulphur, etc.

Both are driven by the flow of energy and both are tied up with the water cycle or the hydrologic cycle.

In nutrient cycle, various chemical compounds of the main element are transferred while in hydrologic cycle a compound i.e., water is circulated as solid liquid and vapour phase.

Material Cycles Cntd…

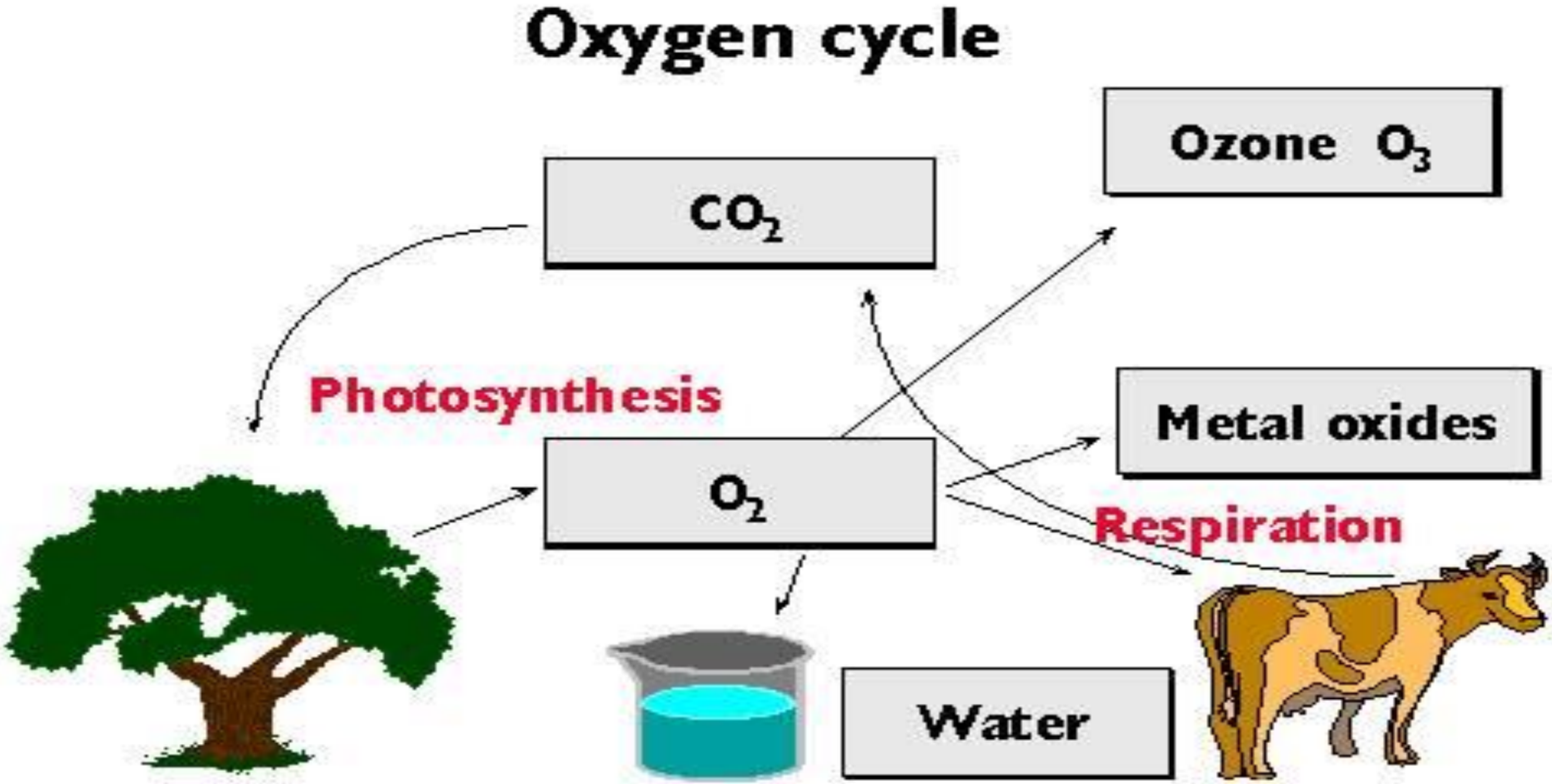
- **Carbon Cycle**



Material Cycles Cntd…

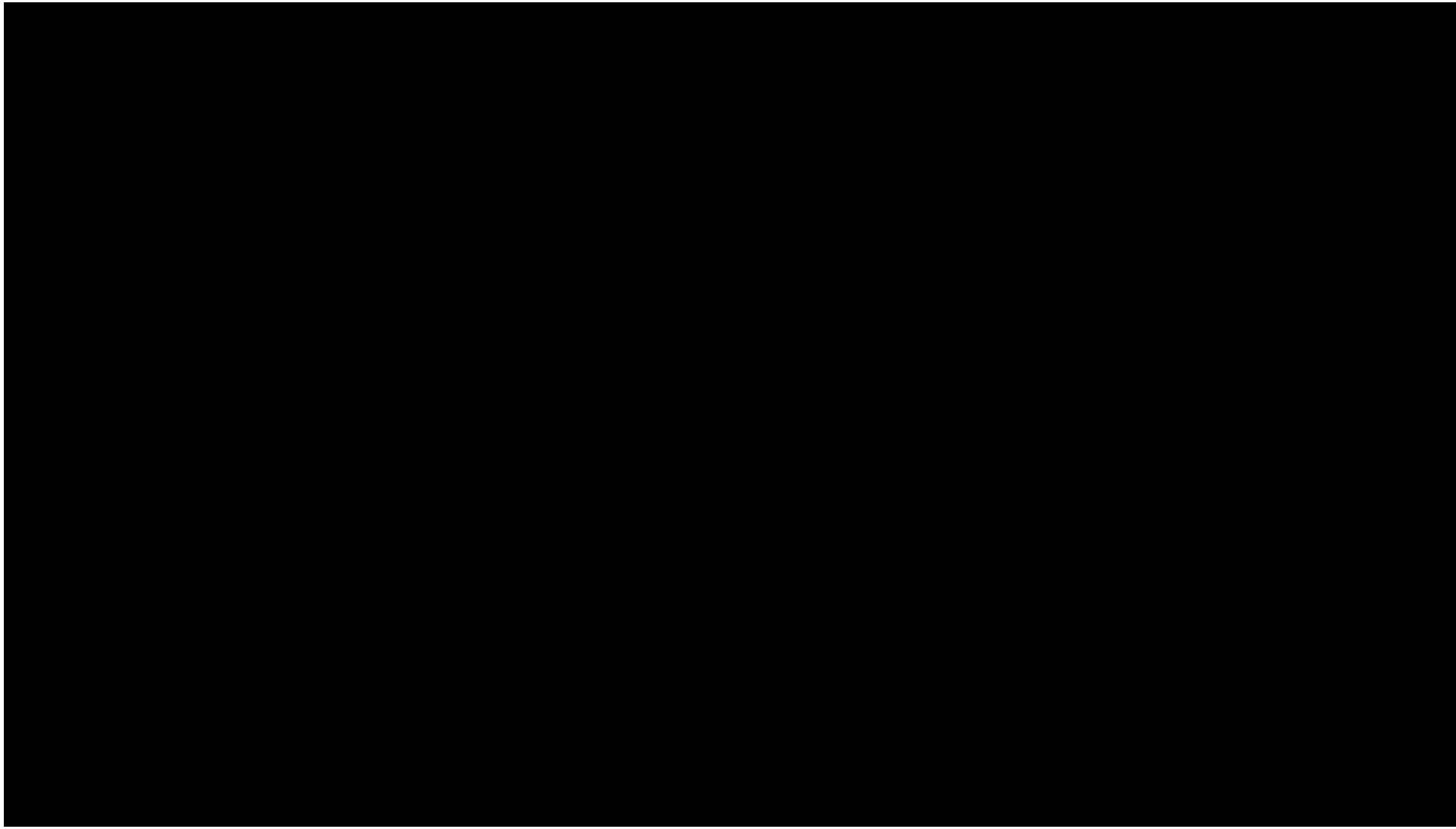
- Most of the CO_2 is returned to atmosphere and natural water by plants and animals through the process of respiration.
- Bacteria and fungi also return CO_2 to the atmosphere.
