

Unit 2 - "Environmental Systems"

The survival of life on Earth depends upon various natural systems that make up "our environment". Starting at the level of chemistry & energy basics, we will look at how abiotic factors interact with biotic ones to form complex ecosystems. Our focus will be on sustainable energy & matter flows through these systems over time.

Essential Questions:

1. *What is the chemical & energetic basis of all environmental systems, and what behaviors do systems show?*
2. *How do flows of energy and matter on Earth create a biosphere that is sustainable over millions of years?*
3. *How do Sun-Earth interactions drive flows of matter & energy in the climate system to affect the biosphere?*

Learning Target – I CAN . . .

Chapter 2: Environmental Systems

1. **12. Define systems within the context of environmental science**
 - a. Define an environmental system and cite examples
 - b. Identify smaller systems within a larger system
2. **13. Explain components and states of matter**
 - a. Describe the constituents of matter
 - b. Differentiate between mass and matter
 - c. Identify water's unique properties
 - d. Indicate how water's unique properties accounts for life on Earth
2. **Distinguish between the various forms of energy and discuss the first and second law of thermodynamics**
 - a. Differentiate between power and energy
 - b. Compare and contrast potential and kinetic energy
 - c. Explain chemical energy
 - d. Describe the first and second laws of thermodynamics
3. **Describe the ways in which ecological systems depend on energy inputs**
 - a. Describe how living organism convert one form of energy to another
 - b. Explain how energy determines the sustainability of the environment for growing food
4. **Explain how scientists keep track of inputs, outputs and changes in complex systems**
 - a. Compare and contrast an open system with closed
 - b. Define steady state
 - c. Define feedback loops
 - d. Explain how changes in input and output rates affect systems
5. **Describe how natural systems change over time and space**
 - a. Cite examples of environmental conditions that vary among ecosystems
 - b. Discuss why it is necessary to track changes in ecosystems over space and time

Chapter 3: Ecosystem Ecology

1. **List the basic components of an ecosystem.**
 - a. Identify the parts that make up an ecosystem
 - b. Explain the components that impact what type of ecosystems occur in different areas
 - c. Identify examples of different boundaries that set apart ecosystems
 - d. Describe processes that are not bound to ecosystem boundaries
2. **Describe how energy flows through ecosystems.**
 - a. Identify organisms that are autotrophs and be able to identify reactants and products of photosynthesis
 - b. Identify organisms that do cellular respiration and the reactants and products of respiration
 - c. Differentiate between primary, secondary, and tertiary consumers and be able to label on a food chain and food web
 - d. Define and identify consumers, producers, scavengers, detritivores, and decomposers in a food web
 - e. Explain the connection between Gross Primary Productivity (GPP) and Net Primary Productivity and be able to calculate given each given numerical values
 - f. Compare and contrast ecosystems based on their productivity and identify the factors that impact their ability to be productive
3. **Describe how carbon, nitrogen, and phosphorus cycle within ecosystems.**
 - a. Define biogeochemical
 - b. Explain the roles of flows and pools in biogeochemical cycles
 - c. Identify the flows & pools within the hydrological cycle & explain how the processes work together
 - d. Identify the flows & pools within the carbon cycle & explain how the processes work together
 - e. Identify the flows & pools within the nitrogen cycle & explain how the processes work together
 - f. Identify the flows & pools within the phosphorus cycle & explain how the processes work together
 - g. Explain how humans are altering each of the cycles mentioned in the previous learning targets
4. **Explain how ecosystems respond to natural and anthropogenic disturbances.**
 - a. Define disturbance as it pertains to an ecosystem
 - b. Define watershed and explain the role it can play in studying the environment
 - c. Define restoration ecology, explain why it is important, and identify key examples

5. Discuss the values of ecosystems and how humans depend on them.

- a. Differentiate between instrumental and intrinsic values of an ecosystems
- b. Explain how the following instrumental services provide value to humans
 - i. Provisions
 - ii. Regulating Services
 - iii. Support Systems
 - iv. Resilience
 - v. Cultural Services
- vi. Explain the factors that impact the intrinsic value of an ecosystem

Chapter 4: Global Climate and Weather

1. Explain the forces that drive global circulation patterns and how those patterns determine weather and climate.

- a. Explain the difference between weather and climate
- b. List the layers of the atmosphere starting at the Earth's surface and moving up
- c. Identify the temperature differences between each layer and the science behind these differences
- d. List the important traits of each layer as it pertains to the environment and humans
- e. Explain how the tilt of the Earth relates to seasons and identify the Earth's position for each season in the Northern hemisphere
- f. Define albedo and identify areas on the earth with low and high albedo
- g. Define adiabatic heat and adiabatic cooling and connect each to convection currents
- h. Identify the location of Hadley and polar cells on a globe
- i. Explain the effect Hadley cells and polar cells have on global climate
- j. Explain what the Intertropical Convergence Zone (ITCZ) is and its connection to weather
- k. Describe the Coriolis Effect and use it to determine global wind patterns
- l. Define gyres and identify their role in global climates
- m. Connect upwellings to ocean productivity
- n. Explain the science behind thermohaline circulation
- o. Identify the differences in ocean temperatures and weather based on El Nino
- p. Identify the properties on different sides of a mountain based on the rain shadow effect and know the science behind why the rain shadow effect occurs

2. Describe the major terrestrial biomes.

- a. Correctly identify biomes on the Whittaker diagram based on their average temperature and annual precipitation
- b. Label biomes on a map of the world
- c. List the major characteristics and unique terms that apply to the following biomes and the reasons behind the characteristics
 - i. Tundra
 - ii. Boreal Forest
 - iii. Temperate Rainforest
 - iv. Temperate Seasonal Forest
 - v. Woodland/Shrubland
 - vi. Temperate Grassland/Cold Desert
 - vii. Tropical Rainforest
 - viii. Tropical Seasonal Forest/Savanna
 - ix. Subtropical Desert

3. Describe the major aquatic biomes.

- a. Identify the different types of wetlands and the vital roles wetlands play in the environment
- b. Identify the unique properties of salt marshes and their importance to the greater environment
- c. Explain the importance of mangroves to coastlines
- d. Identify the types of organisms that live in an intertidal zone and explain why those organisms must have unique adaptations
- e. Explain the importance of coral reefs to humans
- f. Describe the organisms that makeup coral and also the diversity of other organisms in the reef
- g. Explain what coral bleaching is, what causes it, and what its effects would be if it occurs
- h. Label the zones of the open ocean and list the properties of each zone

Module List and Reading Schedule:

<i>Chapter</i>	<i>Mod</i>	<i>Pages</i>	<i>Topic(s)</i>
Chapter 2 - Environmental Systems	04	<i>31 - 43 + SA1</i>	Systems and Matter
	05	<i>43 - 54 + WTS</i>	Energy, Flows and Feedbacks
	Chapter 2 Quiz		
Chapter 3 - Ecosystem Ecology	06	<i>67 - 78</i>	Movement of Energy in Ecosystems
	07	<i>79 - 90 + WTS</i>	Movement of Matter in Ecosystems (BGC cycles)
	08	<i>91 - 95</i>	Ecosystem Responses to Disturbances
	Chapter 3 Quiz		
Chapter 4 - Global Climate and Biomes	09	<i>103 - 109</i>	Unequal Heating of the Earth
	10	<i>110 - 116</i>	Air Currents & Circulation
	11 & 12	<i>117 - 132 + WTS</i>	Ocean Currents & ENSO and Terrestrial Biomes
	13	<i>133 - 139</i>	Aquatic Biomes

	Chapter 4 Quiz
	Unit 2 Exam