Environmental Science

Unit –I Environment and Ecosystem

Part-I Environment

(Segments of Environment: Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem – Water, Carbon, Nitrogen.)

By

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Environmental Science

- **Environmental science** is the study of:
  - How the Nature works
  - How the environment affects the humans and vice versa

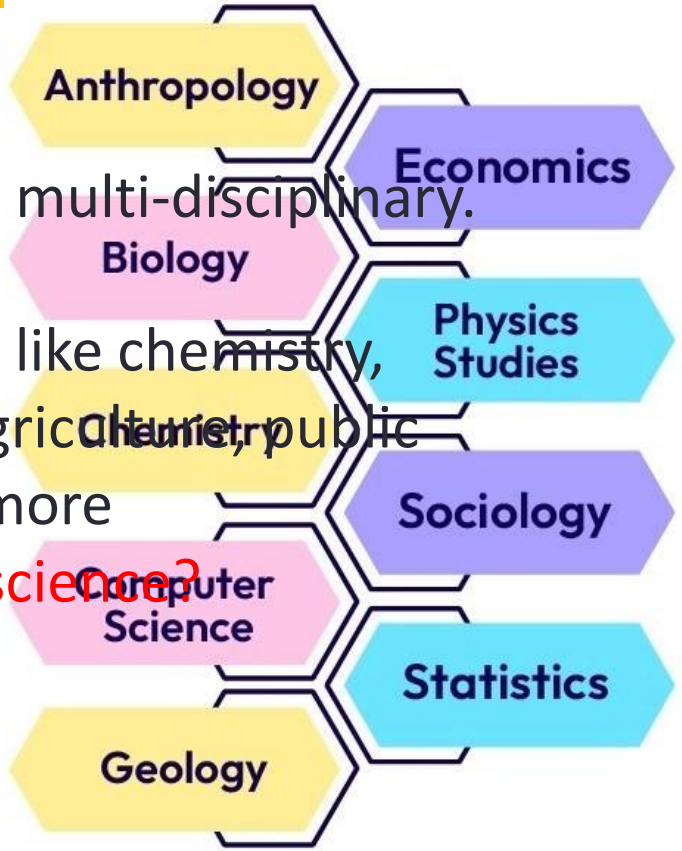
"(Environmental science is) an interdisciplinary field that integrates areas of life, physical and earth science to study and address problems facing the environment and to implement science-based solutions."

Environmental Science :

The science of Environment studies is multi-disciplinary.

It comprises various branches of studies like chemistry, physics, medical science, life science, agriculture, public health, sanitary engineering and many more

Is maths compulsory for Environmental science?



???????

Yes, in some classes you will need basic statistics or basic algebra, but not that much depending on the coursework. Some may require advanced algebra, trigonometry and calculus.

ES Course

Mathematics Foundation (I believe you know very well)

Linear Algebra: | Calculus: | Differential Equations: | Probability and Statistics:

Environmental Chemistry

Fundamentals of Environmental Chemistry: | Principles of Water Chemistry: | Soil Chemistry: | Atmospheric Chemistry:

Environmental Microbiology

Microbiology and Health:

Water Resources

Global Water Resources:| Surface Water Resources| Groundwater Resources:

Water & Wastewater Treatment and Management

Air and Noise Pollution

Solid and Hazardous Waste Management

Global and Regional Environmental Issues

Environmental Management and Sustainable Development

Definitions of Environment Science

- The word ‘Environment’ is derived from the French word ‘Environner’ which means to encircle, around or surround.
- The biologist Jacob Van Uerkal (1864-1944) introduced the term ‘environment’ in Ecology.
- Ecology is the study of the interactions between an organism of some kind and its environment.
- Environmental Science is the interdisciplinary field and requires the study of the interactions among the physical, chemical and biological components of the Environment with a focus on environmental pollution and degradation.

Definitions of Environment Science

- The science of Environment studies comprises various branches of studies like chemistry, physics, life science, medical science, agriculture, public health, sanitary engineering, geography, geology, atmospheric science, etc.
- It is the science of physical phenomena in the environment. It studies the sources, reactions, transport, effect and fate of a biological species in the air, water and soil and the effect of and from human activity upon these.
- Environmental Science deals with the study of processes in soil, water, air and organisms which lead to pollution or environmental damages and the scientific basis for the establishment of a standard which can be considered acceptably clean, safe and healthy for human beings and natural ecosystems.

What is Environment?

- The Environment is about the surrounding external conditions influencing development or growth of people, animal or plants; living or working conditions etc.
- This involves three questions ie.,
  - ✓ what is surrounded?
  - ✓ by what surrounded? and
  - ✓ where surrounded?
- The answer to the first is living objects in general and man in particular.
- The answer to the question what surrounded is that human life is concerned to be the main in the study of environment, however it cannot exist or be understood in isolation from the other forms of life like animal life and from plant life.

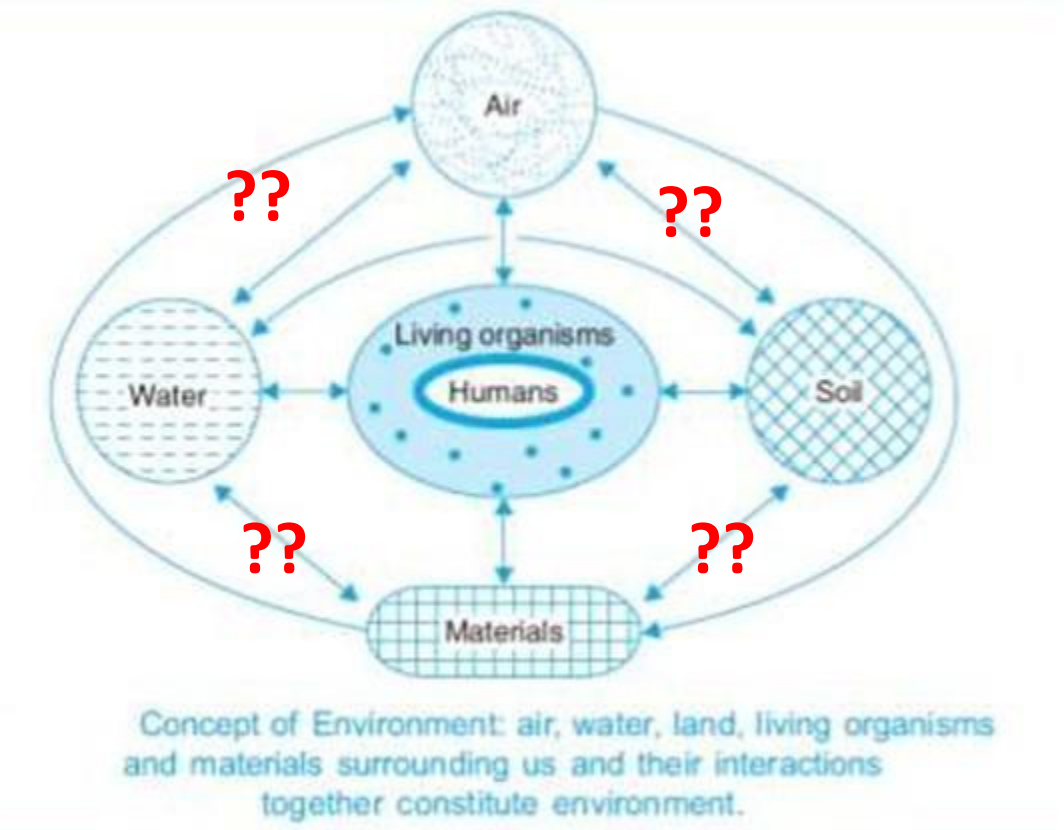
What is Environment?

- Environment belongs to all living beings and is thus important for all.
- Hence, environment refers to the sum total of conditions surround in space and time.
- In the primitive age, the environment consisted of only physical aspects of the planet earth ie., land, water and air as biological communities. As of now, it includes social, economic and political conditions also.
- The answer for the question where surrounded is in nature that physical component of the planet earth, viz land, air, water etc., support and affect life in the biosphere..

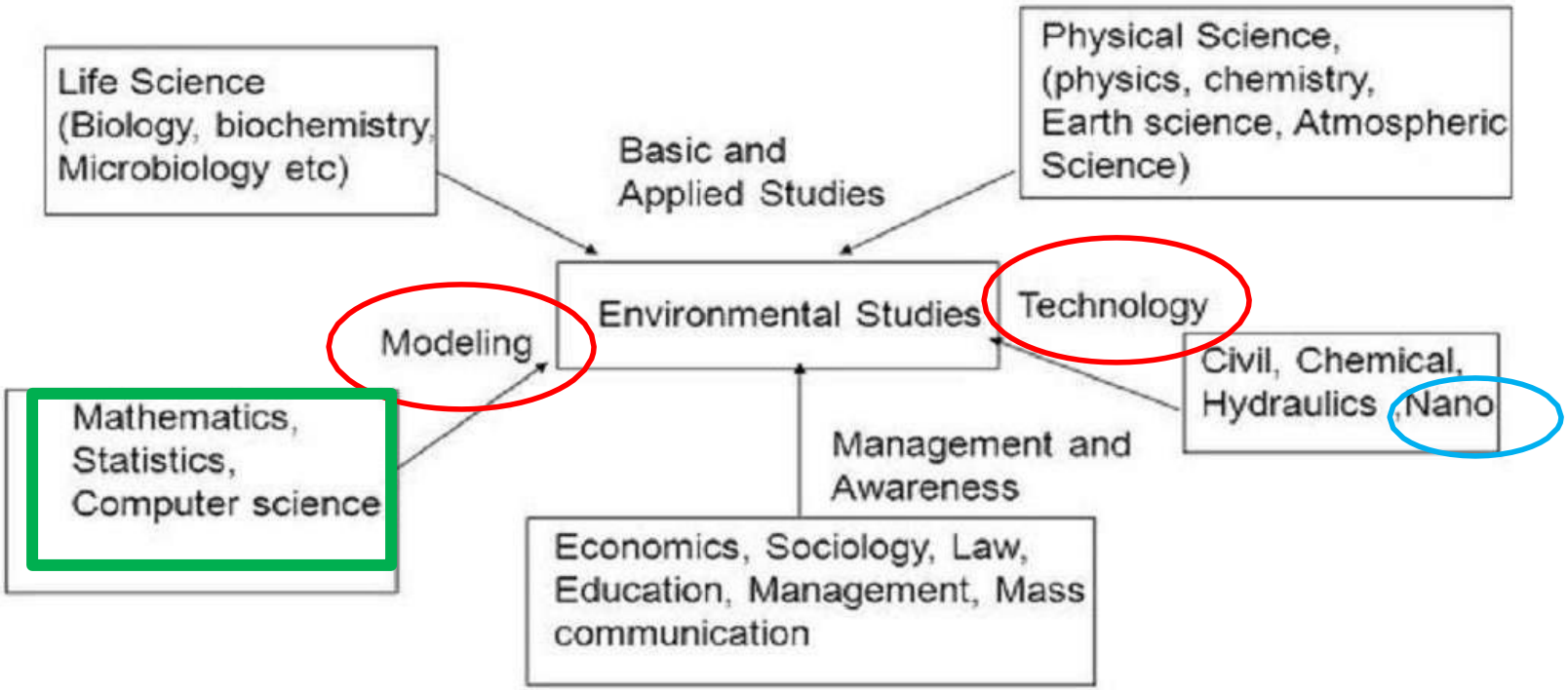
Environment is the sum total of land, water, air, interrelationships among themselves and also with the human beings and other living organisms.

(OR)

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.



Concept of Environment: air, water, land, living organisms and materials surrounding us and their interactions together constitute environment.


Life Science
(Biology, biochemistry, Microbiology etc)
Basic and
Applied Studies
Physical Science,
(physics, chemistry,
Earth science, Atmospheric
Science)
Environmental Studies
Technology
Modeling
Civil, Chemical,
Hydraulics ,Nano
Mathematics,
Statistics,
Computer science
Management and
Awareness
Economics, Sociology, Law,
Education, Management, Mass
communication

- Life sciences including botany, zoology, microbiology, genetics, biochemistry, biotechnology help in understanding the biotic components and their interactions.

- The physical and chemical structure of the biotic components and energy transfer and flow are understood with the help of basic concept of physics, chemistry, atmospheric science and oceanography.

- Mathematics, statics and computer science serve as effective tools in environmental modelling and management.

- Economics, sociology and mass communication provides the input for dealing with socio economic aspects associated with various developmental activities.

- A synthesis with environmental engineering, civil engineering and chemical engineering form the basis for various technologies dealing with the control of environmental pollution, waste treatment and development of cleaner technologies that are important for protection of environment.

- Environmental laws provide the tools for effective management and protection of the environment.

Level of ES Knowledge Test (40 Min)

1. How does air pressure change with altitude in the atmosphere?
2. How do human activities impact the composition of Earth's atmosphere?
3. Give two examples of biotic factors in an ecosystem?
4. What are the current challenges of Air, Water and Soil?
5. What is environmental forecasting, and how does it help in predicting changes in the atmosphere, ecosystems, and weather patterns?
6. How does weather forecasting use data from satellites, weather stations, and computer models to predict short-term atmospheric conditions?
7. What are the main layers of Earth's atmosphere?
8. What do you mean by Tsunami and the common reason for this?
9. What is the Environment Protection Act, 1986, and how does it contribute to the protection and improvement of the environment in India?
10. How does the Wildlife Protection Act, 1972, aim to conserve wildlife and protect endangered species in India?
11. How do industrial and agricultural activities contribute to the contamination of water bodies, and what regulations are in place to address these issues?
12. In your opinion how do you find IT can play a very important role in solving various problems of environmental science.

Possible role of IT person in solving the environmental issues

Data Analytics for Environmental Monitoring:

Use data analytics to monitor and analyze environmental parameters such as air and water quality, deforestation rates, and climate patterns.

Implement machine learning algorithms to predict environmental changes and identify potential threats.

IoT (Internet of Things) for Environmental Sensing:

Deploy IoT devices for real-time monitoring of environmental conditions.

Use sensor networks to collect data on pollution levels, energy consumption, and resource usage.

Green IT Practices:

Promote and implement energy-efficient computing solutions to reduce the carbon footprint of data centers and IT infrastructure.

Optimize hardware and software to minimize energy consumption and extend the lifespan of electronic devices.

Possible role of IT person in solving the environmental issues

Remote Collaboration and Telecommuting:

Advocate for and implement remote work policies to reduce the need for commuting, thereby lowering carbon emissions.

Develop and use virtual collaboration tools to facilitate remote work and reduce travel-related environmental impact.

E-waste Management:

Develop strategies for responsible disposal and recycling of electronic waste (e-waste).

Implement practices for the refurbishment and reuse of electronic devices to extend their lifespan.

Renewable Energy Integration:

Implement IT solutions that support the integration of renewable energy sources into power grids.

Develop and use energy management systems to optimize the use of renewable energy in data centers and IT facilities.

Supply Chain Sustainability:

Utilize IT systems to trace and monitor the environmental impact of products throughout the supply chain.

Implement blockchain technology for transparent and traceable supply chains, ensuring adherence to environmental standards.

Possible role of IT person in solving the environmental issues

Environmental Education and Awareness:

Develop educational platforms and applications to raise awareness about environmental issues and sustainable practices.

Provide tools that empower individuals and businesses to make informed decisions for reducing their environmental impact.

Smart Cities and Sustainable Urban Planning:

Implement smart city solutions that optimize energy usage, traffic flow, waste management, and overall resource efficiency.

Utilize IT for data-driven urban planning to create sustainable and resilient cities.