- It should also be noted that coal, petroleum, etc., are also the part of carbon cycle and are formed in nature by living organisms.
- Decomposition of micro-organism are very important in breaking down dead material with the release of carbon back to the carbon cycle.
- All the carbon of plants, herbivores, carnivores and decomposers is not respired, but some are fermented and some are stored.
- The carbon compounds such as methane that are lost to the food chain after fermentation are readily oxidized to CO_2 by a number of reactions occurring in the atmosphere.

Material Cycles Cntd…



NATURAL RESOURCES

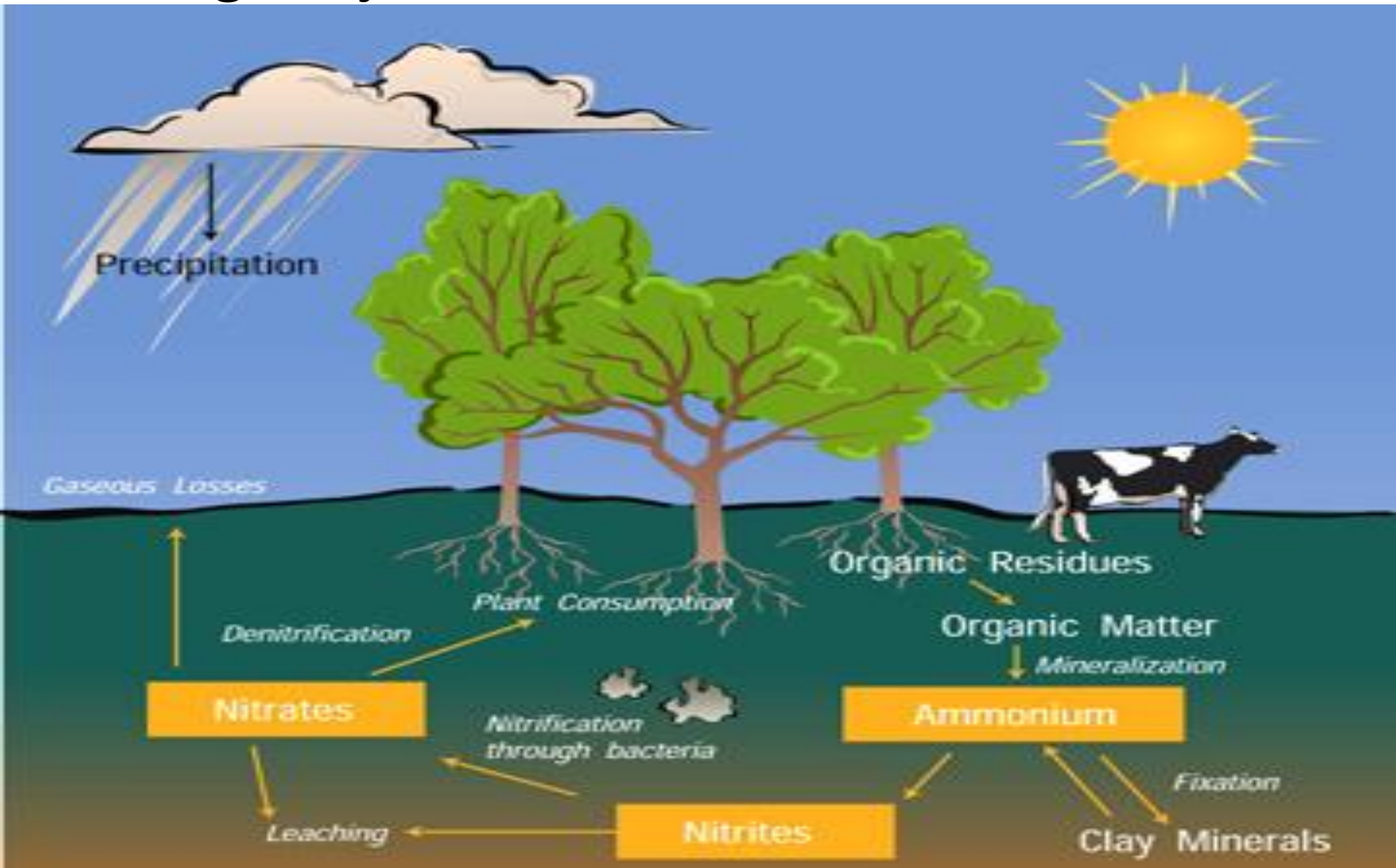
Animated Video showing carbon and Oxygen cycles



