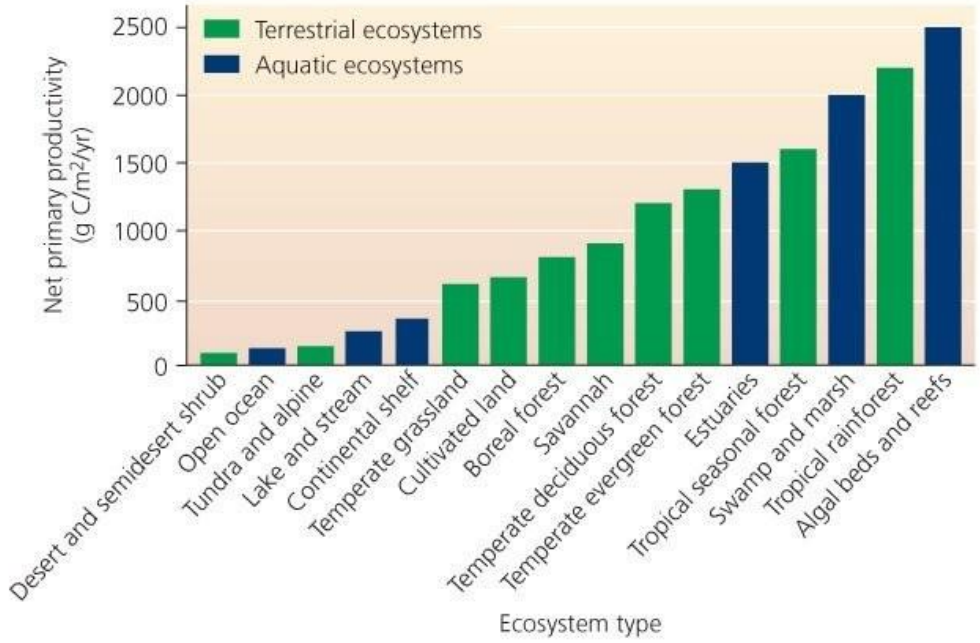
Environment: Science Behind the Stories, 3e **(Withgott et al.)**
Chapter 3 Environmental Systems and Ecosystem Ecology

3.1 Graph and Figure Interpretation Questions



(a) Net primary productivity for major ecosystem types

Figure 3.1

Use Figure 3.1 to answer the following questions.

1) This graph helps to explain _____.
A) why the open ocean is so productive
B) why cultivated lands are a logical choice to replace rain forests
C) why we need to be concerned with damage to rain forests and coral reefs
D) why tundra has such high net primary productivity of biomass
E) the importance of deserts
Answer: C
Diff: 2 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.4 Recognize the importance and complexity of the differing spatial and temporal scales of Earth processes

2) Overall, it appears that _____.
A) some ecosystems are 250 times more productive than others
B) cultivated land is more productive than natural ecosystems
C) shallow waters are more productive than deep waters on a per area basis
D) terrestrial ecosystems have higher productivity than aquatic ones
E) no valid conclusions can be drawn
Answer: C
Diff: 2 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.4 Recognize the importance and complexity of the differing spatial and temporal scales of Earth processes

3) Overall, it appears that terrestrial biomes with high temperatures and more available freshwater _____.
A) tend to have less productivity than those without much freshwater
B) tend to have about the same productivity as those without much freshwater
C) tend to have more productivity than those without much freshwater
D) don't differentiate between freshwater as rainfall and freshwater as ice in glaciers
E) No valid conclusions can be drawn.
Answer: C
Diff: 2 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.4 Recognize the importance and complexity of the differing spatial and temporal scales of Earth processes

3.2 Matching Questions

Match the following.