Collaboration with Environmental NGOs and Agencies:

Partner with environmental organizations to provide technical support and solutions for their initiatives.

Collaborate with government agencies to implement IT systems for environmental regulation and monitoring.

Carbon Footprint Tracking and Reduction:

Develop and use software tools for tracking and analyzing the carbon footprint of organizations.

Implement strategies to reduce carbon emissions through the adoption of sustainable practices.

Segments of Environment

- The environment consists of four segments :

1. **Atmosphere (Air)**
2. **Hydrosphere (Water)**
3. **Lithosphere (Land)**
4. **Biosphere (Living organism)**

The Age of the Earth

Earth is ~ 4.57 Billion years ago

The evolution of Earth is the process by which Earth formed and changed over time.
The Big Bang Theory is the most widely accepted explanation for how Earth formed.

Formation of Earth

- Earth formed from a giant cloud of gas and dust called a nebula.
- The nebula collapsed in on itself, spinning and flattening into a disk shape.
- The dust and gas continued to fall in, heating up and forming the sun.
- The remaining material condensed into planets, moons, and asteroids.

Evolution of Earth's atmosphere

- The Earth's secondary atmosphere was rich in water vapor, carbon dioxide, and nitrogen.
- Water vapor in the atmosphere condensed into liquid water, forming oceans, rivers, and other bodies of fresh water.

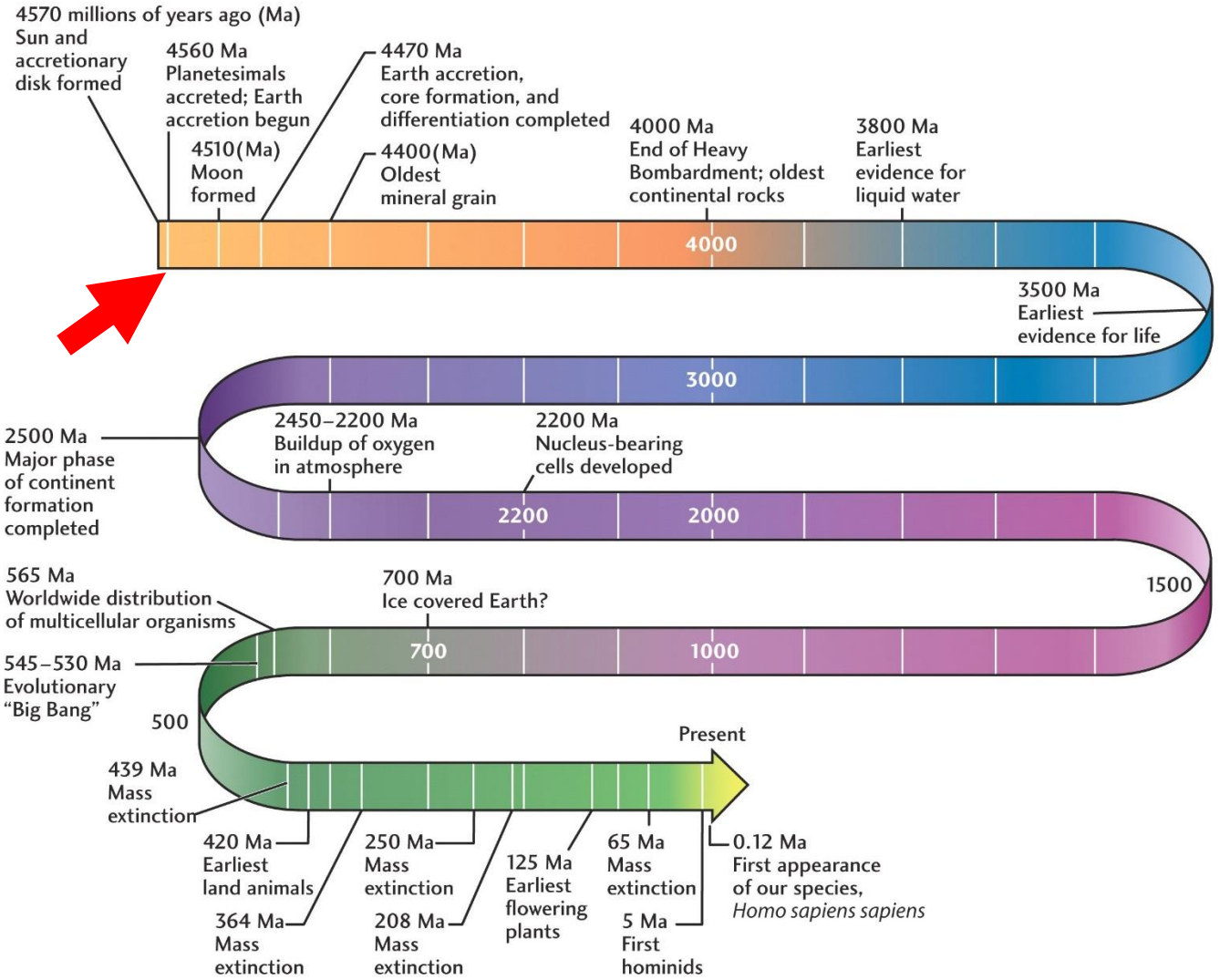
Evolution of Earth's Crust

- As the Earth cooled, a stable crust formed.
- The Earth's interior has different zones, each containing materials with different characteristics.

Evolution of Life on Earth

- The Archean eon, from around 4.0 to 2.5 billion years ago, saw the formation of conditions that supported life.
- The Mesozoic era, from roughly 252 million years ago to 65.5 million years ago, saw the evolution of dinosaurs.

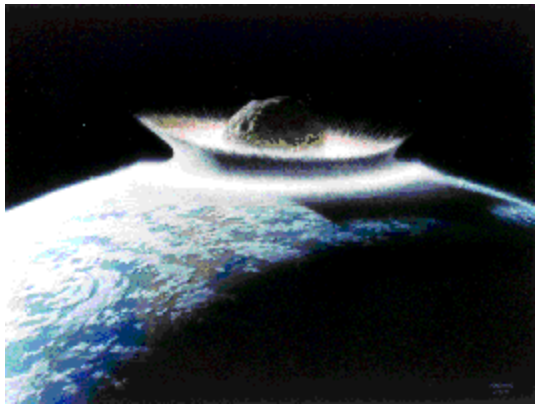
Geologic Time

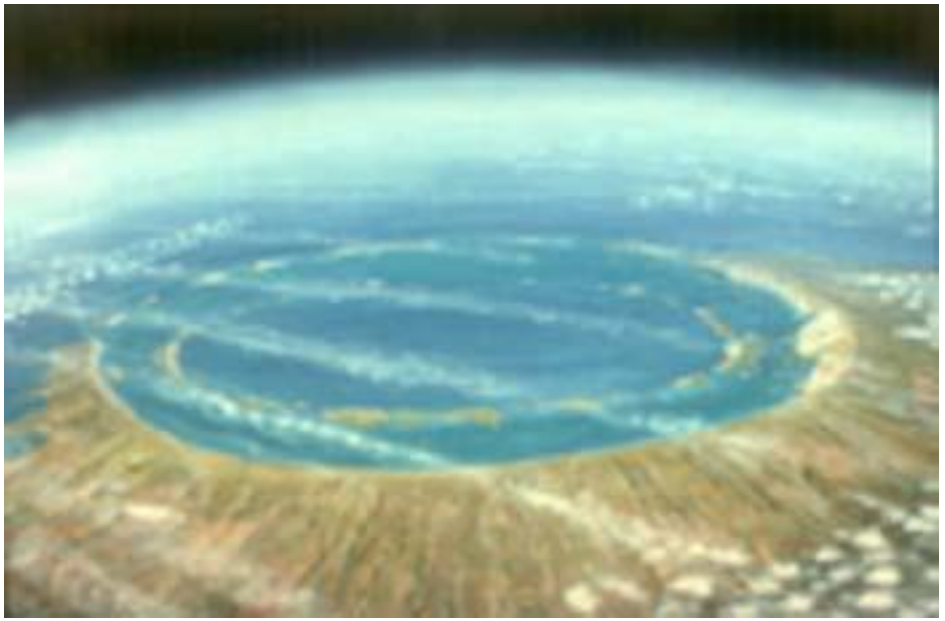


Bombardment From Space

For the first half billion years of its existence, the surface of the Earth was repeatedly broken up by asteroids and comets of all sizes

One of these collisions formed the Moon





Formation of the Moon

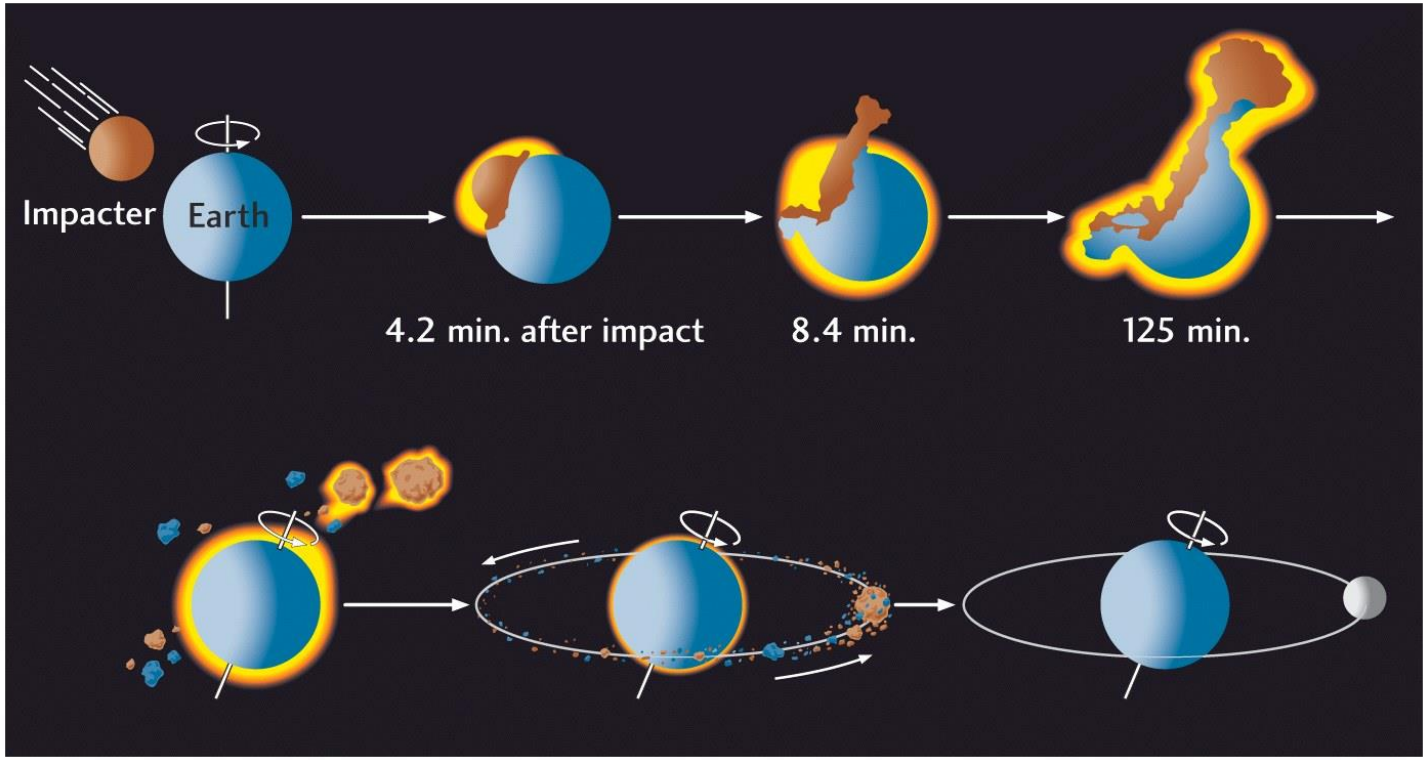
The Giant Impact Hypothesis predicts that around 50 million years after the initial creation of Earth, a planet about the size of Mars collided with Earth

This idea was first proposed about 30 years ago, but it took calculations by modern high-speed computers to prove the feasibility

Formation of the Moon

This collision had to be very spectacular!

A considerable amount of material was blown off into space, but most fell back onto the Earth



Formation of the Moon

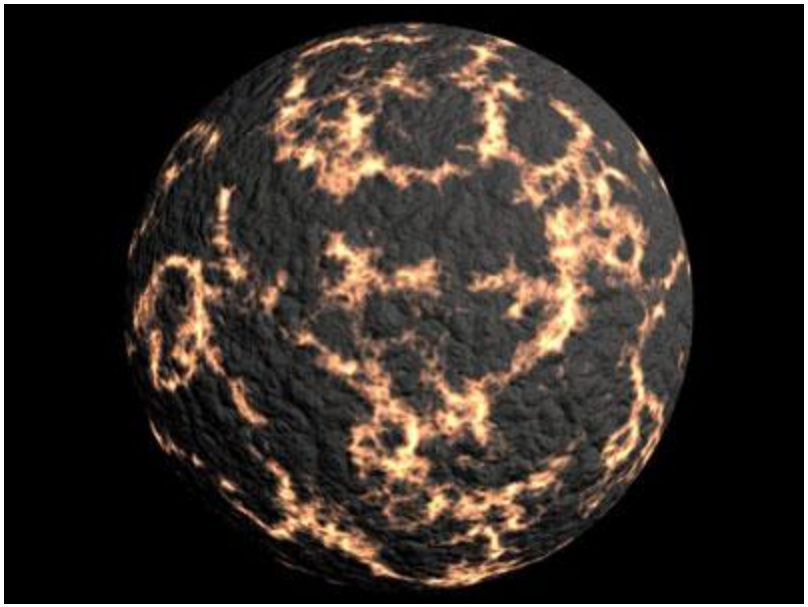
Part of the material from the collision remained in orbit around the Earth

By the process collision and accretion, this orbiting material coalesced into the Moon

The early Moon orbited very close to the Earth

The Early Earth Heats Up

Three major factors that caused heating and melting in the early Earth's interior:

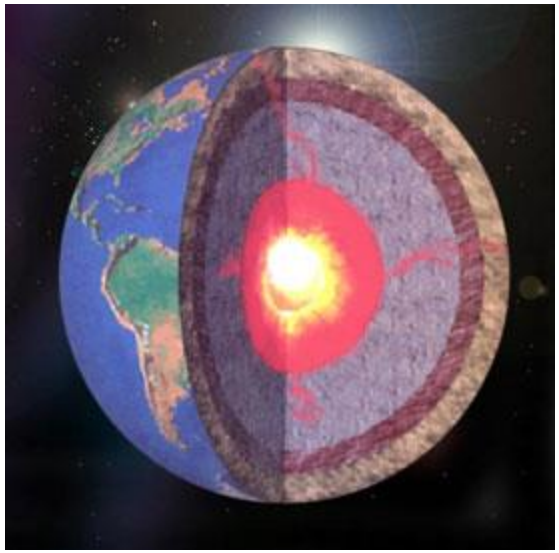


1. Collisions (Transfer of kinetic energy into heat)
2. Compression
3. Radioactivity of elements (e.g. uranium, potassium, or thorium)