NATURAL RESOURCES

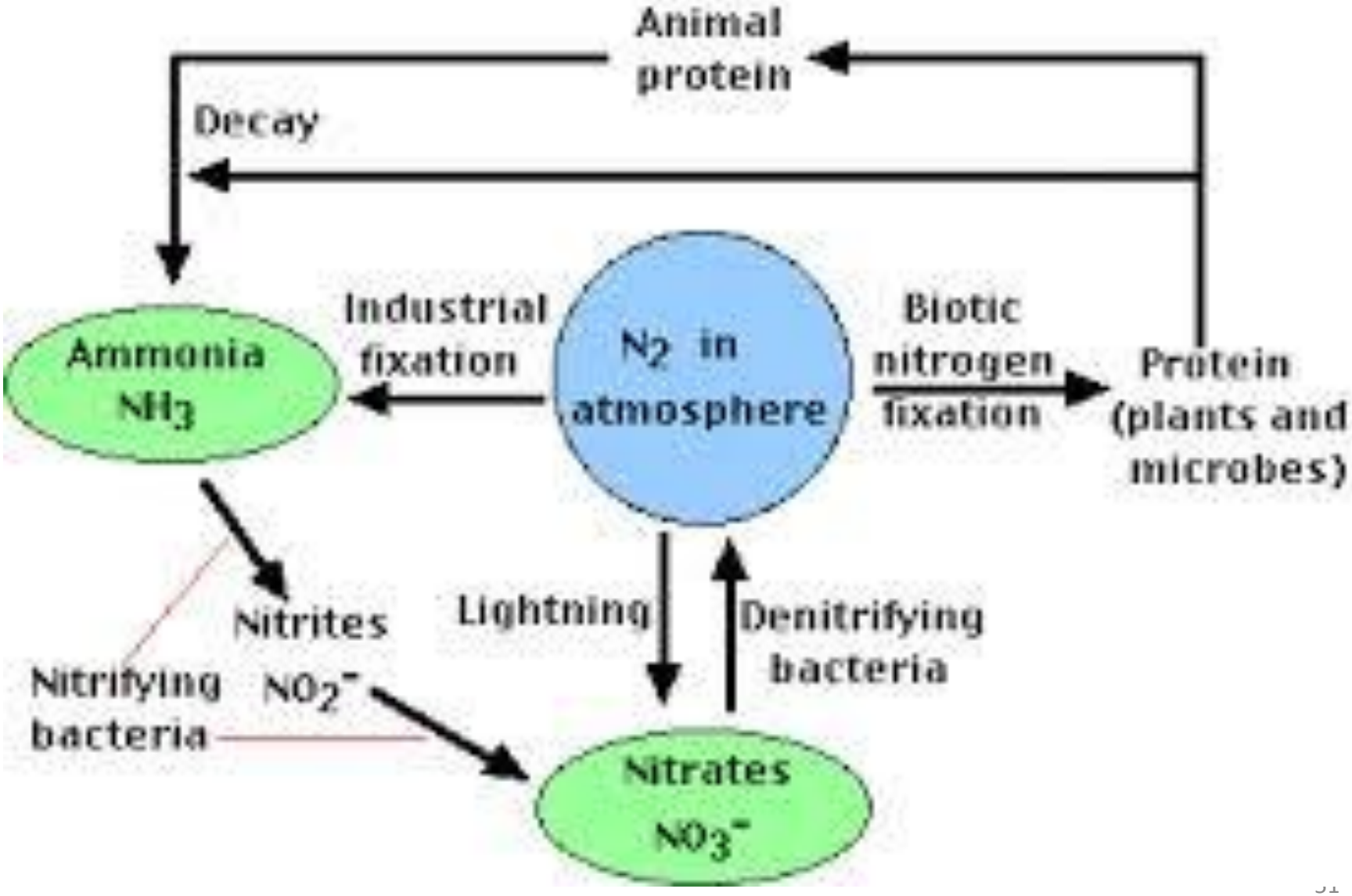
Material Cycles Cntd…

- **Nitrogen Cycle**



NATURAL RESOURCES

Material Cycles Cntd…



Material Cycles Cntd…

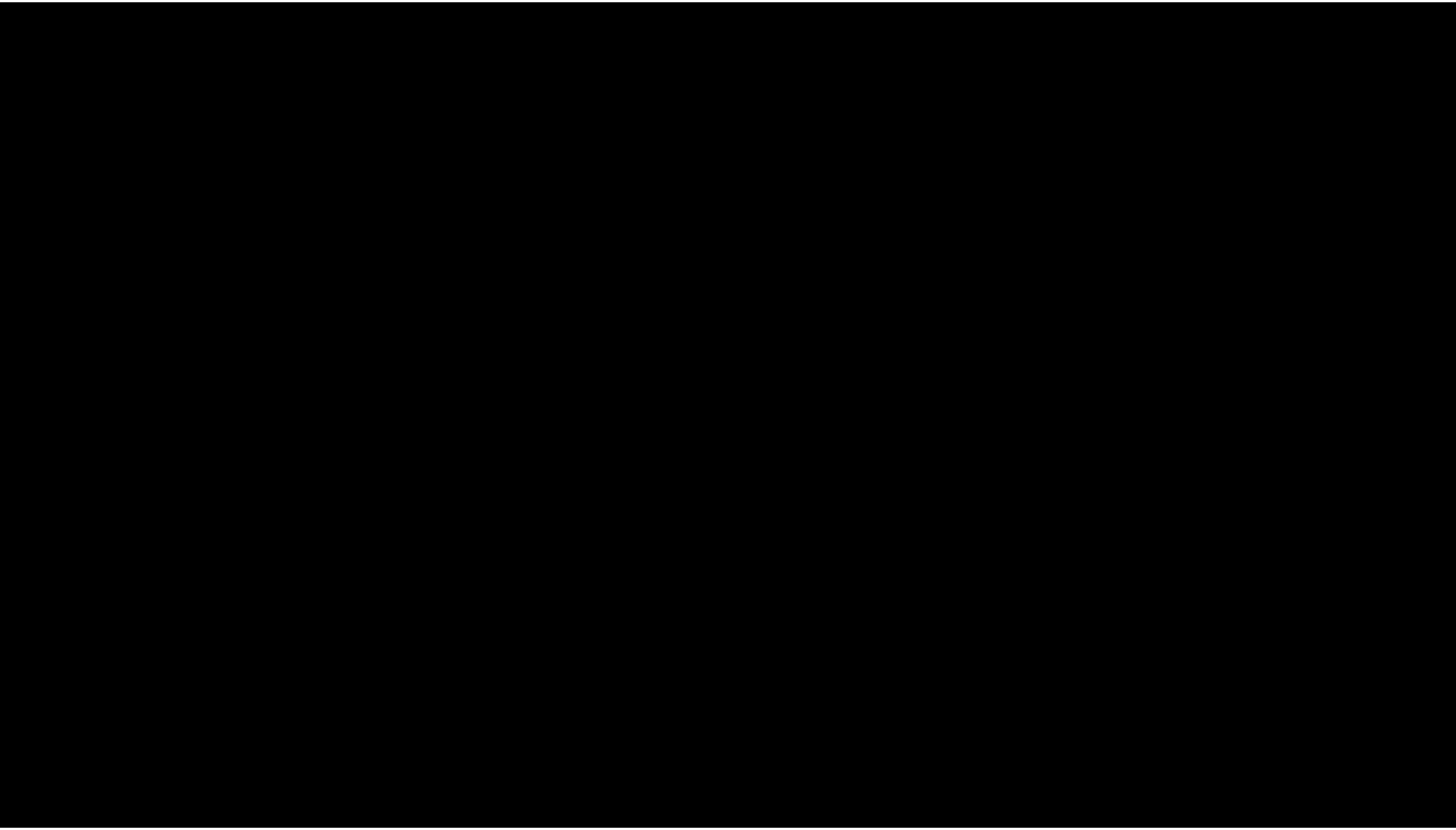
- Nitrogen assimilation means that the inorganic nitrates, nitrites or ammonia must be incorporated into organic compounds.

- Ammonification means that the dead organic remains of plants and animals and excreta are acted upon by bacteria, releasing nitrogen as ammonia.

- Conversion of nitrite into nitrate by nitrobacter is also nitrification. Denitrofication in conversion of nitrite and nitrate into nitrogen by Thiobacillus denitrifications, micro coccus *etc*

