Workplace Environmental Management

WEEK 3 – Environmental of Earth - 1

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Objectives

At the end of this topic students will be able to:

- The environment of Earth
- The Atmosphere and its components
- The Hydrosphere and its components

3.0 Definitions: The environment of Earth

- The environment of has various systems that sustain life.
- Among the critical components of this environment, there are:
- Atmosphere (air)
- Hydrosphere (water).
- The atmosphere, is gaseous and it envelops the Earth as a surround
- The atmosphere is made of many gases such as nitrogen, oxygen, etc.
- They play a crucial role in protecting the planet from harmful solar radiation and meteoroids, as well as the regulation of the climate
- Also, the provision of oxygen essential for respiration is the role of atmosphere.

3.0 Definitions: The environment of Earth cont’d

- The hydrosphere, encompasses all forms of water on Earth's surface
- They include oceans, lakes, rivers, and groundwater,
- Ground water serves the life support system for diverse organisms and regulates temperature to facilitate nutrient and energy transfer as well as shaping Earth's surface through erosion and weathering.

3.1 Atmosphere

- The atmosphere is a dynamic layer of gases that envelops Earth, a very useful component of our planet's environment.
- Its composition, primarily nitrogen (78%) and oxygen (21%), with traces of other gases like argon, carbon dioxide, neon, and water vapor, which creates a life-sustaining blanket around Earth.
- This composition is not only essential for respiration and photosynthesis but also plays a crucial role in regulation of temperatures as well as the protecting life from harmful solar radiation and meteoroids.
- The atmosphere's ability to absorb and release heat helps maintain Earth's climate, making it suitable for a diverse range of organisms.

3.1 Atmosphere cont’d

- Within several layers, each with its own unique properties, the atmosphere is divided and adds to its complexity and functionality.
- The troposphere is the closest to Earth's surface where weather occurs, and temperature decreases with altitude.
- The stratosphere is the home to the ozone layer which sees a temperature increase due to the absorption of ultraviolet radiation.
- Beyond these layers lie the mesosphere, thermosphere, and exosphere with each playing a specific role in Earth's atmospheric processes.
- This structure of layers is not only influencing weather patterns and climate but also impacts communication systems and space travel. Thus, showing the intricate nature of Earth's atmospheric composition and structure.

3.1.1 Composition of Atmosphere

- The atmosphere is a layer of gases that envelops Earth that plays a crucial role in sustaining life and regulating climate.
- The composition of the atmosphere is primarily nitrogen (78.08%), oxygen (20.95%), with trace amounts of other gases making up the remaining percentage.
- Each component is discussed in next slides

3.1.1 Composition of Atmosphere cont'd

- **Nitrogen (N2):** The most abundant gas in the atmosphere, it is important for life as it is a key component of proteins and nucleic acids.
- **Oxygen (O2):** Essential for respiration, it is vital for the survival of most organisms on Earth, including humans.
- **Argon (Ar):** A noble gas, it is and inert and does not react with other elements. It comprises about 0.93% of the atmosphere.
- **Carbon Dioxide (CO2):** Although it is a relatively small component (about 0.04%), carbon dioxide plays a crucial role in the carbon cycle and is important for photosynthesis.

3.1.1 Composition of Atmosphere cont'd

- **Neon (Ne):** Present in trace amounts (about 0.0018%), neon is a noble gas that is inert and does not readily react with other substances.
- **Helium (He):** It is also a noble gas and is lighter than air and is used in various applications such as balloons and airships.
- **Methane (CH4):** A greenhouse gas, methane is in very small amounts (about 0.0002%) but has a significant impact on climate.
- **Krypton (Kr):** It also a noble gas, krypton is present in trace amounts (about 0.0001%) in the atmosphere.