The Core

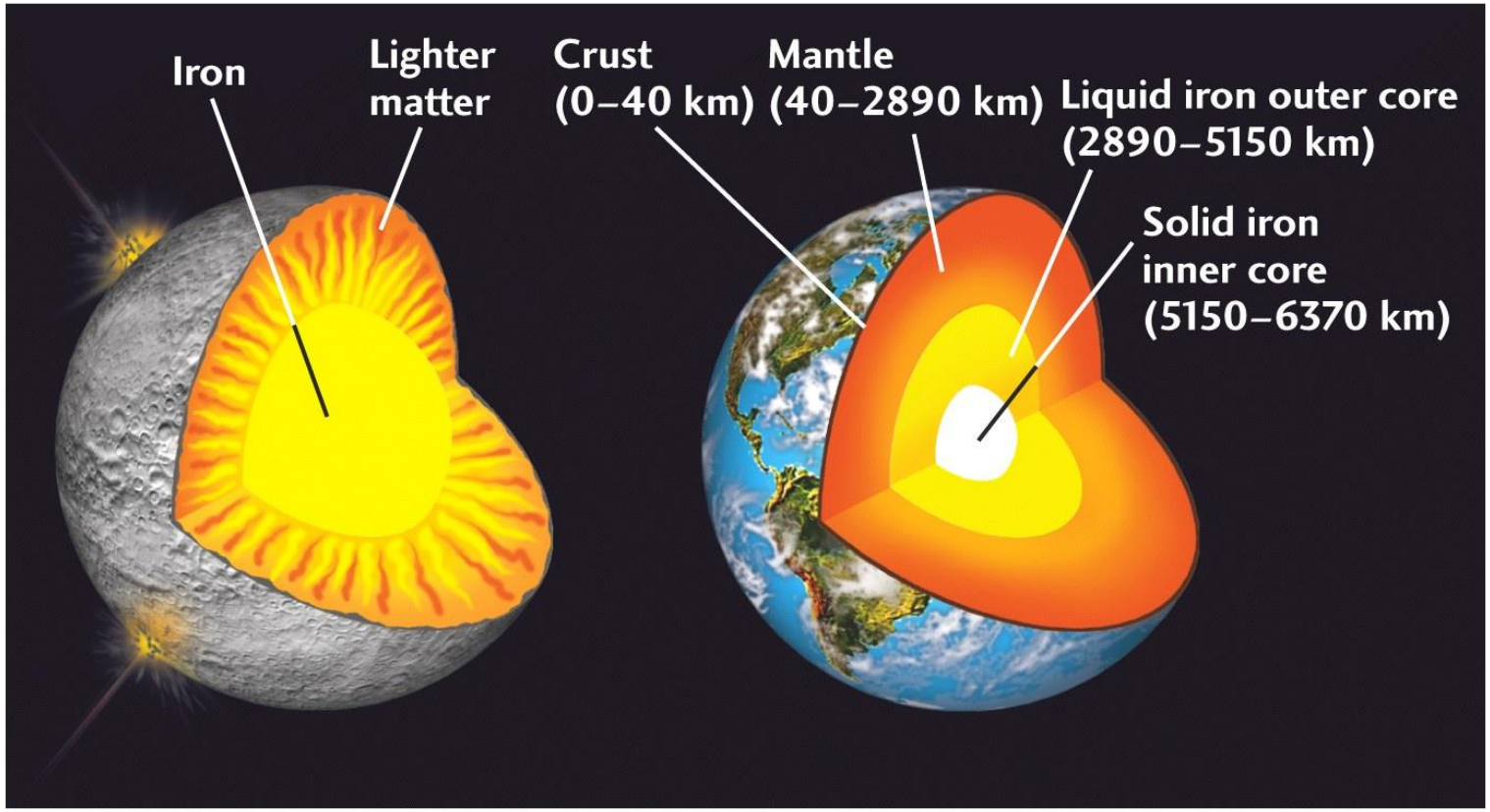
About 100 million years after initial accretion, temperatures at depths of 400 to 800 km below the Earth's surface reach the melting point of iron

In a process called global chemical differential, the heavier elements, including the melted iron, began to sink down into the core of the Earth, while the lighter elements such as oxygen and silica floated up towards the surface



Global Chemical Differentiation

This global chemical differential was completed by about 4.3 billion years ago, and the Earth had developed a inner and outer core, a mantle and crust

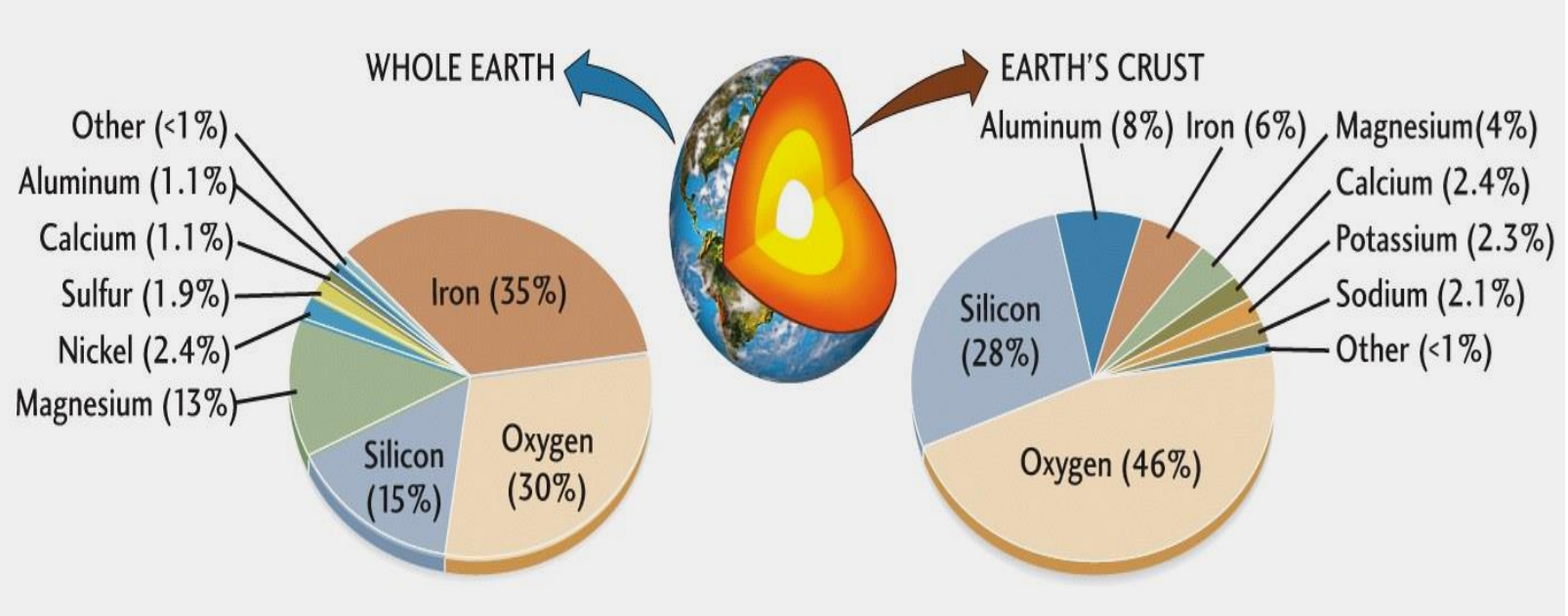


Chemical Composition of Earth

Each of the major layers has a distinctive chemical composition, with the crust being quite different from the Earth as a whole

Whole Earth:
Fe+O+Si+Mg = 93%

Crust:
Si+O+Al = 82%



Chemical Composition of Earth

Lithosphere:

strong, rocky outer shell of the solid Earth including all the crust and the upper part of the mantle to a depth of ~100 km (forms the plates)

Asthenosphere:

weak,ductile layer of the mantle beneath the lithosphere; deforms to accommodate the motions of the overlying plates

Deep Mantle:

mantle beneath the asthenosphere (~400 to 2900 km in depth)

Outer core:

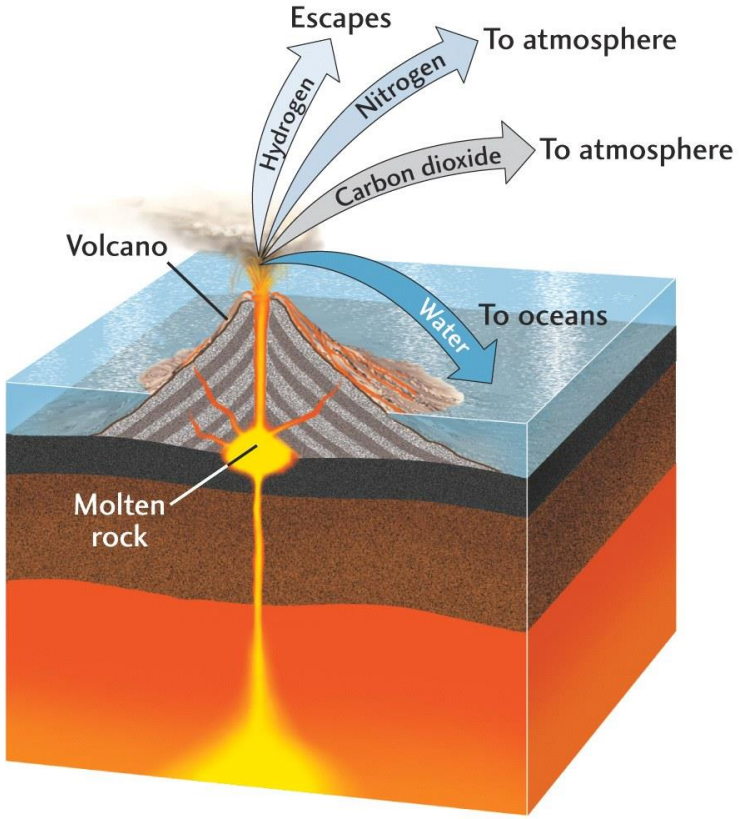
liquid shell composed of mostly iron

Inner core:

innermost sphere composed primarily of solid iron

Chemical Composition of Earth

Continents: Formed from solidified magma that floated up from the Mantle



Oceans and Atmosphere: Fluid and gaseous outer layers believed to have been created by out-gassing of gases and fluids from volcanic eruptions (in a process called volatile transfer)

The Evolving Atmosphere

Right after its creation, the Earth is thought to have had a thin atmosphere composed primarily of helium (He) and hydrogen (H) gases

The Earths gravity could not hold these light gases and they easily escaped into outer space

Today, H and He are very rare in our atmosphere

The Evolving Atmosphere

For the next several hundred million years, volcanic out-gassing began to create a thicker atmosphere composed of a wide variety of gases

The gases that were released were probably similar to those created by modern volcanic eruptions

The Evolving Atmosphere

These would include:

Water vapor (H_2O)

Sulfur dioxide (SO_2)

Hydrogen sulfide (H_2S)

Carbon dioxide (CO_2)

Carbon Monoxide (CO)

Ammonia (NH_3)

Methane (CH_4)

Note that oxygen (O2) gas is not created by volcanic eruptions

Creating the Oceans

It is hypothesized that water vapor escaping from the interior of the Earth via countless volcanic eruptions created the oceans (this took hundreds of millions of years)

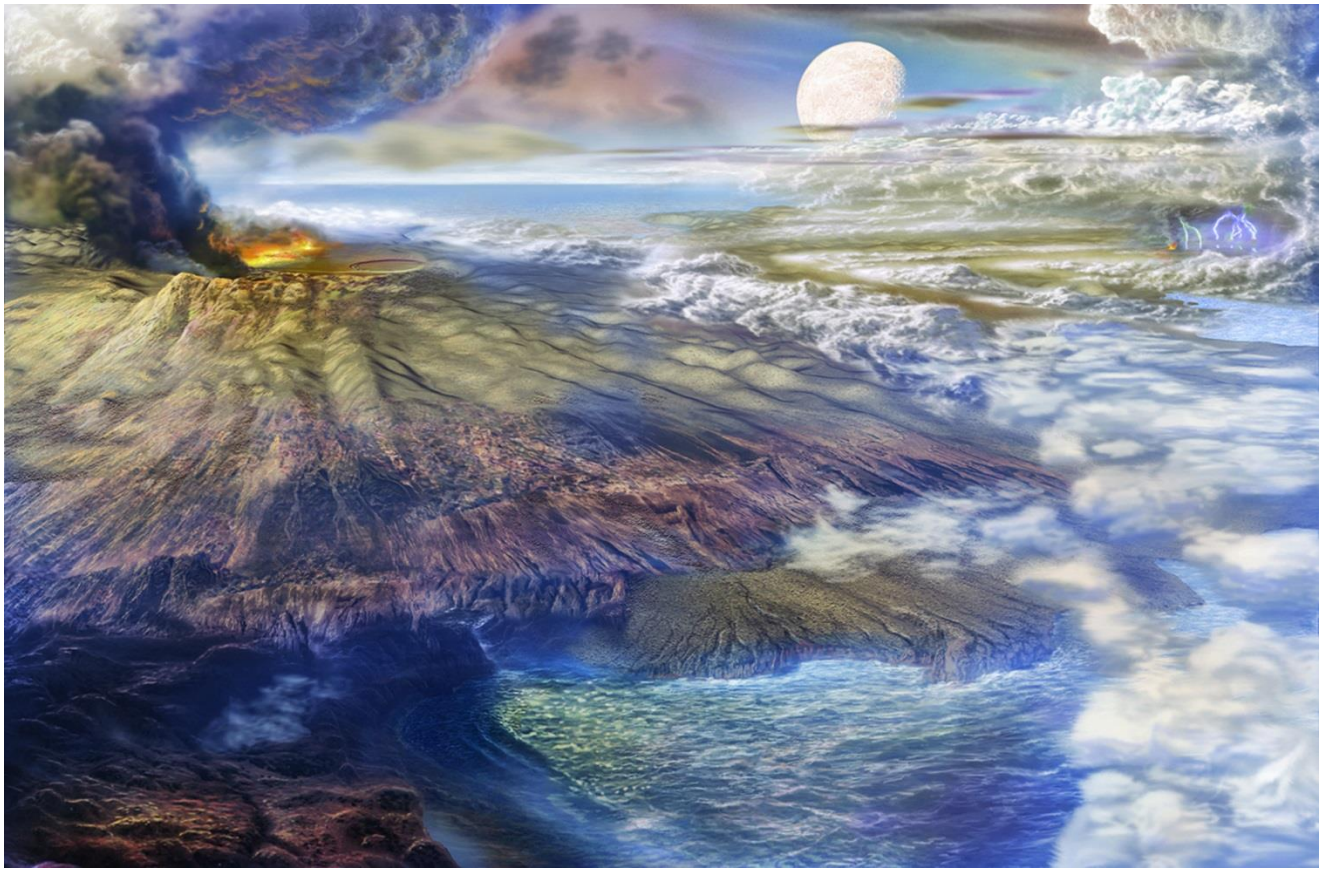
Creating the Oceans

Astronomers also hypothesize that comets impacting the Earth were a major source of water that contributed to creation of the oceans