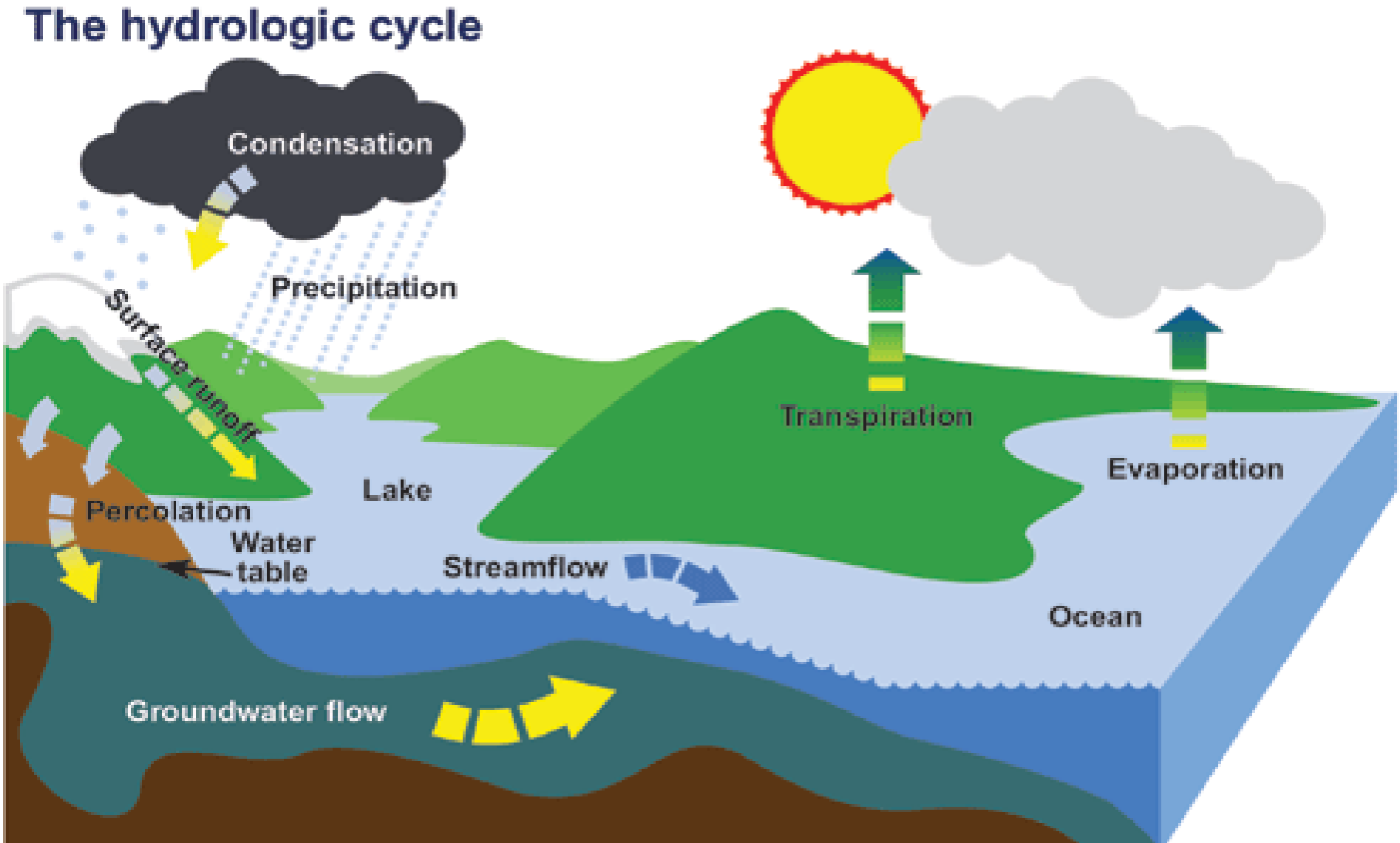
NATURAL RESOURCES

Animated Video showing Nitrogen cycle



NATURAL RESOURCES

Material Cycles Cntd…



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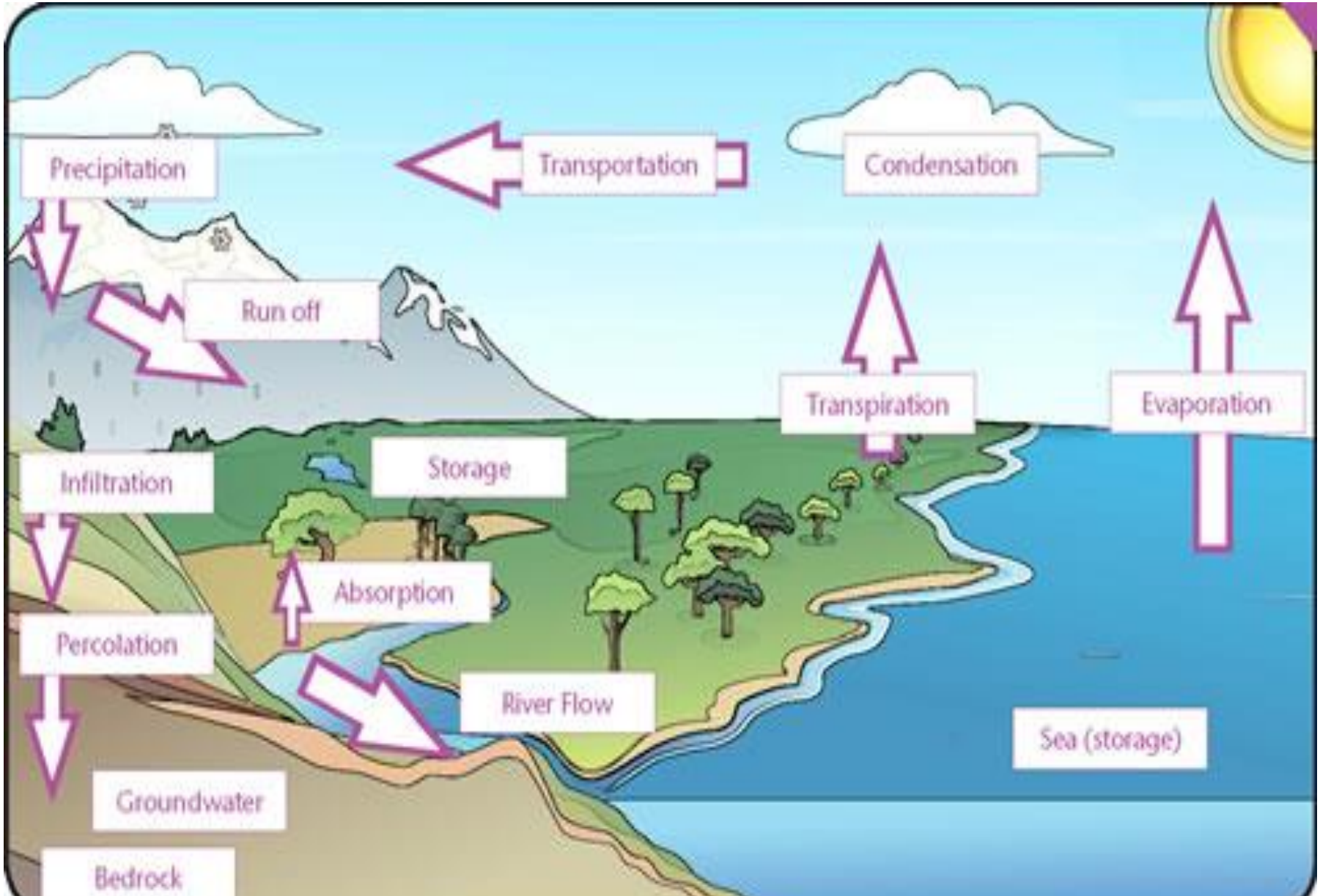
