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ENVIRONMENTAL SCIENCE

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SYLLABUS

Jharkhand PSC State Forest Service (ACF) Main Exam 2024 – 25 [Paper 1]	***Environment, Ecology and Ecosystem Dynamics*** ◈ **Unit – I** : Concept of environment, scope of Environmental Science, environmental components, scope and subdivisions of ecology, ecological principles pertaining to population, community, ecosystem and biome. ◈ **Unit – II** : Population dynamics and population regulations, concept of carrying capacity, population fluctuations, population dispersion, r and k selection, ecotypes and ecophene, habitats and niches. ◈ **Unit – III** : Energy in ecosystem, Primary and secondary production, Biomass, Methods of measuring productivity, Pattern of primary production in the major ecosystems of the world, Energy flow in ecosystems, Feedback and control mechanism, Pathways of energy transfer - grazing and detritus food chain, Ecological efficiency and ecological pyramids. ◈ **Unit – IV** : Biogeochemical cycles : nutrient cycling in the ecosystems, Gaseous cycles (Carbon and Nitrogen) and sedimentary cycles (Phosphorus and Sulphur), Impact of man on nutrient cycles; Major ecosystems of the world : A general idea of forest, grassland, desert, wetland, freshwater and marine ecosystems.
Jharkhand PSC State Forest Service (RFO) Main Exam 2024 – 25 [Paper 1]	***Fundamentals of Environment*** : Concept of environment hydrosphere, lithosphere, atmosphere and biosphere; Impact of man and environment; Period of hunting and food gathering : period of plant and animal domestication; Period of science, technology and industrialization. ***Ecosystem*** : Concept, components, food chain and food web, energy flow and productivity in ecosystem, nutrient cycle in ecosystem, types of ecosystems (forest, grassland, desert, aquatic, marine) and their problems, ecological imbalance.

CHAPTER 1

ENVIRONMENT

CONCEPT & COMPONENTS

1.1 INTRODUCTION

The environment refers to everything that surrounds a living organism—people, places, objects, and phenomena—whether natural or man-made.

In the early stages of human history, the environment was perceived only in terms of physical elements such as land, air, water, and living organisms. Over time, as society evolved, the concept of environment expanded to include social, economic, and political dimensions as well.

- *Definition* : The environment is the *sum of all external conditions surrounding an organism*, including *complex physical, chemical,* and *biological factors*, as well as social and cultural conditions, that influence its *growth, development*, and *survival*.

- The word “environment” is derived from the ***French*** term *Environ* or *Environer*, meaning ‘*to surround*’.

1.2 SCOPE / IMPORTANCE OF ENVIRONMENTAL SCIENCE

Importance highlights the "why" – why environmental science is crucial for our well-being and the planet's health. Scope emphasizes the "what" – what are the different areas and issues environmental science deals with.

Chapter Outline

▷ *Scope*

- **Understanding Natural Processes** : This involves studying how natural systems function, including ecosystems, climate patterns, and geological processes.
- **Human-Environment Interaction** : Environmental science examines how human activities affect the environment, including land use changes, pollution, and resource consumption.
- **Impact Assessment** : It assesses the consequences of human actions on natural systems and seeks to measure and predict these impacts.

▷ *Importance*

- ***Ecosystem Dynamics*** : This area focuses on understanding the mechanisms of ecosystems, including organism interactions, energy flow, and nutrient cycling. It aims to elucidate how these systems maintain balance and respond to changes.
- ***Natural Resources Management*** : This involves the study of how resources such as water, soil, forests, and minerals are distributed, managed, and conserved to ensure their sustainability for future use.
- ***Pollution Control*** : Here, the focus is on identifying pollution sources, understanding its environmental and health impacts, and developing strategies for prevention, treatment, and remediation of pollution in air, water, and soil.
- ***Climate Change Science*** : This encompasses research into the drivers of climate change, its global effects, and the development of strategies for mitigation (reducing greenhouse gas emissions) and adaptation (adjusting to climate impacts).
- ***Biodiversity Conservation*** : This discipline is dedicated to the protection of species diversity, habitats, and ecosystems, emphasizing the importance of biodiversity for ecological stability and human well-being.

> - ***Scope*** and ***Importance*** of environmental science [UPPSC ACF (Main) 2018, Envt. Science Optional, 20 M].
> - ***Definition***, ***Meaning*** and ***Importance*** of study of environmental sciences [UPPSC ACF (Main) 2021, Envt. Science Optional, 8 M].
> - ***Define*** environment. Write down the ***Importance*** and ***Scope*** of environmental science. Discuss briefly on socio-economic causes of environmental degradation. [Odisha PSC Forest (Mains) paper – I | 2015 |20 M].