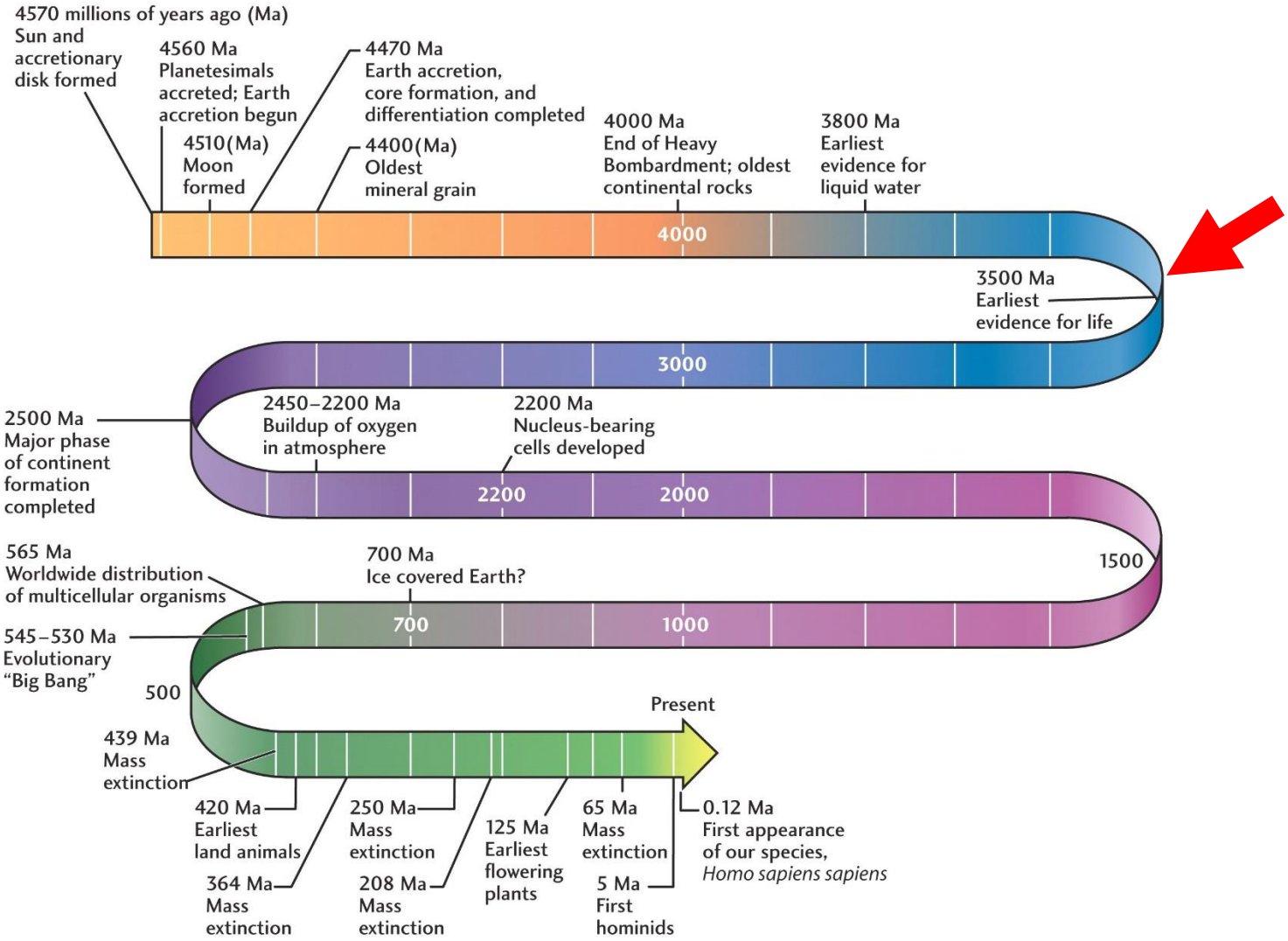
Remember, that comets are best described as “dirty ice balls”

Creating the Oceans

The earliest evidence of surface water on Earth dates back about 3.8 billion years



Geologic Time



A billion Year Old Earth

By 3.5 billion years ago, when the Earth was a billion years old, it had a thick atmosphere composed of CO_2, methane, water vapor and other volcanic gases

By human standards this early atmosphere was very poisonous

It contained almost no oxygen

Remember, today our atmosphere is 21% oxygen

A billion Year Old Earth

By 3.5 billion years ago, the Earth also had extensive oceans and seas of salt water, which contained many dissolved elements, such as iron

A billion Year Old Earth

But most important, by 3.5 billion years ago, there was life on Earth

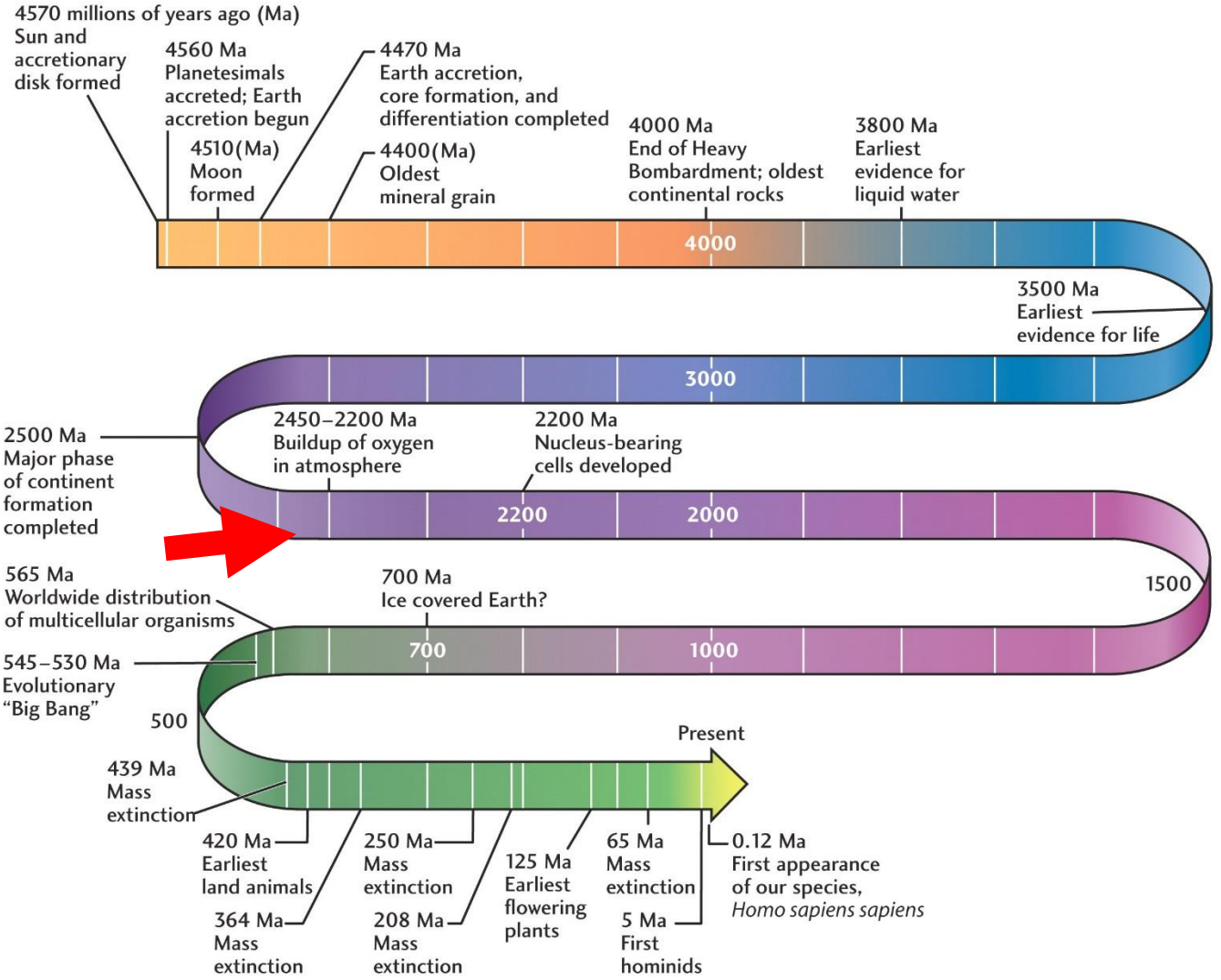
The Continents

By 2.5 billion years ago, the continents had been formed

The density of the continental crust (2.8 gr/cm^3) is lighter that the crust found on ocean bottoms (3.2 gr/cm^3), so the continents rise above the ocean floor

A question that remains unanswered is, when did plate tectonics start?

Geologic Time



Planet Earth

- **Geoshpere (Lithosphere):**

Crust: < 1% (Thin)

Everest: 8.85 km

Mantle, Cores

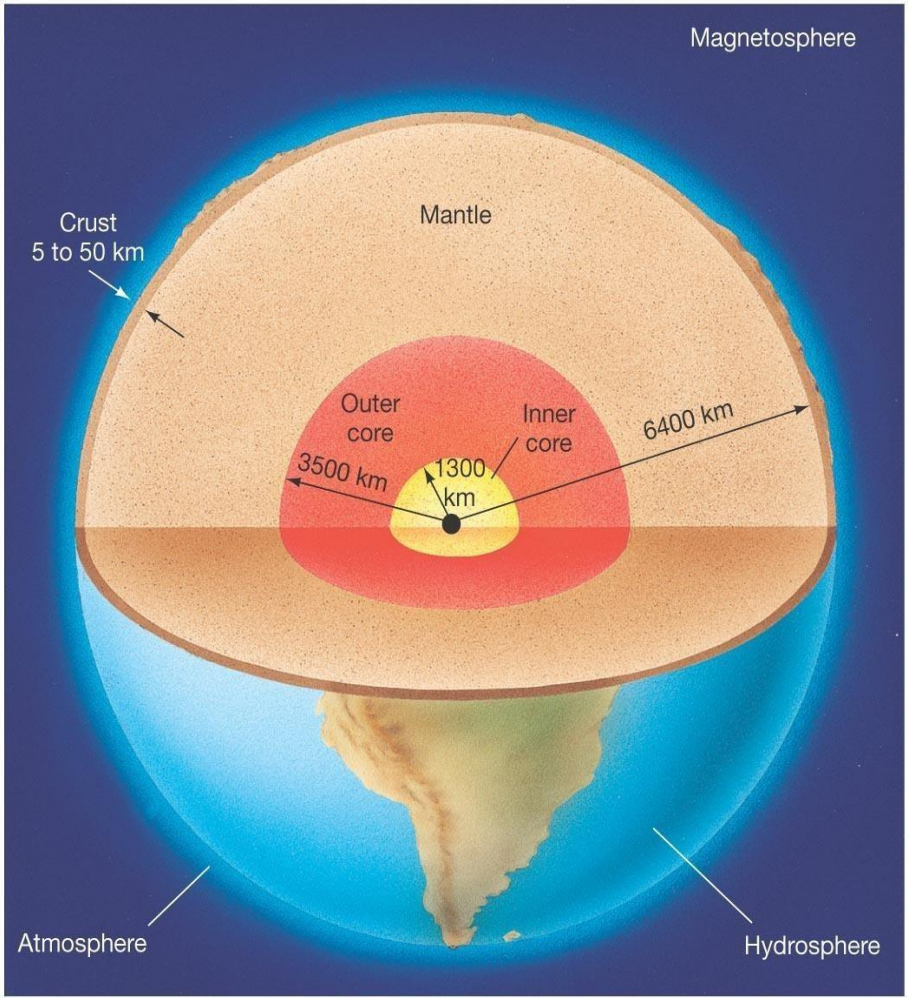
- **Hydrosphere: (oceans)**

Mariana Trench ~ 0.2 %

The Mariana Trench is an oceanic trench located in the western Pacific Ocean, about 200 kilometres east of the Mariana Islands; it is the deepest oceanic trench on Earth.

- **Atmosphere: 30 km (99% of air)**

extends to 120 km

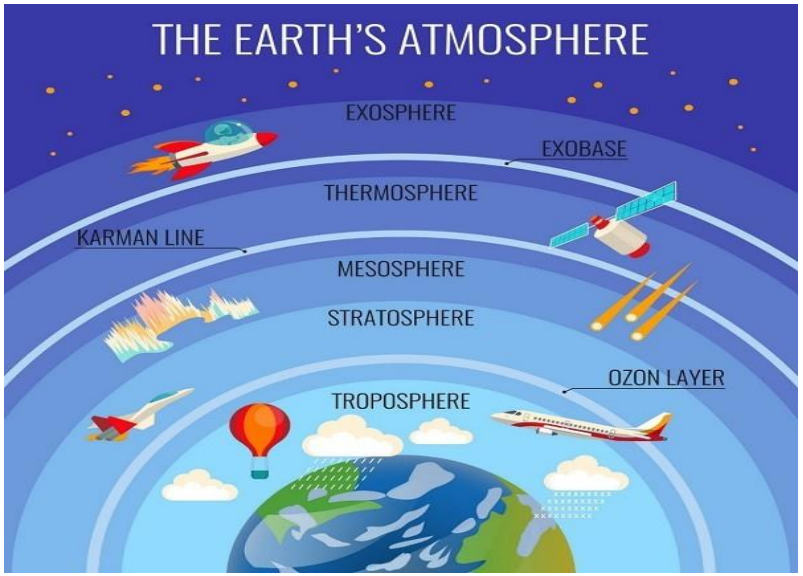


The magnetosphere shields our home planet from harmful solar and cosmic particle radiation, but it can change shape in response to incoming space weather from the Sun.

- **Biosphere:**

Atmosphere

- The **Atmosphere** forms a distinctive protective layer about 100 km thick around the earth.
  - •A blanket of gases called the atmosphere surrounds the earth and protects the surface of earth from the Sun's harmful, ultraviolet rays.
  - •It also regulates temperature, preventing the earth from becoming too hot or too cold.
  - •It saves it from the hostile environment of outer space.
  - •The atmosphere is composed of nitrogen and oxygen besides, argon, carbon dioxide and trace gases (water vapor, carbon dioxide, ozone, methane, various oxides of nitrogen, neon, and helium).
  - •It absorbs most of the cosmic rays from outer space and a major portion of the electromagnetic radiation from the sun.

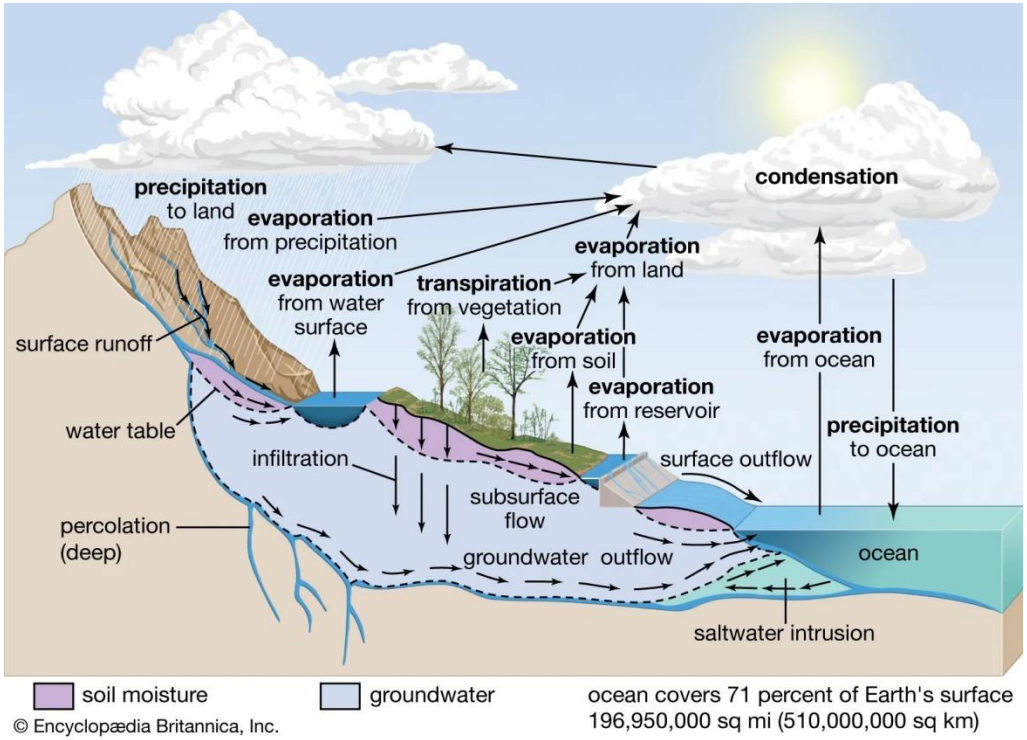


Issues need to be addressed in Atmosphere

- Pollution, acid rain, and holes in the ozone disrupt how the atmosphere normally functions.
- Air in the atmosphere is made up of several gases. It is 78% nitrogen (N) and 21% oxygen (O_2).
- Aerosols |
- Air Quality |
- Atmospheric Chemistry |
- Atmospheric Pressure |
- Atmospheric Radiation |
- Atmospheric Temperature |
- Atmospheric Water Vapor |
- Atmospheric Winds |
- Clouds |
- Precipitation |
- Weather Events

Hydrosphere:

1. The **Hydrosphere** comprises of all types of water resources oceans, seas, lakes, rivers, streams, reservoirs, polar icecaps, glaciers, and ground water.
2. Oceans represent 97% of the earth's water and about 2% of the water resources is locked in the polar icecaps and glaciers.
3. Only about 1% is available as fresh water as surface water in rivers, lakes, streams, and as ground water for human use.