Material Cycles Cntd…



Importance of water quality

Critical Parameters

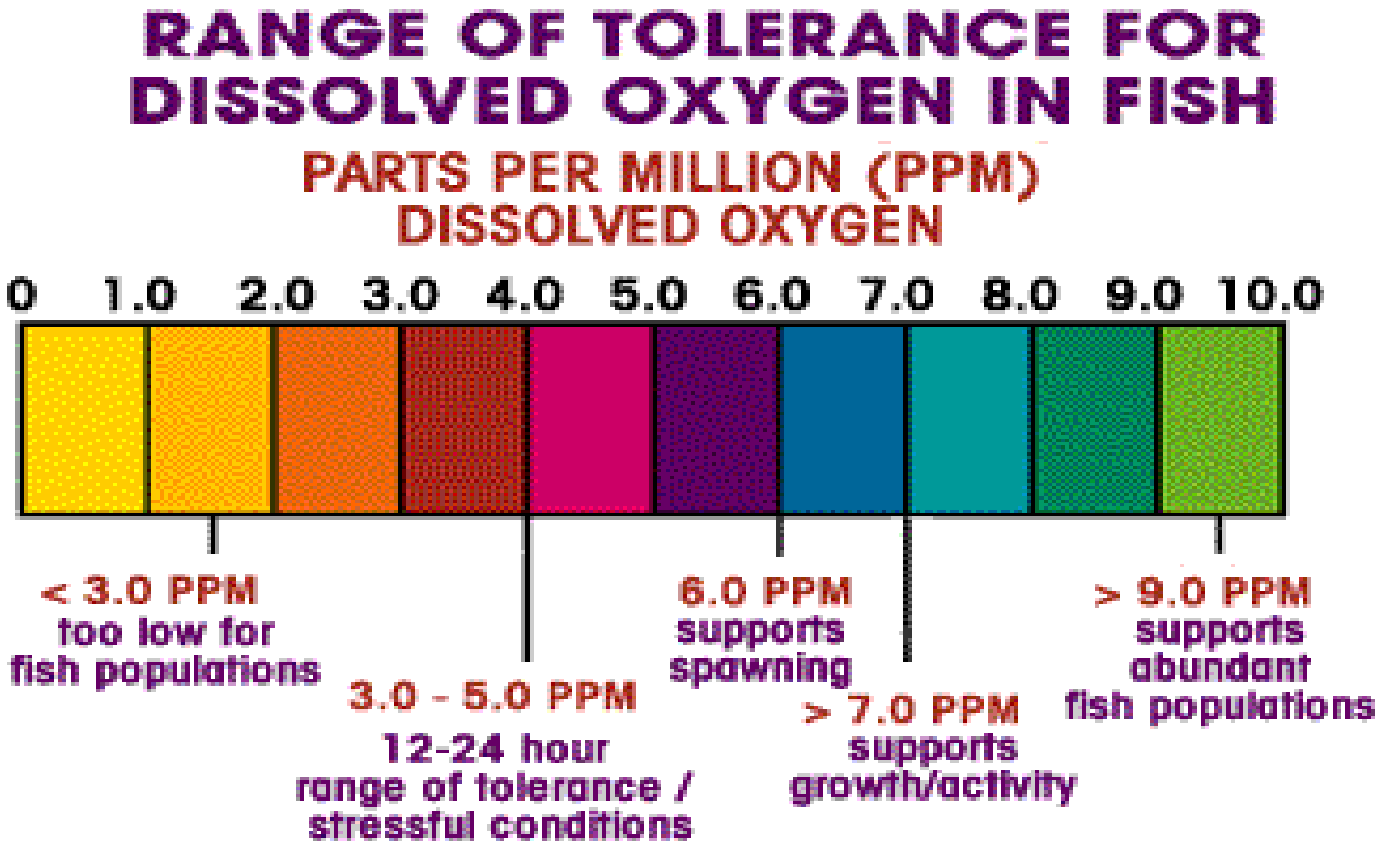
- dissolved oxygen
- temperature
- pH
- un-ionized ammonia
- nitrite
- *nitrate*
- carbon dioxide
- alkalinity
- solids