3.1.1 Composition of Atmosphere cont'd

- **Hydrogen (H2):** The lightest and most abundant element in the universe, hydrogen makes up about 0.00005% of the atmosphere.
- **Xenon (Xe):** A rare noble gas, xenon is present in very small amounts (about 0.000009%) in the atmosphere.
- **Ozone (O3):** Ozone is present in trace amounts in the atmosphere, primarily in the stratosphere, where it plays a crucial role in absorbing ultraviolet radiation from the sun.
- **Water vapor** is also present in variable amounts, typically ranging from about 0.1% to 1% by volume, but this can vary greatly depending on factors such as location, altitude, and weather conditions.

3.1.2 Structure of atmosphere

- The structure of Earth's atmosphere consisting of several distinct layers, each with uniqueness.

Troposphere: Lowest layer extending from the Earth's surface up to approximately 8 kilometers at the poles and 18 kilometers at the equator. Weather phenomena occur within this layer. Temperature decreases with increasing altitude at a rate of approximately 1^{o} Celsius for every 165 meters. The tropopause separates the troposphere from the stratosphere

Stratosphere: is above the troposphere, extending up to approximately 50 kilometers from the Earth's surface. It has little water vapor and relatively dry. Advantages for flight, as it is above stormy weather and has steady horizontal winds. The ozone layer is found in this layer, absorbing harmful UV rays.

3.1.2 Structure of atmosphere cont'd

Mesosphere: Above the stratosphere, extending from 50 to 80 kilometers.

- The coldest atmospheric layer, with temperatures dropping significantly.
- Meteors burn up in this layer. The mesopause separates the mesosphere from the thermosphere.

Thermosphere: Extends from the mesopause from 80 to 400 kilometers. Radio waves are reflected by this layer. Temperature increases with height. Auroras and satellites occur in this layer.

- The lower thermosphere is called the ionosphere, consisting of electrically charged particles (ions) ionized by cosmic and solar radiation.

Exosphere: The outermost layer, gradually merging with space. Contains very few particles. Satellites orbit within this region.

- The atmosphere’s advantages to support life on Earth are:

✓ Protecting shield, absorbing and scattering the Sun's harmful ultraviolet (UV) radiation by preventing it with Earth's surface in dangerous amounts, reducing the risk of skin cancer and other UV-related health issues.

✓ It plays a vital role in regulating Earth's climate by trapping heat from the Sun in a natural process known as the greenhouse effect.

✓ The temperature is suitable for life, preventing drastic temperature fluctuations that could otherwise make the planet uninhabitable.

✓ It provides the oxygen necessary for respiration making up about 21% of the at mosphere, a key component in the metabolic processes of living organisms extracting energy from food.

- ✓ It helps in redistributing heat through atmospheric circulation patterns through the Sun's energy, helps to regulate temperatures globally, creating climate zones that support diverse ecosystems.
- ✓ Overall, the atmosphere's composition and properties are essential for creating and maintaining a habitable environment for life on Earth.

3.2 Hydrosphere

- The hydrosphere is the water component of Earth, encompassing all water on or near the surface of the planet.
- It consists of two main types of water bodies: **saltwater** and **freshwater**

3.2.1 Composition of hydrosphere

Saltwater (Oceans): Oceans make up the majority of the Earth's hydrosphere, covering approximately 71% of the planet's surface.

- The composition of ocean water is primarily saltwater, with an average salinity of about 3.5%.
- It is essential for marine life and plays a crucial role in regulating Earth's climate and weather patterns.

3.2.1 Composition of hydrosphere cont’d

Freshwater (Lakes, Rivers, Glaciers): found in various forms, including lakes, rivers, groundwater, and glaciers.

- It is vital for terrestrial life, providing drinking water, irrigation for agriculture, and habitat for numerous species.
- Groundwater, found underground in aquifers, is a significant source of freshwater for many regions around the world.
- Glaciers and ice caps store a significant amount of Earth's freshwater, particularly in polar regions, and play a crucial role in regulating sea levels.

3.2.2 Structure of the Hydrosphere

- The hydrosphere is a vast interconnected network of water bodies that play a crucial role in Earth's systems.
- It encompasses all water on Earth's surface, including oceans, seas, lakes, river, glaciers, and groundwater.
- This interconnectedness is essential for the water cycle, which involving the movement of water between the atmosphere, hydrosphere, and lithosphere.