Issues need to be addressed in Hydrosphere

- Inadvertent and deliberate discharge of petroleum, improper sewage disposal, and thermal pollution also are seriously affecting the quality of the hydrosphere. The present discussion focuses on three major problems–
- eutrophication (**the gradual increase in the concentration of phosphorus, nitrogen, and other plant nutrients in an aging aquatic ecosystem such as a lake)**,
- acid rain, and the buildup of the so-called greenhouse gases.

- Every year in the oceans there is discharge of 30 million tons of oil, of which 10.5 million tons - from maritime accidents, with coastal cities
- Leakage from the soil and rivers is made about 62 million tons of nitrogen and phosphorus
- Only in the North Sea annually dumped more than 60,000 tons of various chemical contaminants, including 8 tons of mercury
- 31,800 tons of chlorides, sulfates 14,000 tons, 9,700 tons of calcium, magnesium 3443 tons, 2000 tons of nitrate

- 25% of the world's population has a risk to become sick as result of low quality of water
- approximately every 10th resident of the planet becomes sick
- nearly 4 million children and 18 million adults die
- It is admitted that 100 cases of cancer of 20 to 35 years old (especially colon and bladder) are due to consumption of chlorinated drinking water

Lithosphere & Biosphere

Lithosphere: It means the mantle of rocks constituting the earth's crust. The solid component of the earth is called Lithosphere, which includes soil, earth, rocks and mountains etc. The lithosphere mainly contains three layers

-(a) Inner and Outer Core: Central fluid or vaporised sphere of diameter of about 2500km from the centre.

-(b) Mantle: It is about 2900-3000 km above the core in molten state.

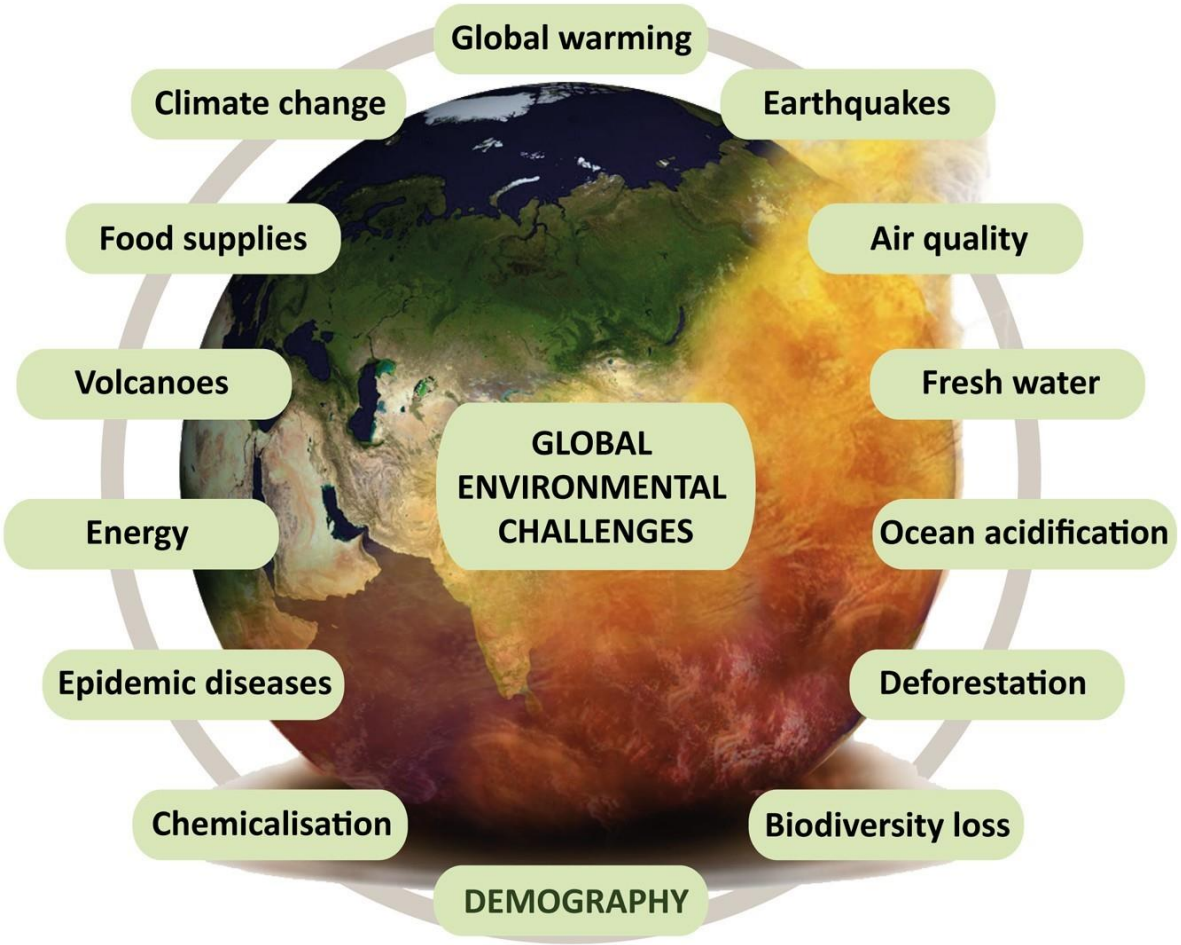
-(c) Crust: Outermost solid zone about 8-40 km above mantle.

Biosphere: This segment of environment consists of atmosphere (air- O_2, N_2, CO_2). Lithosphere (land- minerals, salts, food, nutrients) and hydrosphere (water- dissolved oxygen, Salts) which influences and support the entire biotic and abiotic life systems.

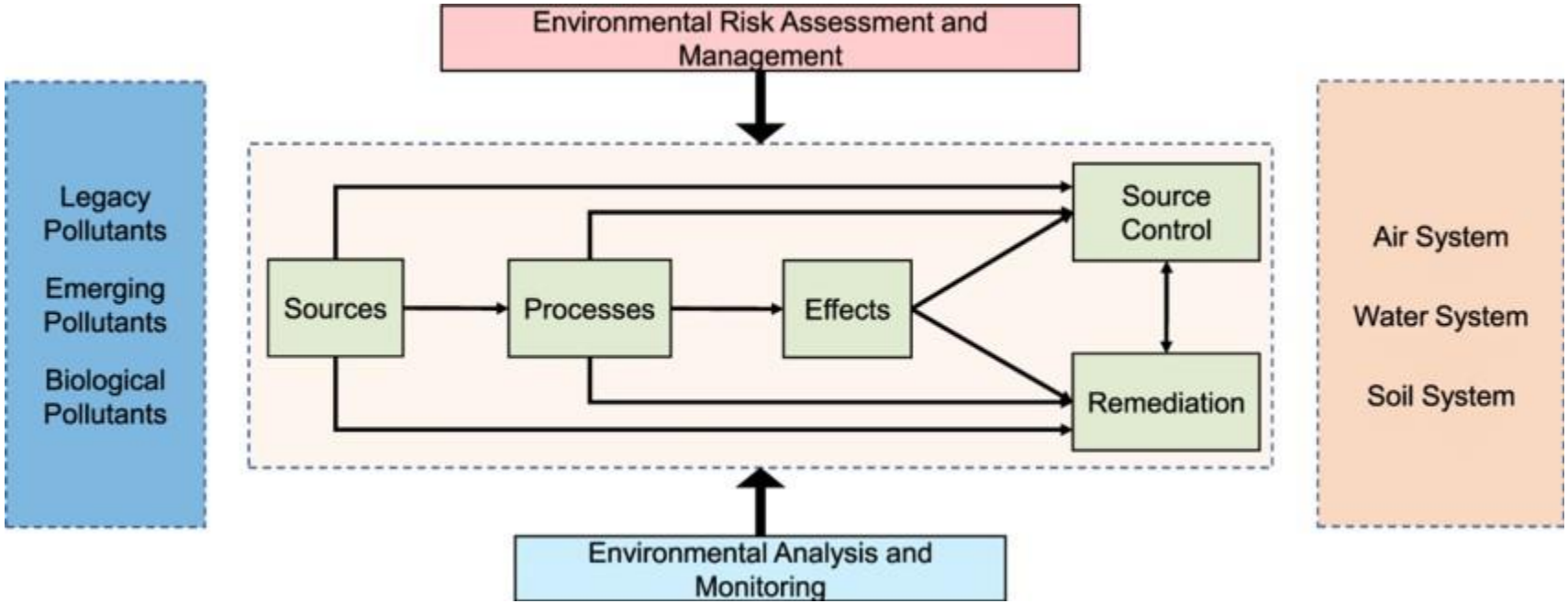
Biosphere

- Biosphere indicates the realm of living organisms and their interactions with environment, viz atmosphere, hydrosphere and lithosphere.

Environmental Challenges



Areas of Research in Environmental Science



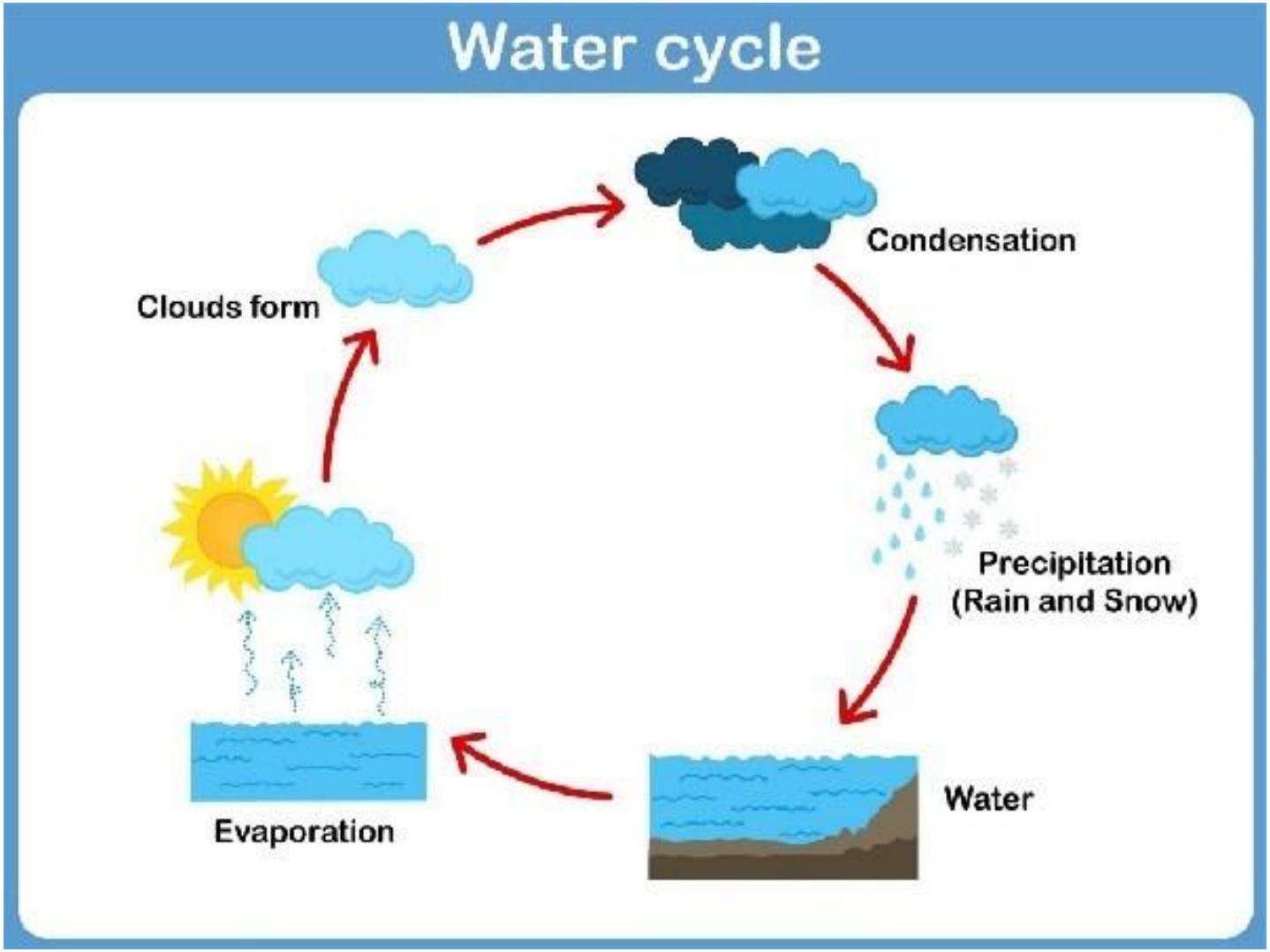
Different types of cycles

A natural process in which elements are continuously cycled in various forms between different compartments of the environment (e.g., air, water, soil, organisms).

- Water Cycle
- Carbon Cycle
- Nitrogen Cycle
- Oxygen Cycle
- Phosphorus Cycle
- Sulphur Cycle

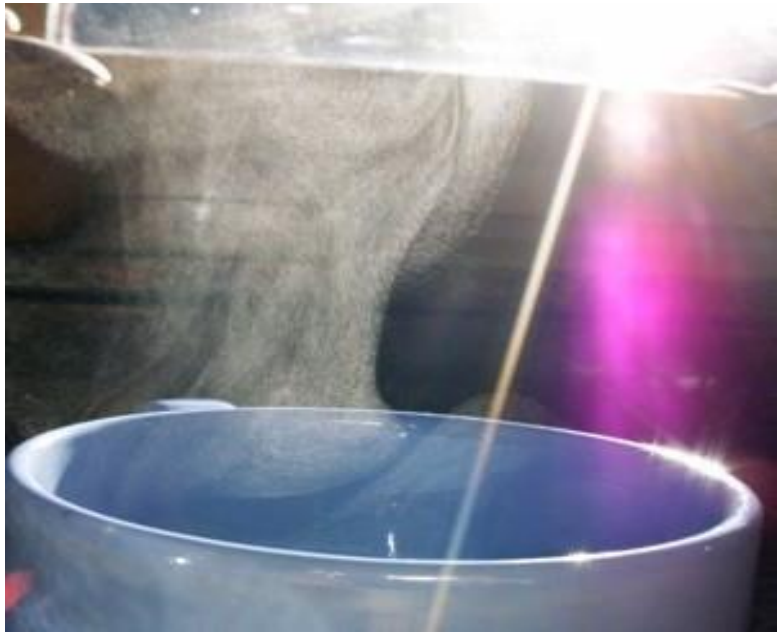
The Water Cycle

- Life on Earth depends on water.
- Even before there was life on earth, water cycled through stages.
- Plants use water to produce food through the process of photosynthesis.
- Heterotrophs use water in almost every life process throughout their entire life.