Importance of water quality

Water Sources

- Groundwater
- Surface Water
- Municipal Water Supplies

Importance of water quality



Importance of water quality

Water Sources – Ground Water

Advantages:

- Constant Temperature

Disadvantages:

- Dissolved H_2S and CO_2
- Low Dissolved Oxygen
- Supersaturation
- High Iron Concentration

Importance of water quality

Water Sources – Municipal Water

Advantages

- Availability
- Reliability

Disadvantage

- Chlorine
- Fluorine
- Cost

Importance of water qu

pH

- Measures hydrogen ion concentration
- Negative log of hydrogen ion concentration
- Ranges from 0 to 14 std. units
- pH
  - 7 neutral
  - 0 - 7 acidic
  - 7 - 14 alkaline

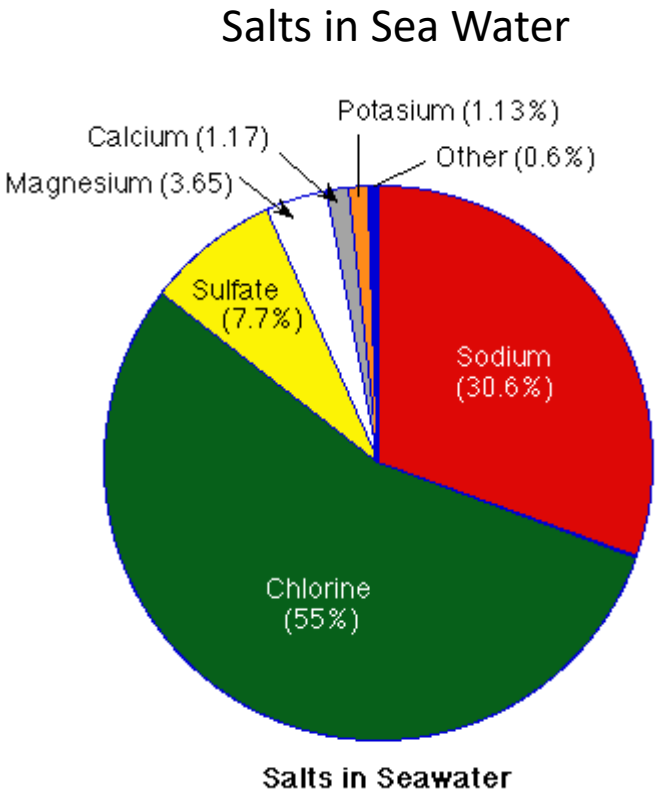
Concentration of Hydrogen ions compared to distilled water		Examples of solutions at this pH
10,000,000	pH= 0	Battery acid, Strong Hydrofluoric Acid
1,000,000	pH = 1	Hydrochloric acid secreted by stomach lining
100,000	pH = 2	Lemon Juice, Gastric Acid Vineger
10,000	pH = 3	Grapefruit, Orange Juice, Soda
1,000	pH = 4	Acid rain Tomato Juice
100	pH = 5	Soft drinking water Black Coffee
10	pH = 6	Urine Saliva
1	pH = 7	"Pure" water
1/10	pH = 8	Sea water
1/100	pH = 9	Baking soda
1/1,000	pH = 10	Great Salt Lake Milk of Magnesia
1/10,000	pH = 11	Ammonia solution
1/100,000	pH = 12	Soapy water
1/1,000,000	pH =13	Bleaches Oven cleaner
1/10,000,000	pH = 14	Liquid drain cleaner

Importance of water quality

Salinity

- Classification of Ground Water
- Composition Based on Total Dissolved Solids Content

Type of Water	Dissolved salt content (mg/l)
Fresh water	< 1,000 mg/l
Brackish water	1,000 - 3,000 mg/l
Moderatly saline water	3,000 - 10,000 mg/l
Highly saline water	10,000 - 35,000 mg/l
Sea water	> 35,000 mg/l



Alkalinity

Alkalinity (50 -150 mg/l as $CaCO_3$)

Formula	Common Name	Equivalent Weight
NaOH	sodium hydroxide	40
Na_2CO_3	sodium carbonate	53
$NaHCO_3$	sodium bicarbonate	83
$CaCO_3$	Calcium Carbonate	50
CaO	slaked lime	28
$Ca(OH)_2$	hydrated lime	37

Importance of water quality

Hardness

Classified as:

soft (0-75 mg/L

moderately hard (75 – 150 mg/L)

hard (150-300 mg/L)

very hard (> 300 mg/L)