Oceans and Seas: It is the largest components of the hydrosphere, covering approximately 71% of Earth's surface.

- They play a critical role in regulating climate, storing heat, and absorbing carbon dioxide from the atmosphere.

3.2.2 Structure of the Hydrosphere cont'd

Lakes and Rivers: They are freshwater bodies that are essential for supporting terrestrial and aquatic ecosystems. They also serve as sources of drinking water, irrigation, and transportation.

Glaciers and Ice Caps: They are massive bodies of ice that store freshwater, important indicators of climate change and contribute to sea level rise when melt.

Groundwater: Found beneath the Earth's surface in soil pore spaces and in the fractures of rock formations, vital source of drinking water and ecosystems support.

Interconnectedness: Interconnection is made through the water cycle. This cycle involves processes such as evaporation, condensation, precipitation, and runoff helping to distribute water around the planet and regulates Earth's climate.

- Hydrosphere plays a critical role in sustaining life on Earth and is essential for maintaining the planet's ecosystems and climate for the continued well-being of both humans and the environment.

- Hydrosphere is advantageous as follows:

Life Support: The hydrosphere is essential for all forms of life on Earth. Water is a fundamental requirement for the survival of organisms, serving as a medium for biological processes and providing habitats for aquatic life.

Climate Moderation: Water has a high specific heat capacity, meaning it can absorb and store large amounts of heat energy. This property helps to moderate Earth's climate by absorbing heat during the day and releasing it at night, thereby regulating temperature fluctuations.

Nutrient Transport: Water plays much in the transport of nutrients of ecosystems. Rivers and streams carry nutrients from land to the oceans, where they are essential for supporting marine life. Water also facilitates the transport of nutrients within aquatic environments, ensuring the health and productivity of these ecosystems.

Erosion and Sediment Transport: The movement of water through rivers, streams, and oceans causes erosion of rocks and land surfaces. This erosion shapes the Earth's surface, creating diverse landforms such as valleys, canyons, and deltas. Water also transports sediment, which is important for building and maintaining habitats for various organisms.

Recreation and Tourism: The hydrosphere provides numerous recreational opportunities, like swimming, boating, and fishing. Water-based tourism is a signific ant economic driver, attracting visitors to coastal areas, lakes, and rivers.

Water Supply: The hydrosphere is a vital source of freshwater for consumption of humans, agriculture, and industry. Groundwater, rivers, lakes, and reservoirs, contribute to the water supply, making it essential for sustaining human life and economic activities.

Regulation of Earth's Energy Balance: Water plays a crucial role in regulating Earth's energy balance during the processes of evaporation and condensation. Water vapor in the atmosphere helps to regulate the amount of solar radiation that reaches the Earth's surface, influencing global climate patterns.

Biodiversity Support: The hydrosphere supports a wide range of biodiversity, including numerous species of fish, plants, and other organisms. Aquatic ecosystems are among the most diverse on Earth, providing habitats for a multitude of species.

Thank you for your good attention

Q&A

References

- The Role of the Atmosphere in Climate Regulation, Smith J. K. and Johnson L. M, Journal of Climate Studies, 2020.
- Water Resources and the Hydrosphere: A Global Perspective, Brown A. R. and White E. S., Environmental Science Review, 2018.
- Understanding the Composition of the Earth's Atmosphere, Patel R. N. and Jones P. T, Earth Sciences Journal, 2019.
- The Hydrosphere and Its Role in Ecosystem Sustainability, Garcia M. A. and Nguyen T. H, Environmental Biology, 2017.
- Impacts of Climate Change on the Atmosphere and Hydrosphere, Wang S. and Zhan g Q., Climate Change Research, 2016.
- Atmospheric Circulation Patterns and Their Impact on the Hydrosphere, Kim H. and Lee S., Earth and Environmental Science Letters, 2021.
- The Role of Water Vapor in Atmospheric Processes, Jones R. E. and Smith P. A, Journal of Atmospheric Science, 2019.