Water cycle
Condensation
Clouds form
Precipitation
(Rain and Snow)
Water
Evaporation

Steps of the Water Cycle

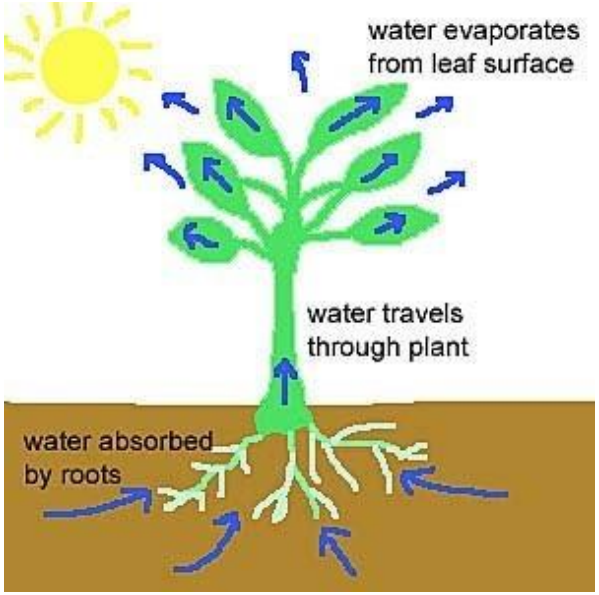
- **Evaporation** is the change of a liquid to water vapor (gas).
- **Condensation** is the change of water vapor (gas) to a liquid.



Steps of the Water Cycle

- **Precipitation** is any atmospheric water vapor that falls to the Earth.
  - Rain
  - Freezing rain
  - Snow
  - Sleet
  - Hail

- **Transpiration** is the evaporation of water from parts of plants, especially leaves but also stems, flowers and roots.

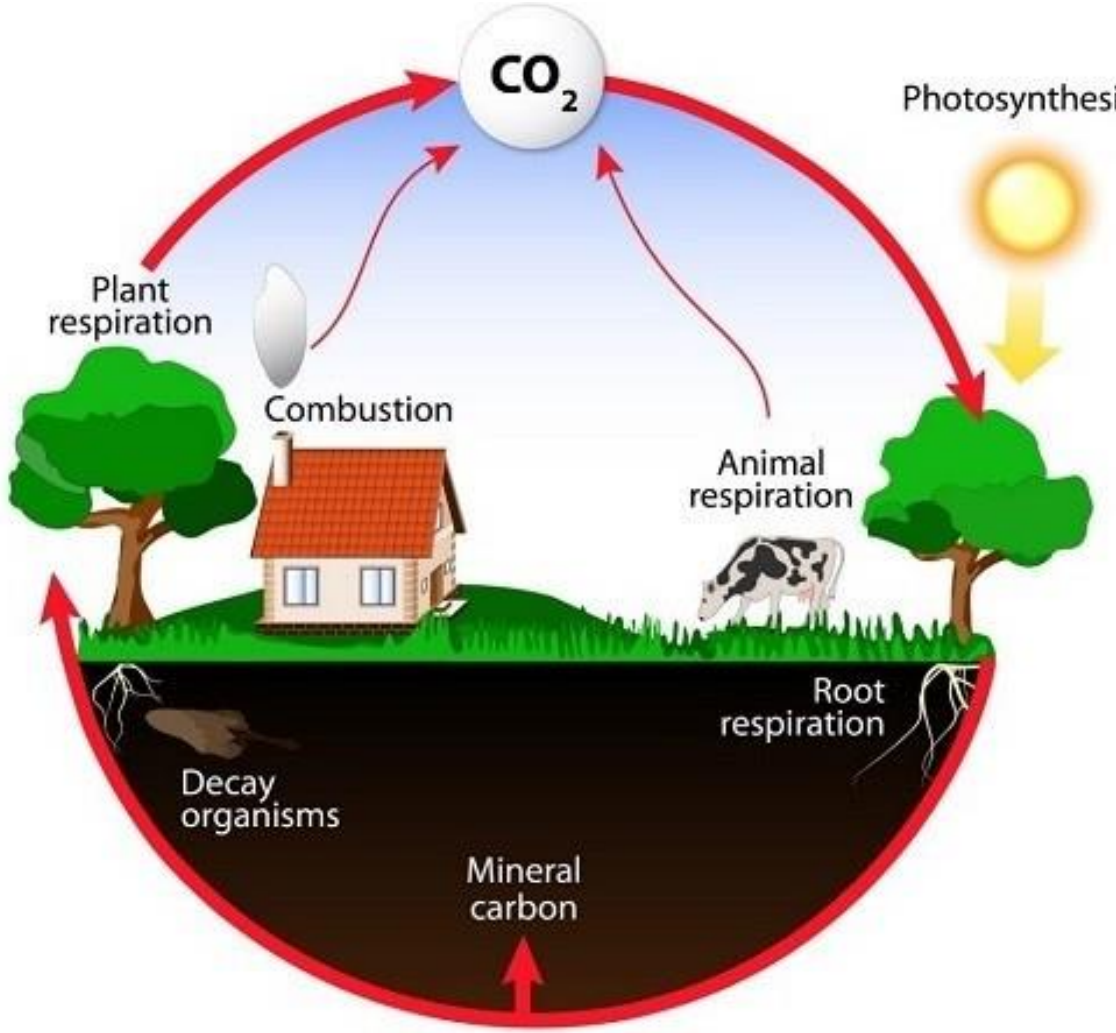


Carbon Cycle

- Carbon enters into the living world in the form of carbon dioxide through the process of photosynthesis as carbohydrates. These organic compounds (food) are then passed from the producers to the consumers (herbivores & carnivores). This carbon is finally returned to the surrounding medium by the process of respiration or decomposition of plants and animals by the decomposers. Carbon is also recycled during the burning of fossil fuels.
- The atmosphere; carbon dioxide gas is one form of carbon in the air.
- Photosynthesis- Autotrophs use carbon dioxide in photosynthesis. In photosynthesis, the sun's energy is used to make high-energy carbon molecules.
- Wastes- Autotrophs and heterotrophs break down the high-energy carbon molecules for energy. Carbon dioxide is released as a waste.
- Organisms- use high-energy carbon molecules for growth. A large amount of the world's carbon is contained in living things.

Carbon Cycle

- Soil- When organisms die and decay, the carbon molecules in them enter the soil. Microorganisms break down the molecules, releasing carbon dioxide.
- Fuel- Over millions of years, the remains of dead organisms are converted into fossil fuels, such as coal, gas, and oil. These fuels contain carbon molecules.


CO_2
Photosynthesis
Plant respiration
Combustion
Animal respiration
Root respiration
Decay organisms
Mineral carbon

Carbon Cycle

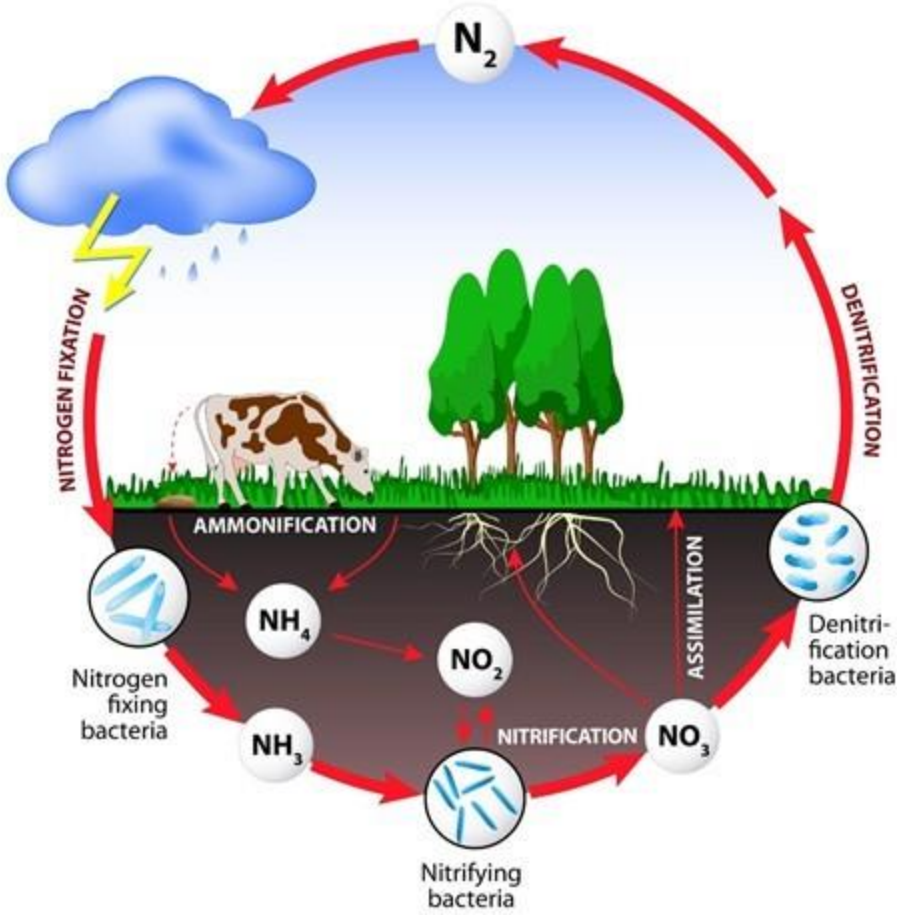
- Pollution- combustion of fossil fuels and wood releases carbon dioxide.

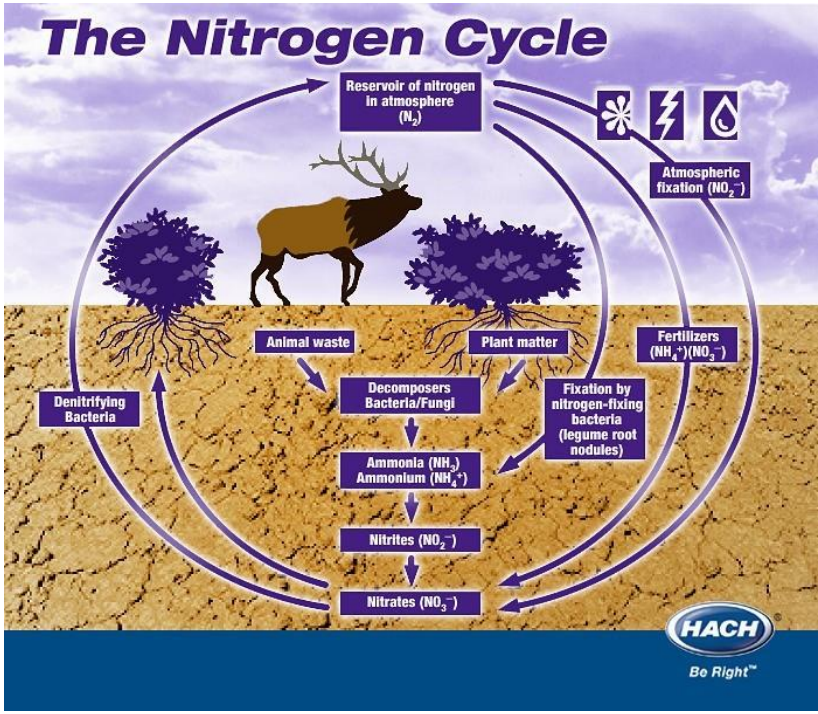
Nitrogen Cycle

- Nitrogen (N_2) makes up about 78% of our atmosphere. It is not usable to humans and animals in this form however, it takes lightning and certain bacteria to convert nitrogen into a usable form.
- Plants use the nitrogen to make important molecules such as proteins. (fertilizers)
- Herbivores eat plants and convert nitrogen-containing plant proteins into nitrogen-containing animal proteins.
- Decomposers break down urine, an animal waste which contains excess nitrogen.
- When an animal urinates, nitrogen returns to the water or soil.
- When organisms die. Their nitrogen molecules return to the soil. Plants reuse these nitrogen molecules.
- Nitrogen “Fixing” Bacteria also act on these molecules and put nitrogen
- back into the air.

Nitrogen cycle completes in 5 steps:

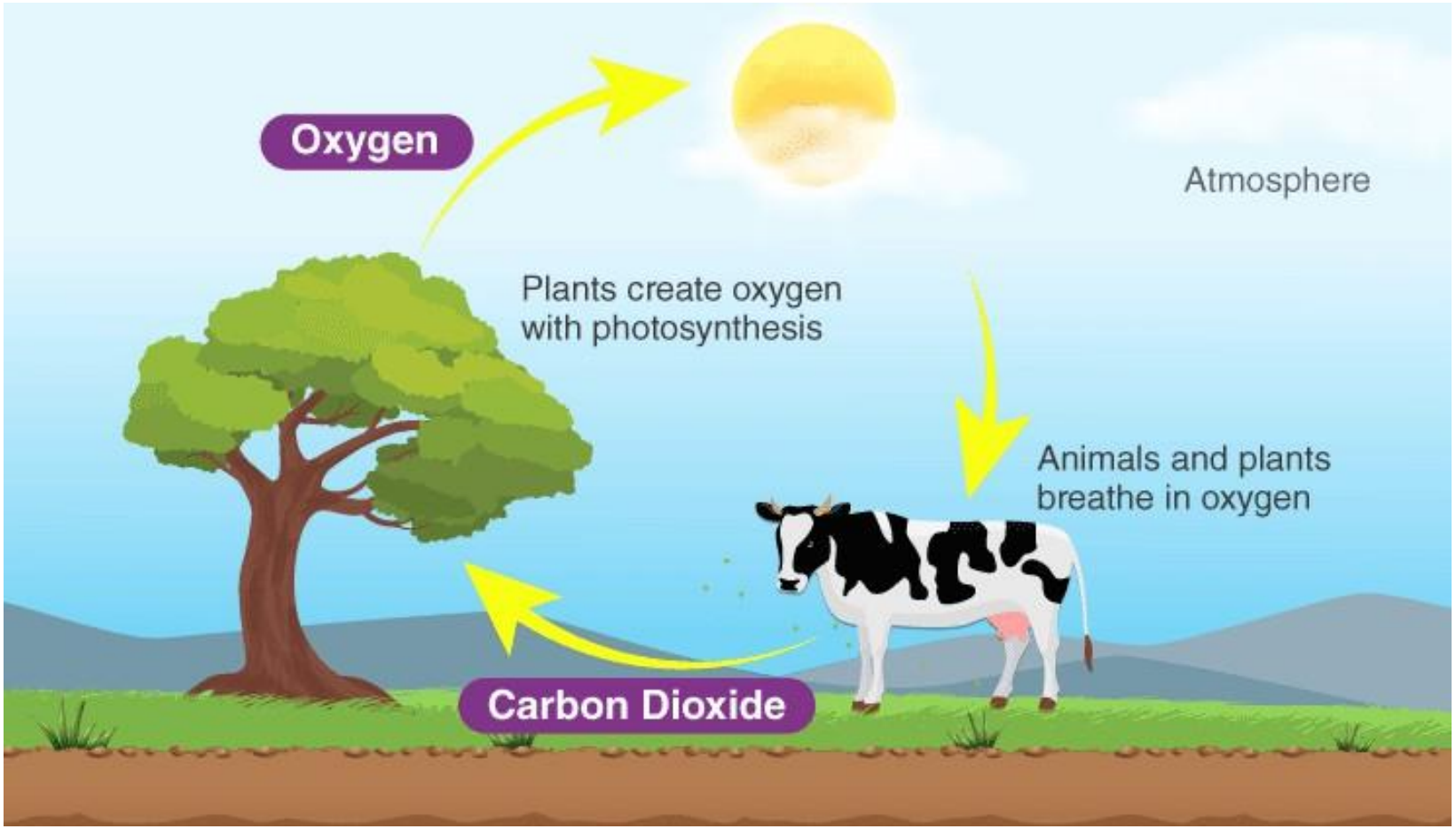
- **Nitrogen Fixation**
  - Conversion of $N_2 \rightarrow NH_3$
- **Nitrogen Cycle**
  - Combustion, volcanic action, Lightning, Industrial processes (making fertilizer).
  - Bacteria (Azotobactor, Clostridium, Nostoc etc.)
- **2) Nitrification**
  - Conversion of $NH_3 \rightarrow NO_3$
  - Soil bacteria convert in a two step process.
- **3) Assimilation**
  - Roots absorb NH_3, NH_4, or NO_3 and incorporate them into nucleic acids and protein.
- **4) Ammonification**
  - Amino acids and nucleotides are broken down into waste products NH_3 or NH_4
- **Denitrification**
  - The reduction of NO_3 to N_2 .Denitrifying bacteria return some of the nitrogen to the atmosphere