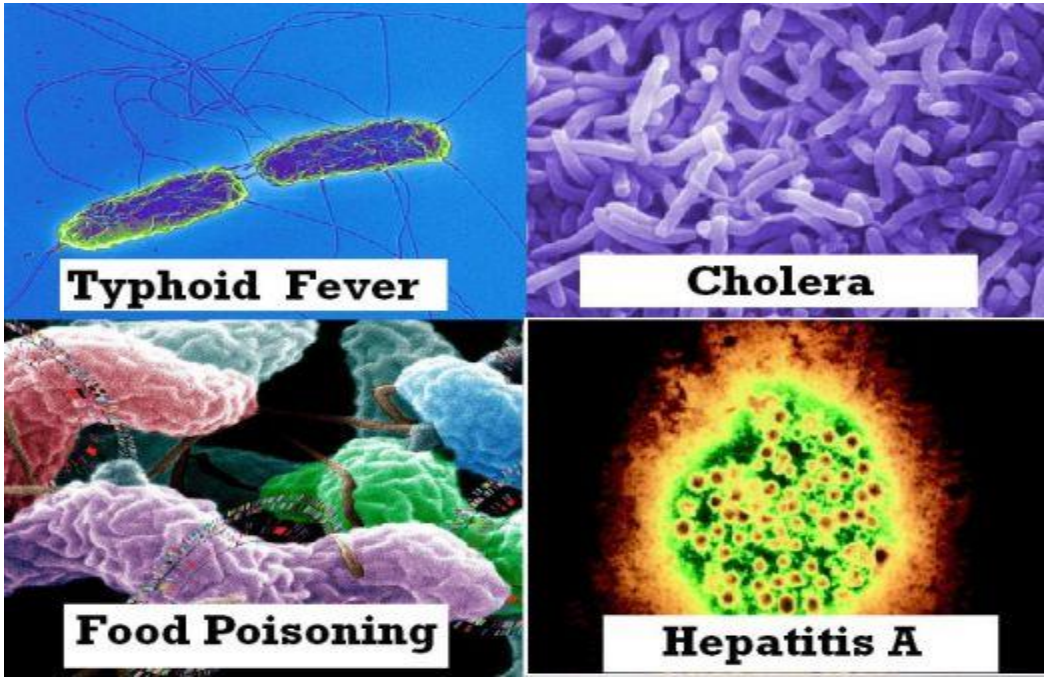
Recommended range: 20 to 300 mg/L $CaCO_3$

Water Borne Diseases

- About 1.1 billion people in the world still lack access to safe water for drinking and 2.4 billion people have no basic sanitation.

- The large majority of people are seriously affected by or die from preventable water and sanitation related diseases are rural dwelling and the urban poor in the developing countries.

- Current international estimate of deaths are due to water related diseases which range from 2.2 million to 5 million annually.



Classification of Water Related Diseases

Disease Classification	Description
Water Borne Diseases	**Caused by the consumption of water contaminated by human or animal excreta (feces, urine) containing disease causing organisms such as bacteria, viruses.**
Water-Washed Diseases (Water Scared Diseases)	**Caused by poor personal hygiene and skin or eye contacts with contaminated water and / or insufficient quantities of water for personal hygiene and washing Ex: Scabies,trachoma(eye infection),flea, lice, typhus.**
Water-based Diseases	**Caused by parasite found in intermediate organisms living in contaminated water. These diseases are passed on to humans when they drink / wash with it. Ex: Dracunculiasis,Schistosomiasis etc**
Water Related Insect-Vector Diseases	**Caused by insects, especially flies and mosquitoes that breed in or feed near contaminated water sources. Ex: Malaria, dengue, blindness, sleeping sickness,yellow fever.**

Fluoride Problem in Drinking Water

Fluoride Problem in Drinking Water

Fluorosis

- Fluoride in water is mostly of geological origin. Waters with high levels of fluoride content are mostly found at the foot of high mountains and in areas where seas has made geological deposits.

- Excess fluoride, most commonly in drinking water can cause fluorosis which affects the teeth (dental) and bones (skeletal).

- Moderate amounts lead to dental effects, but long term ingestion of large amounts can lead to potentially severe skeletal problems.

- Fluorosis is caused by excessive intake of fluoride. The dental effects of fluorosis develop made earlier than the skeletal effects in people exposed to large amounts of fluoride.

- Clinical dental fluorosis is characterized by staining and pitting of teeth. In more severe cases all the enamel may be damaged.

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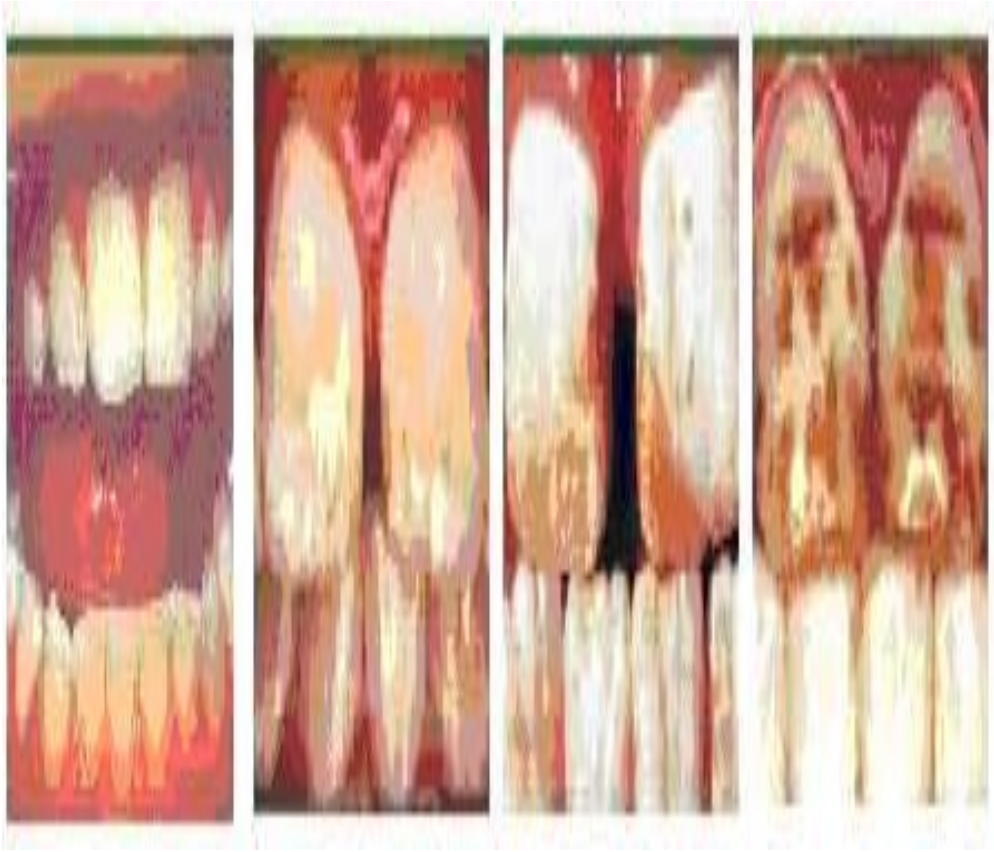
Dental Fluorosis