- ***Environmental Policy and Legislation*** : It involves the creation, analysis, and enforcement of laws and policies aimed at protecting the environment. This includes international agreements, national laws, and local regulations.
- ***Human-Environment Interaction*** : This aspect examines how human activities influence the environment, assessing impacts like urbanization, industrialization, and agriculture, and devising methods to reduce negative environmental footprints.
- ***Sustainability Practices*** : This field explores sustainable development principles, aiming to harmonize economic growth, social development, and environmental protection to ensure that current human needs are met without compromising future generations' resources.

WHY ENVIRONMENTAL SCIENCE IS INTERDISCIPLINARY?

Environmental science is inherently ***Interdisciplinary Science*** because it necessitates the integration of knowledge from various disciplines like biology, chemistry, and physics, social sciences (such as economics and

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- ***Coral-Safe Sunscreen*** : his project combined knowledge from chemistry, marine biology, and environmental science to create a product that protects human skin without harming marine ecosystems.

- ***Green Infrastructure*** : integrates natural elements into urban planning to mitigate issues like air pollution and urban heat islands.
- ***AI-Driven Environmental Monitoring*** : by combining computer science with environmental studies.

1.3 COMPONENT OF ENVIRONMENT

The ***Environment*** encompasses all the external conditions and factors—both living (biotic) and non-living (abiotic)—that surround and influence organisms. These components interact continuously to sustain life on Earth. Broadly, environmental components can be classified into :

- ***Biotic*** (Living) Components
- ***Abiotic*** (Non-living/Physical) Components
- ***Energy*** Component
- ***Cultural*** or ***Built*** Environment.

- What do you mean by the term ***Environment***? What are its ***Basic Components***? [Arunachal PSC ACF (MAIN) 2012, Environmental Science Optional, 4 M].
- What are the ***Physical*** and ***Biological Components*** of environment? How do the physical and biological components of environment interact with each other? Explain with example [Arunachal PSC ACF (MAIN) 2018, Environmental Science Optional, 6 M].

1.4 EXERCISE

- Why is environmental science considered as an ***Interdisciplinary Science***? What is the ***Scope*** of environmental science? [Arunachal PSC ACF (MAIN) 2018, Env^{t}. Science Optional, 4 M].
- What are the ***Physical*** and ***Biological Components*** of environment? How do the physical and biological components of environment interact with each other? Explain with example [Arunachal PSC ACF (Main) 2018, Environmental Science Optional, 6 M].
- Abiotic components of an ecosystem [UPPSC ACF (Main) 2018, Environmental Science Optional | 20 M].
- Components of ecosystem and biotic factors [UPPSC ACF (Main) **2019**, Environmental Science Optional | 8+8 M].
- Explain biome and ecosystem with the help of suitable diagram [UPPSC ACF (Main) 2021, Environmental Science Optional | 20 M].
- Explain in detail the biotic and abiotic environmental factors of an ecosystem [UK PSC RFO (Main) 2012, Environmental Science Optional | 25 M].

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CHAPTER 2

ATMOSPHERE

STRUCTURE & COMPOSITION

The Earth is enveloped by a mixture of gases known as the atmosphere, which makes life possible. It provides the air we breathe, shields us from harmful ultraviolet (UV) radiation from the Sun, traps heat to maintain a warm and stable environment, and prevents extreme temperature (△) fluctuations between day and night.

— Approximately 97% of the atmosphere's total mass is concentrated within the first 29 kilometres above Earth's surface.
— 99% Mass ---------> 32 Km

2.1 COMPOSITION OF ATMOSPHERE

▶ ***Gases*** :

- Nitrogen (N_2) = 78% (Most abundant gas, relatively inert)
- Oxygen (O_2) = 20.9% (Essential for life)
- Argon (Ar) = 0.93% (Inert noble gas)
- Carbon dioxide (CO_2) = 0.04% (Crucial for plant life, Green House Gas)
- Neon (Ne) = 0.0018%
- Helium (He) = 0.0005%

Vertical Distribution

- The proportion of gases is not constant throughout the atmosphere.
- **Ozone (O_3)** : Concentrated in the stratosphere (10-50 km).
- **Carbon Dioxide (CO_2)** & **Water Vapor (H_2O)** : Found up to about 90 km.
- **Oxygen (O_2)** : Present up to about 120 km.
- **Higher Layers** : Gas composition changes significantly, with lighter gases becoming more dominant.

▶ ***Water vapour*** : Constitutes **0% to 5%** of atmospheric volume, depending on the location and conditions.

— In a warm and humid region, it can reach up to **4%**
— In cold, arid regions like polar areas and deserts, it is often less than **1%**.