N_2
NITROGEN FIXATION
DENITRIFICATION
AMMONIFICATION
ASSIMILATION
NITRIFICATION
NH_4
NO_2
NH_3
NO_3
Nitrogen fixing bacteria
Denitri-fication bacteria
Nitrifying bacteria


The Nitrogen Cycle
Reservoir of nitrogen in atmosphere (N_2)
Atmospheric fixation (NO_3^-)
Animal waste
Plant matter
Fertilizers (NH_4^+)(NO_3^-)
Denitrifying Bacteria
Decomposers Bacteria/Fungi
Fixation by nitrogen-fixing bacteria (legume root nodules)
Ammonia (NH_3) Ammonium (NH_4^+)
Nitrites (NO_2^-)
Nitrates (NO_3^-)
HACH
Be Right™

Oxygen Cycle

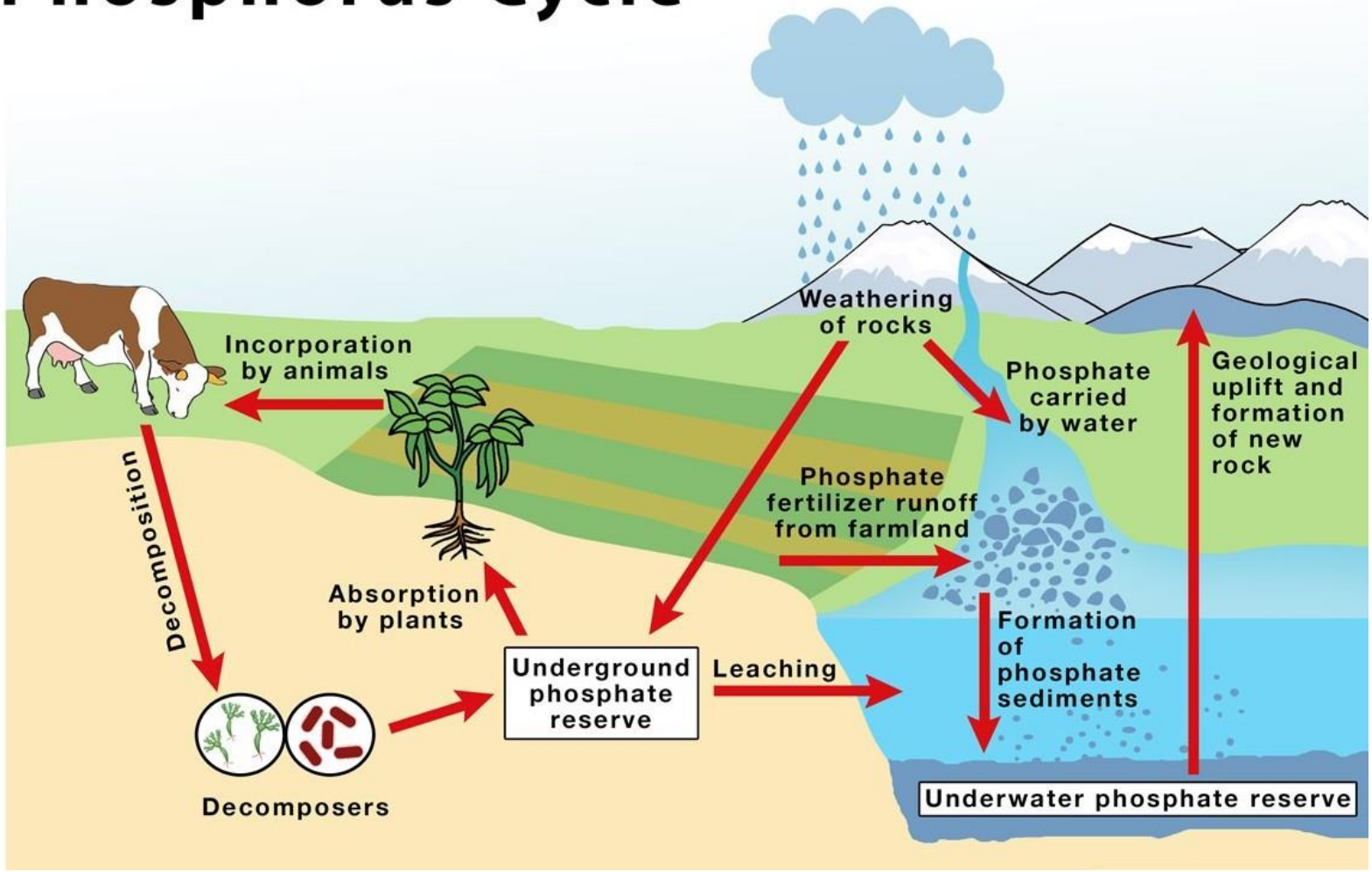
- This biogeochemical cycle moves through the atmosphere, the lithosphere and the biosphere.
- Oxygen is an abundant element on our Earth. It is found in the elemental form in the atmosphere to the extent of 21%.
- Oxygen is released by the plants during photosynthesis. Humans and other animals inhale the oxygen exhale carbon dioxide which is again taken up by the plants. They utilise this carbon dioxide in photosynthesis to produce oxygen, and the cycle continues.


Oxygen
Atmosphere
Plants create oxygen
with photosynthesis
Animals and plants
breathe in oxygen
Carbon Dioxide

Phosphorous Cycle

- In this biogeochemical cycle, phosphorus moves through the hydrosphere, lithosphere and biosphere.
- Phosphorus is extracted by the weathering of rocks. Due to rains and erosion phosphorus is washed away in the soil and water bodies. Plants and animals obtain this phosphorus through the soil and water and grow.
- Microorganisms also require phosphorus for their growth. When the plants and animals die they decompose, and the stored phosphorus is returned to the soil and water bodies which is again consumed by plants and animals and the cycle continues.

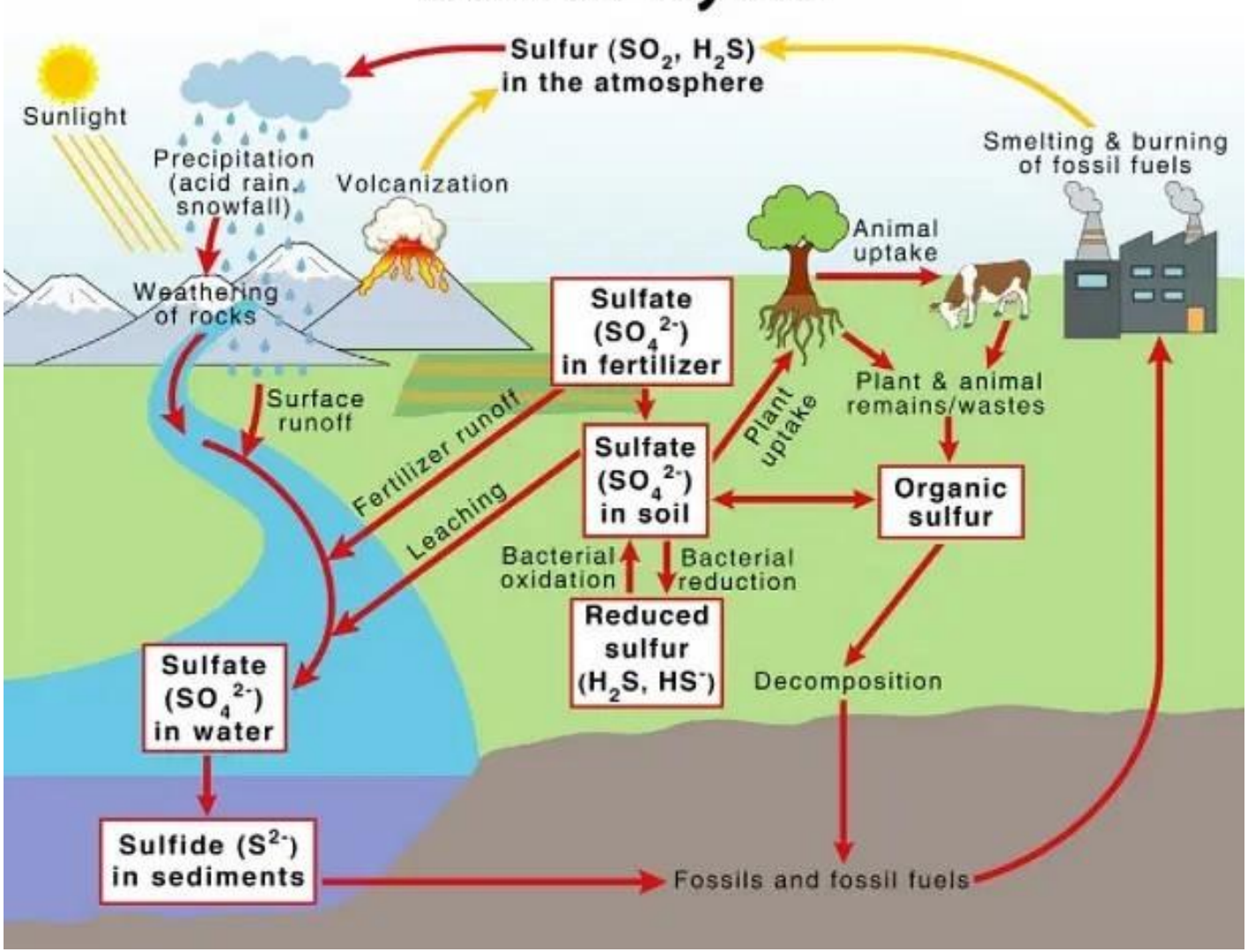
Phosphorus Cycle



Sulphur Cycle

- This biogeochemical cycle moves through the rocks, water bodies and living systems.
- Sulphur is released into the atmosphere by the weathering of rocks and is converted into sulphates. These sulphates are taken up by the microorganisms and plants and converted into organic forms.
- Organic sulphur is consumed by animals through food. When the animals die and decompose, sulphur is returned to the soil, which is again obtained by the plants and microbes, and the cycle continues.

Sulfur Cycle



Summary of Unit I: Environment and Ecosystem

1. Introduction to Environmental Science:

- Environmental science is an interdisciplinary subject that explores the interaction between humans and the environment.
- It involves various scientific disciplines like chemistry, physics, biology, and earth sciences.
- The subject helps in understanding how natural systems function and how human activities impact them.

2. The Big Bang Theory and Evolution of Earth:

- The Big Bang Theory explains the origin of the universe and Earth.
- We explored this concept through a video lecture and interactive discussion.

3. Layers of the Atmosphere:

- The atmosphere consists of five main layers: Troposphere, Stratosphere, Mesosphere, Thermosphere, and Exosphere.
- Each layer has distinct characteristics and plays a crucial role in Earth's climate and weather systems.
- Understanding was reinforced through a quiz and video lesson.

4. Segments of the Environment and Related Issues:

- **Atmosphere:** Protects life on Earth and regulates temperature; issues include air pollution, ozone depletion, and climate change.
- **Hydrosphere:** Comprises all water bodies; issues include water pollution, eutrophication, and ocean acidification.
- **Lithosphere:** Solid outer part of Earth; issues include deforestation, soil erosion, and land degradation.
- **Biosphere:** The zone of life on Earth; issues include biodiversity loss, habitat destruction, and ecological imbalances.

5. Geochemical Cycles in the Ecosystem:

- **Water Cycle:** Movement of water through evaporation, condensation, precipitation, and infiltration.
- **Carbon Cycle:** Circulation of carbon between the atmosphere, organisms, and oceans, influenced by respiration and combustion.
- **Nitrogen Cycle:** Conversion of atmospheric nitrogen into usable forms through nitrogen fixation, assimilation, and denitrification.
- **Sulfur Cycle:** Movement of sulfur through rocks, water, and air. Released by volcanic eruptions, fossil fuel combustion, & decay
- **Phosphorus Cycle:** Weathering of rocks releases phosphorus into soil & water. Absorbed by plants, moves through food chain, returns via decomposition.

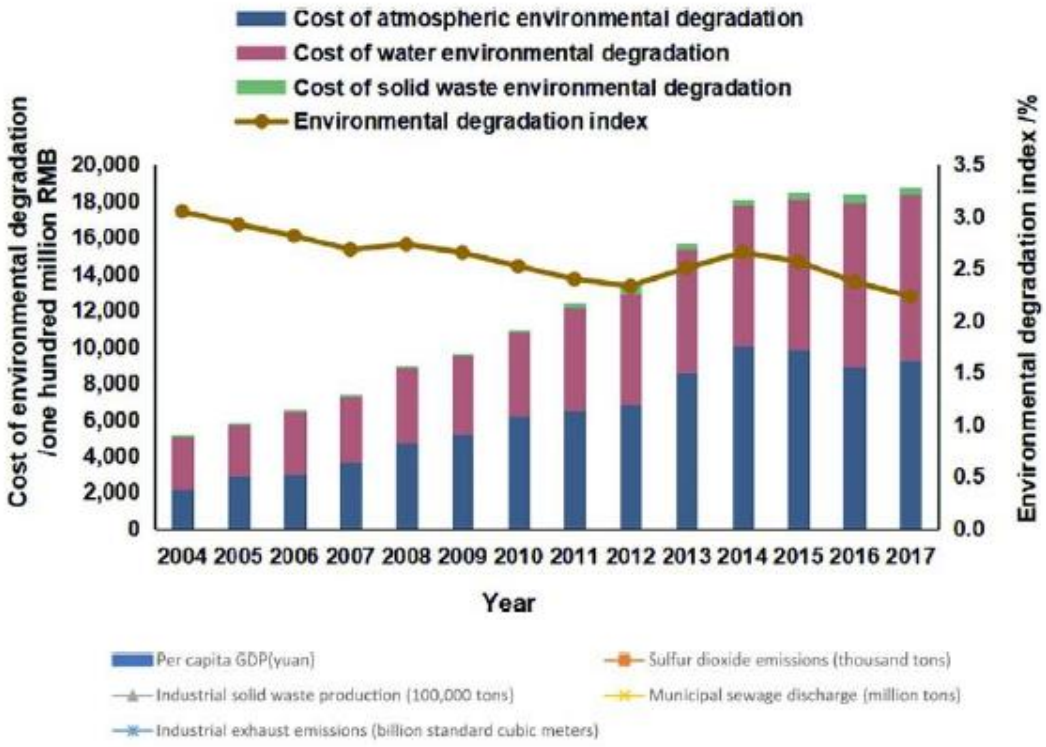
Assignments for Better Understanding:

•Two assignments focused on **Carbon Cycle** and **Water Cycle** were given to reinforce understanding.