Very Mild Mild Moderate Severe

Fluorosis is caused by excessive intake of fluoride. The dental effects of fluorosis develop made earlier than the skeletal effects in people exposed to large amounts of fluoride. Clinical dental fluorosis is characterized by staining and pitting of teeth. In more severe cases all the enamel may be damaged.

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Skeletal Fluorosis

High level exposure to fluoride can lead to skeletal fluorosis (photos). Here, fluoride accumulates in the bone progressively over many years.

The early symptoms of skeletal fluorosis include stiffness and pain in the joints. In severe cases the bone structure may change and ligaments may calcify resulting impairment of muscles and pain.

Acute high level results in abdominal pain excessive saliva, nausea and vomiting.

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Cause:

Acute high level is very rare and usually due to accidental contamination of drinking water. Moderate level chronic exposure (>1.5 mg/l) is more common. People affected by fluorosis are often exposed to multiple sources of fluorosis, such as in food, water, air and excessive toothpaste. However, drinking water is typically the most significant source.

The MCLG (maximum contaminant level goals) for fluoride is 4.0 mg/L or 4.0 ppm. EPA(Environmental Protection Agency, United States) has set this level of protection based on the best available science to prevent potential health problems.

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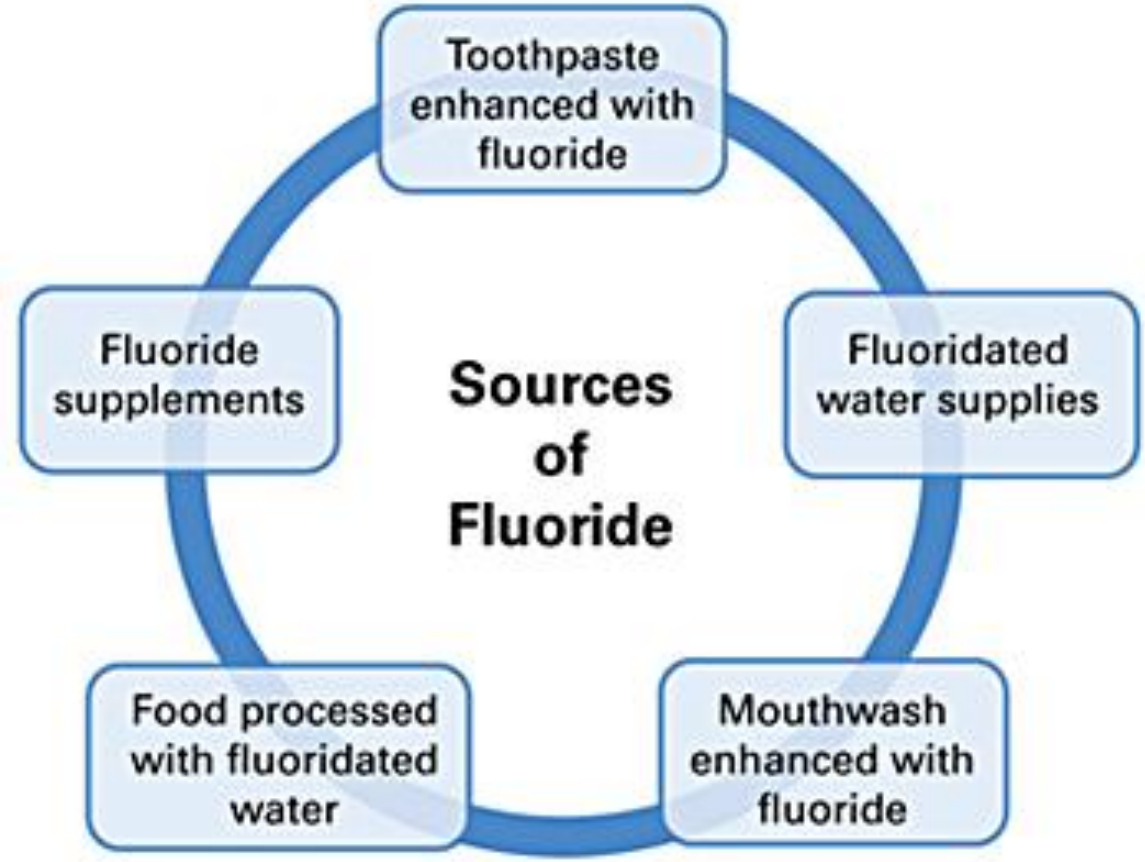

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Interventions:

Removal of excess fluoride in drinking water is difficult and expensive. The preferred option is to find a supply of safe drinking water with safe fluoride level where access to safe water is already limited, defluoridation may be the only option. Use of bone charcoal, contact precipitation, use of Nalgonda activated alumina. Since all method produces sludge with very high concentration of fluoride that has to be disposed off. Only water for drinking and cooking purposes should be treated.

Fluoride Significance in Drinking Water

Fluoride is voluntarily added to some drinking water systems as a public health measure for reducing the incidence of cavities among the treated population.

Water fluoridation is recognized to prevent tooth decay. Fluoridated drinking water can significantly reduce cavities as well as tooth decay by up to ninety percent.

American Medical Association and the American Dental Association both came out in favor of fluoridation as a safe and effective way to reduce cavities and tooth decay in the general population. In fact, the Centers for Disease Control hailed fluoridation as one of the top ten achievements of the twentieth century! The World Health Organization points out that benefits are greatest for the economically disadvantaged, who often don't have access to adequate dental care.

THANK YOU