Chapter Outline

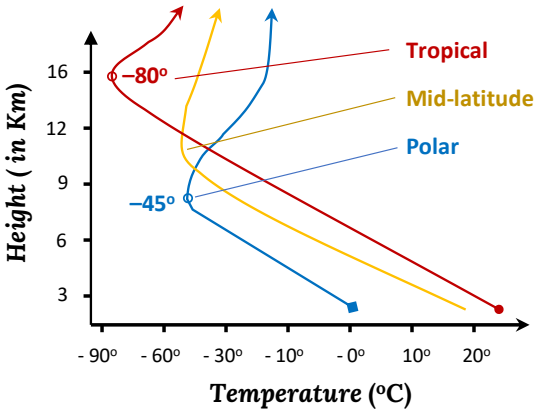
TROPOSPHERE : REGION OF MIXING

The Troposphere is the lowest layer of Earth's atmosphere, extending from the surface up to an average height of ≈ 11 kilometres.

- It contains approximately **75-80%** of the atmosphere's mass, with **99%** of the Earth's water vapor concentrated in this layer.
- All weather events, including clouds, rain, and storms, occur within the troposphere.
- **Height** : Vary with ◈ Latitude – ≈ 16 km at the equator and around 6 km at the poles.
  ◈ Seasonal – Generally higher in summer and lower in winter.

Tropopause : This is the boundary layer between the troposphere and stratosphere, typically about **1.5 km thick**, where mixing of air stops. The temperature at the tropopause is much lower at the equator (around **– 80°C** at about **17 km**) compared to the poles (approximately **-45°C** at around **8-9 km**) due to the lapse rate of about **6.5°C/km**.

- Its height also affected by the latitude and seasonal change.



STRATOSPHERE : WEATHER-FREE ZONE

The ***Second Layer*** of Earth's atmosphere, situated above the troposphere and extending ***up to about 50 kilometres*** in altitude. Unlike the troposphere where temperature decreases with altitude, the stratosphere experiences a ***gradual temperature increase***. This phenomenon is primarily attributed to the presence of the ***Ozone Layer***, concentrated ***between 15 and 30 kilometres***, which absorbs harmful ultraviolet radiation from the sun and converts it into heat.

- Temperature gradually increases with height (△↑↑Ⓗ), reaching approximately 0°C at an altitude of 50 Km (upper boundary).
- **Ozonosphere (O_3) = 15 – 30 Km** within the stratosphere. However, the traces of ozone can be found up to an 80 Km.
- **Clouds and Moisture** : The lower stratosphere may occasionally host ***Cirrus Clouds***.
- Largely free from weather phenomena like storms (turbulence) and clouds, making it an ***ideal region for aircraft operations***.

Write on the – Write about the ***Formation*** and ***Depletion*** of ***Stratosphere*** and ***Troposphere Ozone*** and list major effects of tropospheric ozone on plants [Himachal RFO (Main) 2017 Environmental Science Optional | 15 M].

Ozone is a ***Triatomic Allotrope*** of ***Oxygen***, consisting of three oxygen atoms (O_3), unlike the more common diatomic oxygen (O_2). This unique structure gives ozone distinct chemical properties. It is primarily found in two layers of Earth's atmosphere.

- **Stratosphere** : Contains about 90% of the total atmospheric ozone.
- **Troposphere** : Contains the remaining 10% of ozone.

Ozone molecules are chemically the same in both layers, consisting of three oxygen atoms. However, they influence humans and other organisms in a totally different way.

Stratospheric Ozone : A Protective Shield

As it plays a vital role in protecting life on Earth by absorbing harmful ultraviolet (UV) radiation. In particular, effectively filters out most of **UV-B radiation**, which is known to cause biological damage.

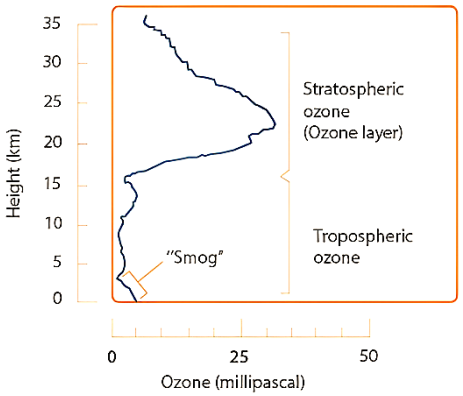


Figure : **Ozone Distribution**

Tropospheric Ozone : A Harmful Secondary Pollutant

Tropospheric ozone is a *toxic photochemical oxidant* formed through the interaction of solar radiation with primary pollutants, such as nitrogen oxides (NO_x) and volatile organic compounds (VOCs). It poses significant risks to human health, animals, and plants, making it a major environmental concern.

OZONE FORMATION

- **Stratospheric ozone** forms naturally through chemical reactions driven by solar ultraviolet (UV) radiation and oxygen molecules.

  First, UV radiation strikes an oxygen molecule (O_2), splitting it into two highly reactive oxygen atoms ($O^\bullet$). Each of these atoms then reacts with another oxygen molecule to form an Ozone molecule (O_3). These reactions occur continuously in the presence of UV radiation.

$$O_2 \xrightarrow[< 200\ nm]{UV-C} 2\,O^\bullet$$

$$O^\bullet + O_2 + m \longrightarrow O_3 + m$$

Here, "**m**" represents a third-body molecule that absorbs excess energy.