Sample Exam Questions

Ques 1: How can advanced technologies such as carbon capture, AI-driven climate models, and renewable energy systems contribute to restoring and maintaining the balance of the carbon cycle?

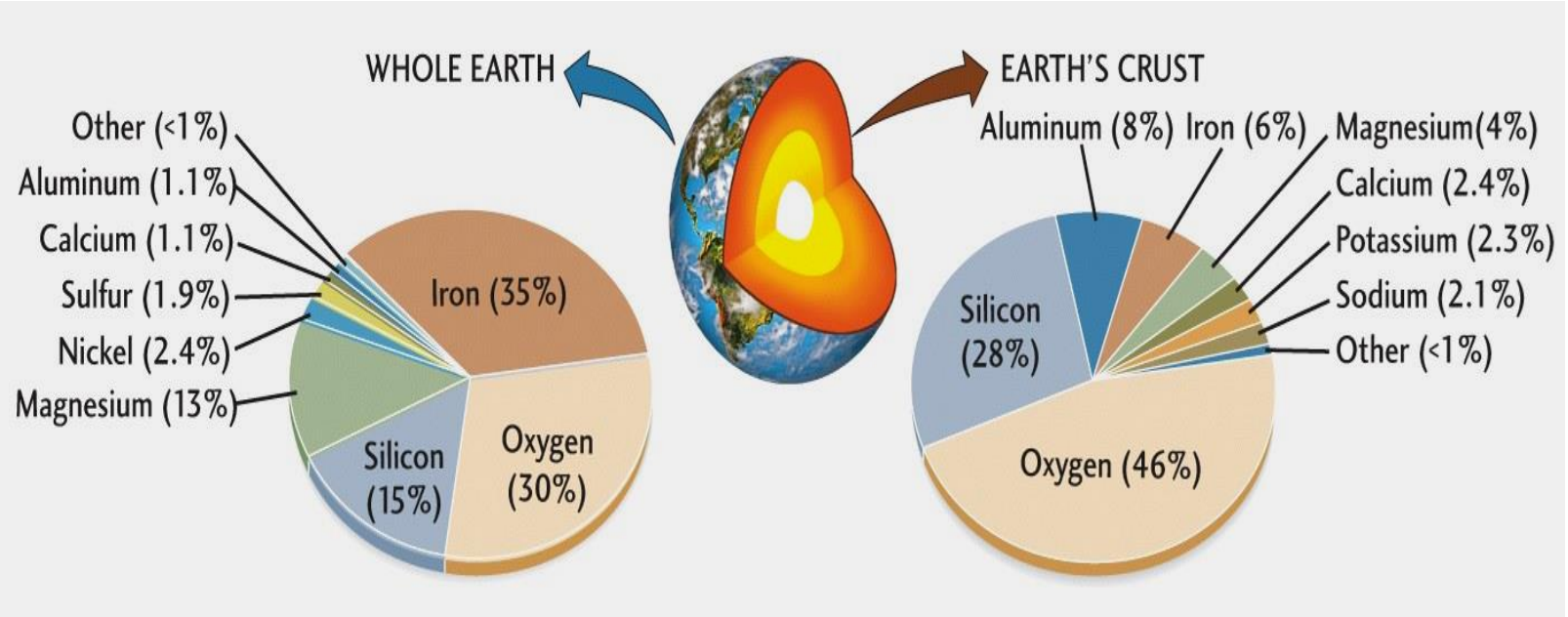
Ques 2: Comment on following two statistical analysis related to environmental data.



Ques 3: What factors influence the distribution of elements in the whole Earth and its crust?

a) How does Earth's internal structure contribute to the higher concentration of iron in the whole Earth compared to the crust?

b) Why are lighter elements like oxygen and silicon more abundant in the Earth's crust than in the whole Earth?



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Minor Examination March 2, 2024

(HS103) Ecology and Environment Sciences

Time Duration: Two hours **Maximum Marks**: 30

Note:-Attempt All.

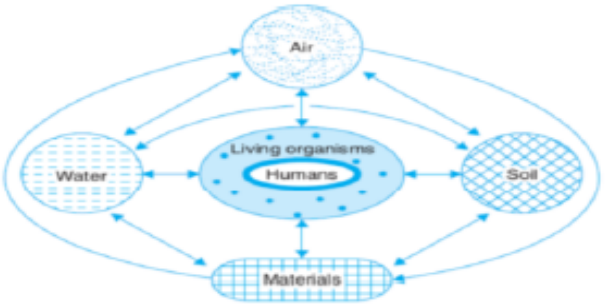
Q.1. Answer in True/False to *Any 10* of the following and give a very brief justification of your answer. 10

(a) Cosmic inflation occurred during the Quark Epoch.
(b) The exosphere is the densest layer of the Earth's atmosphere.
(c) Bioaccumulation occurs exclusively in aquatic ecosystems.
(d) The nitrogen cycle is primarily a biological process and does not involve any abiotic components.
(e) The concept of dark energy was introduced to explain the accelerated expansion of the universe.
(f) The ionosphere, which is part of the thermosphere, is responsible for reflecting radio waves back to Earth.
(g) Biomagnification is solely dependent on the toxicity of the substance being magnified.
(h) The ionosphere, found in the thermosphere, is responsible for the Northern Lights.
(i) Aerosols are exclusively human-made particles released into the atmosphere.
(j) Relative humidity is a measure of the actual amount of water vapor in the air compared to the maximum it could hold at that temperature.
(k) The greenhouse effect is primarily driven by the presence of ozone in the troposphere.
(l) Indoor air quality is influenced by factors such as ventilation, humidity, and the presence of pollutants.

Q.2. Discuss the consequences of bioaccumulation and biomagnification on ecosystems and human health. Include examples of specific toxins and their effects on different trophic levels. **05**

Q.3. Write a brief note on the evolution of earth and the basic chemical composition of the Earth. **05**

Q.4. Write a note on the interaction among the various components of environment, affecting the life of a human being, represented through following diagram. **05**



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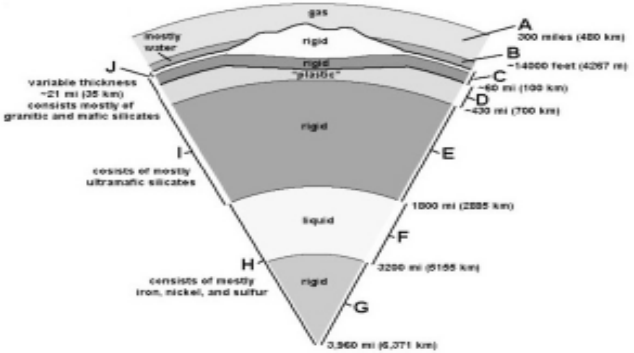
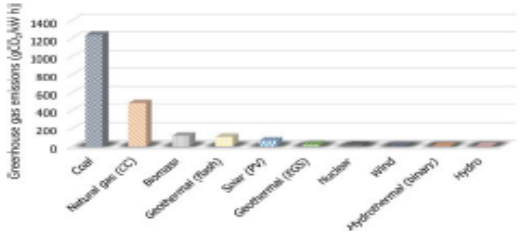
Q.5. Explain the diagram below, representing the structure of earth and Match letters (A to J) to features on the Structure of the Earth diagram and asnwer following **05**

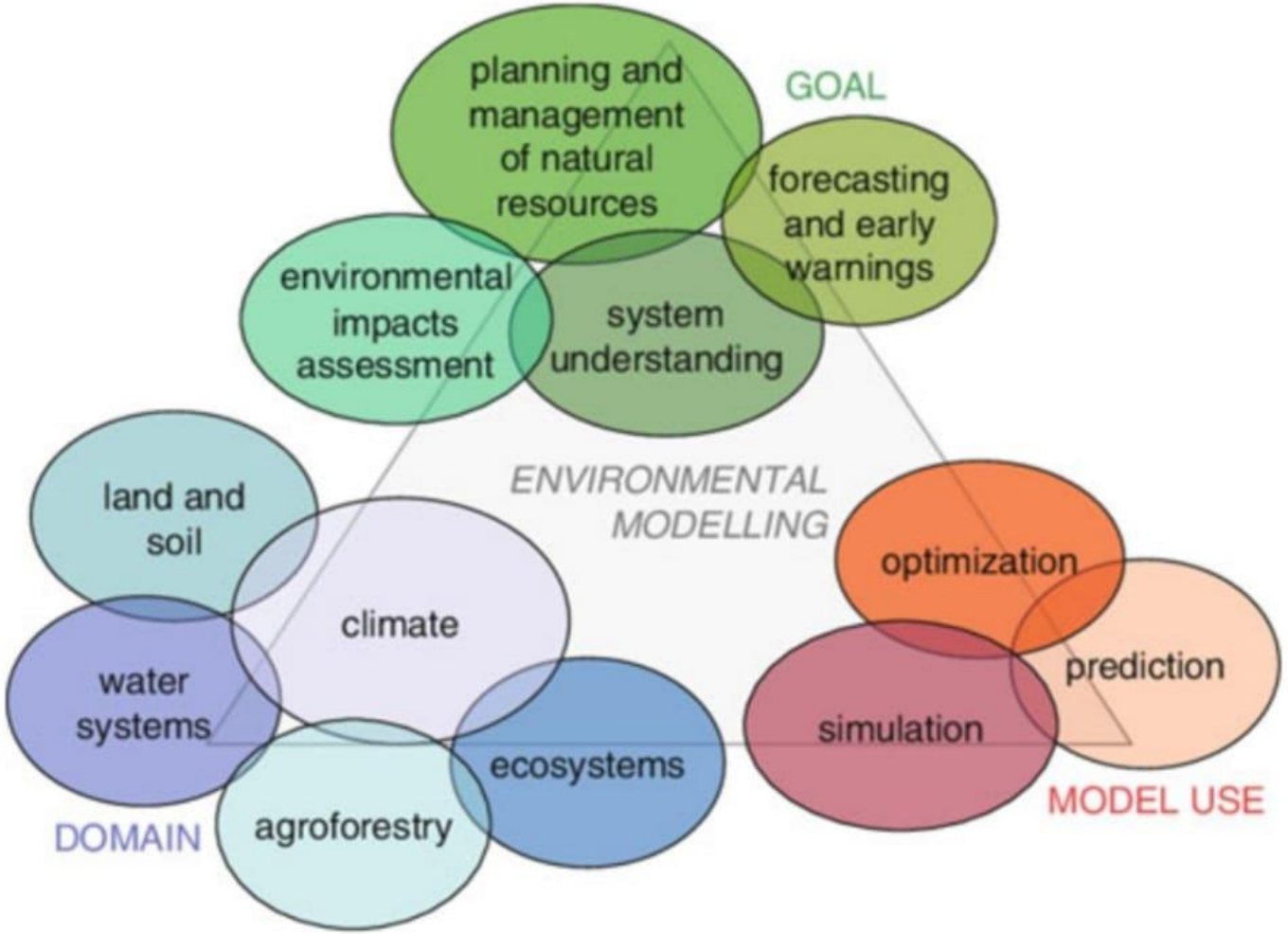
(a) Which layer represents Earth's crust?
(b) Which layer represents the lithosphere?
(c) Which layer represents the asthenosphere?
(d) Which layer or layers represent the core?



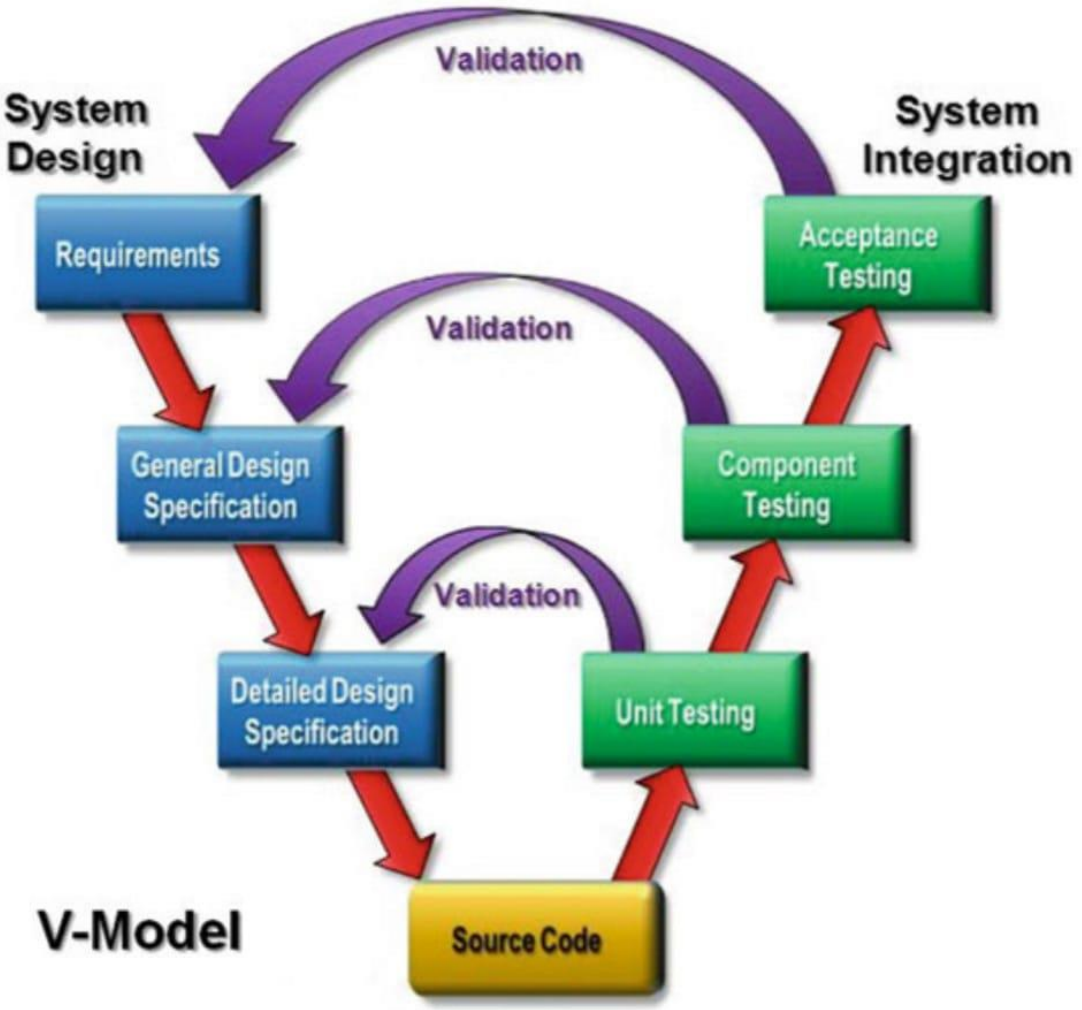
OR

Q5. Comment on following two statistical analysis related to environmental issues. **05**





Pictorial Description of Environmental Modelling



Model Development Techniques

Feedback on Class's Performance

📌 Observations:

- **First Assignment:** Majority of students **submitted copied reports** with **no original analysis**, indicating a lack of effort and understanding.
- **Quizzes and assignments:** Not taken seriously, with poor engagement and results.
- **Second Assignment:** Showed **significant improvement**, with more **genuine efforts** and inclusion of **some analysis**.