- **Tropospheric Ozone** : Forms near the Earth's surface through chemical reactions primarily involving hydrocarbons, nitrogen oxides (NO_x), and ozone itself, all of which require sunlight to proceed. The combustion of fossil fuels serves as a major source of the pollutant gases that drive the production of tropospheric ozone.

$$NO_x + VoC \xrightarrow{\text{Sun light}} O_3$$

OZONE DEPLETION

- ***Photodissociation of Ozone*** : Ozone absorbs UV radiation and is broken down into diatomic oxygen (O_2) and a free oxygen atom.

$$O_3 \xrightarrow[200-300\ nm]{UV-B/C} O_2 + O^\bullet$$

$$O^\bullet + O_3 \longrightarrow 2O_2$$

- ***Catalytic Destruction*** : Certain chemicals, particularly those containing chlorine (Cl) and bromine (Br), act as catalysts in ozone depletion. For example, chlorofluorocarbons (CFCs), once widely used in refrigeration and aerosol sprays, release chlorine atoms upon exposure to UV light in the stratosphere. These chlorine atoms can destroy thousands of ozone molecules.

$$Cl + O_3 \rightarrow ClO + O_2$$

$$ClO + O^\bullet \rightarrow Cl + O_2$$

This cycle allows a single chlorine atom to destroy thousands of ozone molecules before it is eventually removed from the stratosphere

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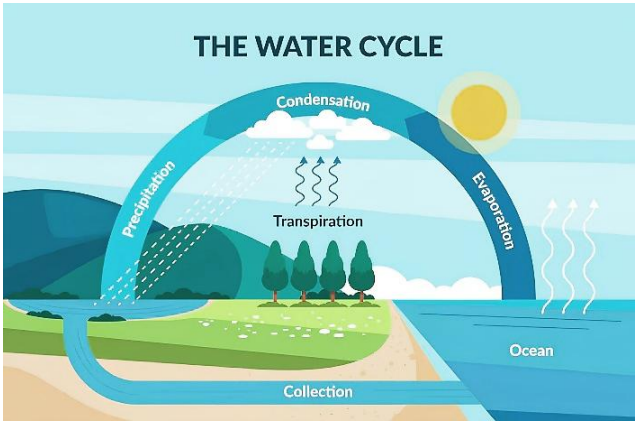
CHAPTER 3

HYDRO, LITHO & BIOSPHERE

3.1 HYDROSPHERE

The **hydrosphere** encompasses all the waters on, under, and over the surface of Earth. It is a discontinuous layer of water in all its forms: liquid, solid (ice and snow), and gas (water vapor). Essentially, it's the combined mass of water found on the planet, regardless of its state or location.



Hydrology is the scientific study of the movement, distribution, and management of water on the Earth's surface and beneath the surface, including the study of its physical & chemical properties, and its relationship with the living and material components of the forest ecosystem.

COMPONENTS OF HYDROSPHERE

- ***Ocean*** : Out of the total water on Earth, ***96.5% is oceanic (saline) water***, making it the largest component of the hydrosphere. It is saline primarily because of sodium chloride, with about 35 grams of dissolved salts per liter. These vast water bodies act as heat reservoirs, influencing global weather patterns and supporting a wide array of marine ecosystems.
- **Freshwater** : The remaining **2.5%** of Earth's water is ***Freshwater***, of which approximately **68.5%** is locked in ***Ice Sheets*** and ***Glaciers*** (*e.g.*, Antarctica, Greenland, the Himalayas). This water remains

Chapter Outline

Write on the following - Composition of hydrosphere [UPPSC ACF (Main) 2019, Environmental Science Optional | P1/1(e) | 8 M | 150 Words]

- **Mineral Dissolution** : **Ionic Enrichment and Water Hardness**

  Water can dissolve various minerals from the lithosphere, altering its chemical composition. For instance, when rainwater seeps through soil and rock, it can dissolve minerals such as ***Calcium Carbonate***, ***Magnesium***, and ***Iron***. This process can affect hardness and pH levels.

  $$CaCO_3 + H_2O + CO \rightarrow Ca^{2+} + 2HCO_3^-$$

  This increases water hardness (Ca^{2+}, Mg^{2+}) and alkalinity (HCO_3^-), affecting pH and suitability for domestic/industrial use

- **Acidification & Toxic Metal Mobilization**

  Human activities, such as burning fossil fuels, release sulfur dioxide (SO_2) and nitrogen oxides (NO_x) into the atmosphere. These pollutants can combine with water vapor to form acid rain, which has a pH lower than that of normal rainwater. When this acidic precipitation falls on the lithosphere, it can leach harmful metals like aluminum from rocks and soils into nearby water bodies.

- **Eutrophication (Nutrient Runoff)** : Fertilizers used in agriculture often contain high levels of phosphorus and nitrogen. When it rains, these nutrients can wash off the lithosphere into rivers and lakes (hydrosphere), leading to nutrient enrichment.

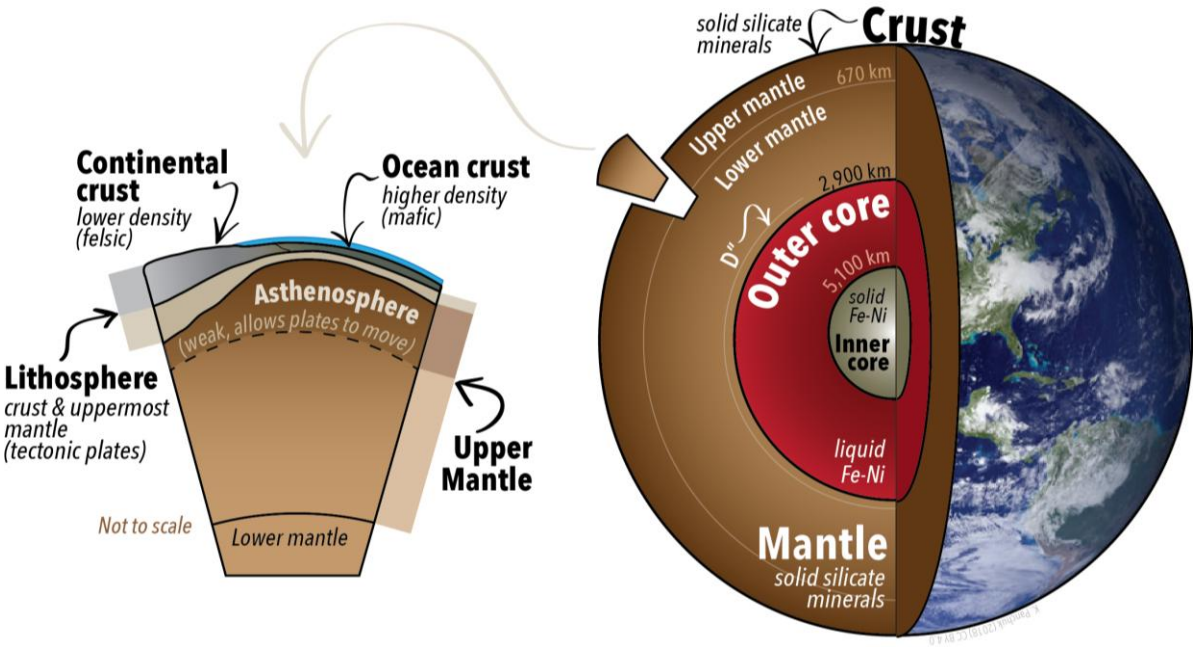
3.2 LITHOSPHERE

Lithosphere is a rigid, outermost layer of the Earth, encompassing both the crust and the uppermost portion of the mantle.

- Write on the following – (a) Lithosphere composition? [UPPSC ACF (Main) 2018, Environmental Science Optional | P1/1(a) | 8 M | 150 Words].
- Write notes on – Lithosphere with a suitable diagram [UPPSC ACF (MAIN) 2017, Environmental Science Optional | 20 M].

COMPOSITION

The lithosphere is composed of a variety of rocks, minerals, and other materials. The most common rocks in the lithosphere are igneous rocks, which are formed from the cooling and solidification of magma or lava.



CHAPTER 4

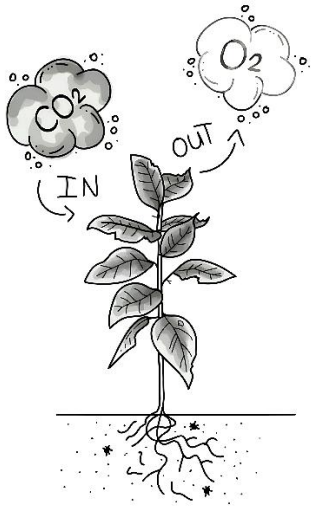
ECOLOGY

4.1 WHAT IS ECOLOGY ?

Ecology is the study of **Interactions** among living organisms, and between them and their connections to the surrounding abiotic (physical) environment.

or

Study of how organisms ***interact with each other*** and their environment. It's about understanding the connections between living things (like plants, animals, and humans) and the world around them.



- The word ecology comes from the **Greek** word **Oikos**, which means "***House***", and **Logos**, means '***the study of***'.
- ***Ernst Haeckel***, a German biologist, ***coined the term ecology*** in 1866 to encourage biologists to consider the ways organisms interact.
- ***Father of ecology*** : ***Reiter***
- The term ***Ethology*** for ecology was used by : ***Geoffroy Hilaire***.
- The term ***Hexicology*** for ecology was used by : ***G.H. Mivart***
- Study of ecology was initiated in India by : W. Dudgeon
- ***Father of Indian Ecology*** : ***Prof. Ram Deo Misra*** [~~Not baba Ramdeo~~].

Chapter Outline

▷ **Biosphere** : The **biosphere**, also called the **ecosphere** or **giant ecosystem**, is the largest and nearly self-sufficient biological system. It encompasses all ecosystems on Earth and is referred to as the "**life-supporting zone**" of the planet.

4.3 ECOSYSTEMS

Ecosystems is a community of living organisms interacting with each other and their environment, which includes both biotic factors (like plants, Animals, and microorganisms) and abiotic factors (such as air, water, soil, and climate). This interaction encompasses various processes, including energy flow and nutrient cycling, essential for sustaining life within a specific geographical area.

✍ word ecosystem was first proposed by the British ecologist Sir **Arthur G. Tansley** (1935).

TYPES OF ECOSYSTEMS

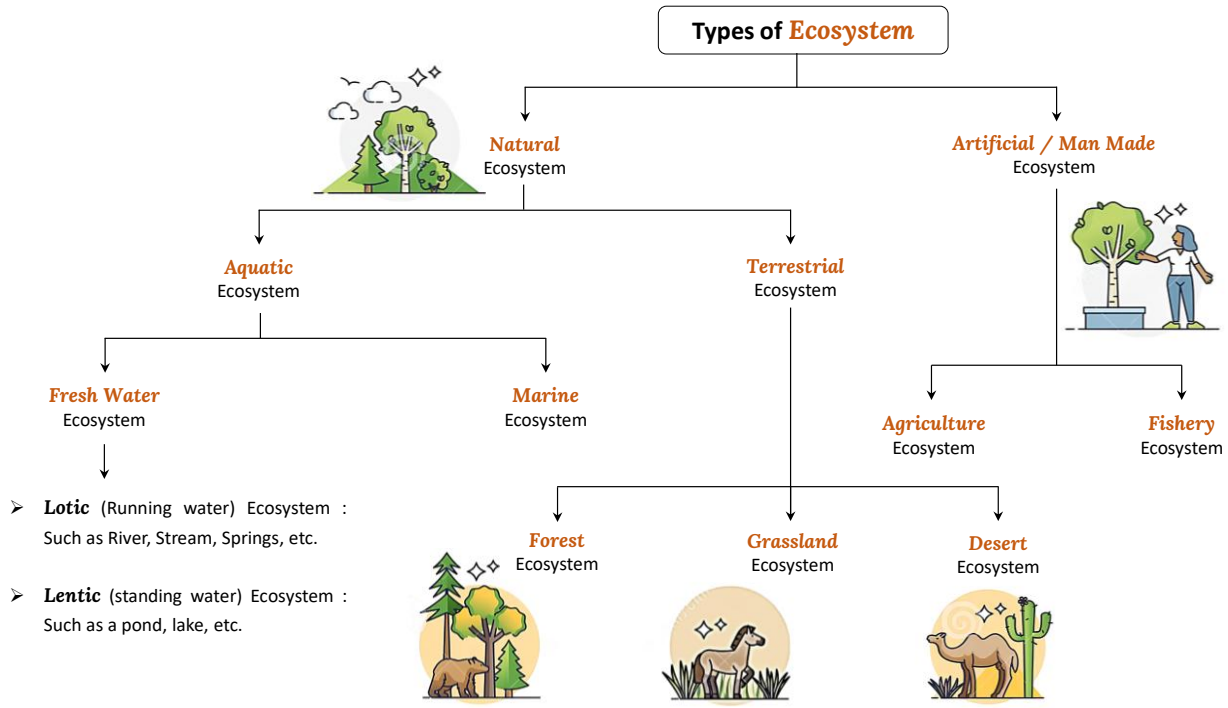
▶ **Natural Ecosystem** : These are the ecosystem established and maintained by the natural forces. Based on habitat, this can be further subdivided into –

(1) ***Terrestrial ecosystem*** : Ecosystem present in the terrestrial habitats fall under this category. These includes – Forest ecosystem, Grassland ecosystem, Desert ecosystem, Tundra ecosystem, etc.

(2) ***Aquatic ecosystem*** : Ecosystem present in the aquatic habitats are considered under this category. They can be further grouped into –

(a) *Freshwater ecosystem* : Ecosystems found in the freshwater habitat come under this group. A freshwater ecosystem can be ***Lotic*** (running water such as river, stream, springs, etc.) or ***Lentic*** (standing water such as a pond, lake, etc.).

(b) *Marine ecosystem* : Ecosystems of deep water bodies, such as Oceans, Seas, and Estuaries, are categorized as marine ecosystems.



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UNIT IV

BIO-GEO CHEMICAL CYCLE

SYLLABUS
⇛ **ACF [Paper – I / Environment, Ecology and Ecosystem Dynamics]** **[Unit – IV : Biogeochemical cycles]** Nutrient cycling in the ecosystems, Gaseous cycles (Carbon and Nitrogen) and sedimentary cycles (Phosphorus and Sulphur), Impact of man on nutrient cycles.
⇛ **RFO [Paper – I]** **[Unit – II : Ecosystem]** Nutrient cycle in ecosystem

1.1 BIO-GEO-CHEMICAL CYCLE ?

Biogeochemical cycles describe *the continuous movement of essential elements like carbon, phosphorus, nitrogen, and sulphur between living organisms and their environment (soil, air, water). These cycles ensure that these elements are constantly recycled and available for life to thrive*. Here, the word '*Bio*' represents living organisms, '*Geo*' denotes the Earth's environment (including soil), and '*Chemical*' refers to elements like carbon, phosphorus, nitrogen, and sulfur that undergo regular transitions. Whereas, the term '*Cycle*' indicates a repeated movement through a circular path; the removal of nutrients from one ecosystem to another and their eventual return to the original ecosystem. While this can happen for some elements involved in the geochemical cycle, it's not the case for most.

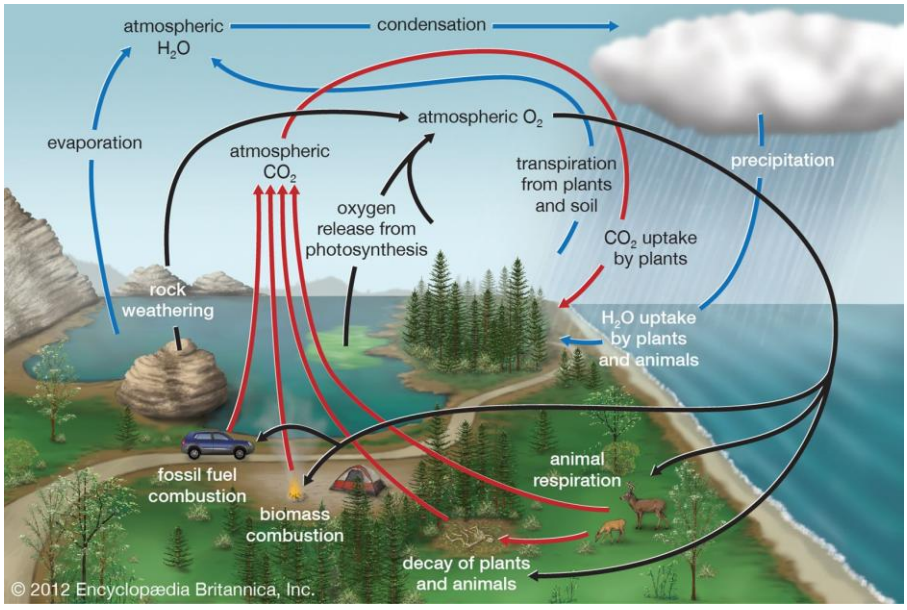

Figure 1.1 : *The Biogeochemical Cycle = Nutrient Cycling Between Ecosystems*

- **Definition** : A *More or less circular pathways*, through which the *Chemical Elements*, including all the essential elements of protoplasm, circulate in the biosphere from the *Environment* to *Organisms* and back to the environment, are known as biogeochemical cycles.
- Biogeochemical cycles are **natural pathways** through which **essential elements** and **molecules**, such as Carbon, Nitrogen, Phosphorus, and Sulfur, move and transform between **living organisms** (biotic) and **non-living** (abiotic components, such as the atmosphere, oceans, and Earth's crust) of the **Earth's system**. These cycles sustain life and maintain ecological balance.

ROLE / IMPORTANCE

- Geochemical cycling generally involves the removal of chemicals from one ecosystem and their deposition in another, where they may remain indefinitely or be transferred to the next ecosystems. This process fuels primary production (plant growth) and supports the entire food web [*Drive Ecosystem Productivity*]
- These processes influence nutrient levels and energy flow within an ecosystem.
- Cycle ensures the continuous availability of essential elements like carbon, nitrogen, phosphorus, and water, which are the building blocks of all living organisms [*Sustain life*].
- Cycles like the water cycle and the carbon cycle play a crucial role in regulating Earth's climate by influencing temperature, precipitation patterns, and atmospheric composition [*Regulating climate*].
- These cycles also demonstrate the interconnectedness of the biosphere (living organisms) with the geosphere (rocks and minerals), atmosphere (air), and hydrosphere (water), highlighting the interdependence of all Earth systems [*Climate change connectivity*].

TYPES OF CYCLES

- **Gaseous cycle** : A type of biogeochemical cycle in which the *reservoir is the air* or the *oceans* (*via* evaporation). Such cycles include those of *Nitrogen*, *Oxygen*, and *Carbon*. These elements can enter or leave ecosystems in various forms (gas, vapor, solid, or solution); however, for nitrogen, carbon, and oxygen, the gaseous state is the predominant form of entry.

  Every day, a very large amount of CO, CO_2, and oxides of sulfur and nitrogen are released into the atmosphere due to human activities such as industrial processes, vehicle emissions, and the burning of fossil fuels. In addition to these pollutants, a wide array of organic chemicals and pesticides also circulate through these atmospheric cycles. These substances, after being emitted, remain in the atmosphere for varying periods, undergoing complex interactions and transformations before eventually settling or being removed through various environmental processes.

- **Sedimentary cycle :** A type of biogeochemical cycle, in which the *reservoir is Earth's crust*. This includes *Iron*, *Calcium*, *Phosphorus*, *Sulphur*, and other more-earthbound elements. Sedimentary cycles vary from one element to another, but each cycle consists fundamentally of a *solution* (or water-related) phase and a *rock* (or sediment) *phase*. They are considered less ideal cycles because they take a long time to complete their circulation.

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Write a note on Biogeochemical cycle [UPPSC ACF/RFO (Main) 2021 | **20 Marks** | Environmental Science Optional]

Approach : ❶ Understand the question – Here, the examiner asking for a "Note", means, a concise and informative explanation with more focus on the definition, types, importance and relevance of biogeochemical cycles.

❷ Introduction : Start by defining what is a biogeochemical cycle is, followed by mentioning the significance of this cycles in maintaining the balance of ecosystems.

❸ Main Body : Briefly describe the major types of biogeochemical cycles with suitable ***diagrams*** and ***examples***. Explain how these elements move through the atmosphere, hydrosphere, lithosphere, and biosphere.

❹ Explain how human activities (e.g., pollution, deforestation) are disrupting these natural cycles

❺ Conclusion : Summarize the importance of maintaining these cycles for ecological balance, and Mention the potential consequences of disruption and the need for sustainable practices.

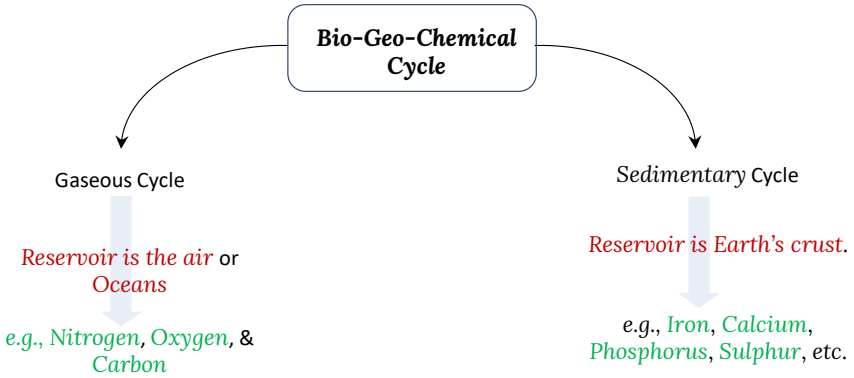
A biogeochemical cycle is a **natural process** by which **essential elements and compounds**, such as **carbon, nitrogen**, **oxygen**, and **water**, move through and are **recycled within the Earth's ecosystems**. These cycles involve the interaction between **biological (living organisms)**, **geological (earth and soil)**, and **chemical** (molecular transformations) components of the environment.

① Always Underline **Key-terms**

These cycles are crucial for maintaining the balance of ecosystems, supporting life, and regulating the Earth's environment.

TYPES OF BIOGEOCHEMICAL CYCLE

② Separate the main body either by using **UPPER CASE** or by using a **color pen** and **Boxing**.



(1) **Carbon cycle**: involves the movement of carbon among the atmosphere, oceans, soil, and living organisms. Plants absorb carbon dioxide (CO_2) during photosynthesis, converting it into organic matter. This carbon moves through the food chain as animals consume plants. Eventually, carbon is returned to the atmosphere through respiration, decomposition, and the burning of fossil fuels, playing a key role in climate regulation.

_____ Diagram _____

③ A very essential part. देखो भाई, आप अपनी स्वयं की Copy पढ़ना नहीं चाहते, तो फिर परीक्षक क्यों पढ़ें? ऊपर से हस्तलिखित पढ़ने में दिमाग का वैसे ही दही हो जाता है, इसलिए परीक्षक अक्सर ऊपर-ऊपर से पढ़कर आगे बढ़ जाते हैं और सही से अंक नहीं मिलते। तो कुल मिलाकर आपको उनका काम आसान करना होता है जिससे आपको Marks मिल सकें और वो यह Diagram / Flowchart करते हैं। और ऊपर से ये आपकी Copy को दिखने में अच्छा बना देते हैं।

(2) **Nitrogen cycle**:

(3) **Phosphorus cycle**:

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