A) evaporation
B) cryosphere
C) detritivores
D) biome
E) evaporation/precipitation
F) groundwaters
G) ecosystem
H) decomposers
I) transpiration
J) biomass
K) river runoff
L) biosphere

1) the largest flux of water in the hydrological cycle
Diff: 1 Type: MA
Bloom's Taxonomy: 3 - Applying
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

2) consists of all the planet's living (and recently deceased and decaying) organisms
Diff: 1 Type: MA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.2 Outline the characteristics of Earth's major subsystems

3) matter contained in living organisms
Diff: 1 Type: MA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.2 Outline the characteristics of Earth's major subsystems

4) the process by which water moves from lakes or rivers to the atmosphere
Diff: 1 Type: MA
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

5) the second largest reservoir of water on Earth
Diff: 1 Type: MA
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

6) describes a category that fungi and bacteria fit into
Diff: 2 Type: MA
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

Answers: 1) E 2) L 3) J 4) A 5) B 6) H

3.3 Short Answer Questions

1) What are some factors that contribute to the "dead zone" in the waters off the Gulf of Mexico?
Answer: Invention of synthetic ammonia; Midwestern farm practices; global nitrogen cycle thrown out of balance, uptake of dissolved oxygen by benthic bacteria, sinking algal blooms, fresh water less dense than salt water, poor vertical mixing
Diff: 2 Type: ES
Bloom's Taxonomy: 4 - Analyzing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

2) The largest reservoir of phosphorus on Earth is in _____.
Answer: sediment and sedimentary rocks
Diff: 2 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

3) "The missing carbon sink" is likely in _____.
Answer: soils or plants of the northern and boreal forests
Diff: 2 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

4) A reservoir in which sources are equal to sinks is said to be in _____.
Answer: steady state
Diff: 2 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

5) What are the main anthropogenic sources of phosphorus and why are they a problem?
Answer: The major anthropogenic source of phosphorus is effluent from sewage treatments, which tends to be phosphate rich. Fertilizers also provide large amounts of anthropogenic phosphorus, and many detergents play a part as well. Introduction of phosphates from all of these sources into surface waters causes eutrophication and algae growth, leading to murkier waters and changes in the structure and function of ecosystems.
Diff: 2 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

6) What is the net effect of human activity on Earth's carbon reservoirs?
Answer: Humans have changed the rates of flux for carbon and are shifting carbon from the lithosphere, as a source, into the atmosphere, as a sink. Some of this carbon also enters the ocean (another sink). Most of the carbon is entering the atmosphere in the form of carbon dioxide.
Diff: 2 Type: ES
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

7) Define homeostasis.
Answer: The ability of a system to maintain constant, or stable, internal conditions.
Diff: 2 Type: ES
Bloom's Taxonomy: 1 - Remembering
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

8) The extremely low dissolved oxygen concentrations in the "dead zone" represent a condition called _____.
Answer: hypoxia
Diff: 1 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

9) The process of nutrient enrichment, subsequent increased production of organic matter, and eventual ecosystem degradation is known as _____.
Answer: eutrophication
Diff: 1 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

10) The term _____ describes all of the interacting organisms and the abiotic factors that occur in a particular place at the same time.
Answer: ecosystem
Diff: 1 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

11) Briefly explain what the main difference is between the flow of matter and the flow of energy in an ecosystem.
Answer: Most of the matter remains within the system (closed system), while the usable energy is constantly lost from the system and has to be replenished from an outside source (open system).
Diff: 2 Type: ES
Bloom's Taxonomy: 4 - Analyzing
Objective: 3.2 Outline the characteristics of Earth's major subsystems

12) Substances move through the environment in cycles called nutrient cycles or _____ cycles.
Answer: biogeochemical
Diff: 1 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

13) In the process of _____, autotrophs such as green algae and plants use solar energy, water, and carbon dioxide from the air to produce new biomass.
Answer: photosynthesis
Diff: 1 Type: SA
Bloom's Taxonomy: 2 - Understanding
Objective: 3.2 Outline the characteristics of Earth's major subsystems

14) The total biomass that heterotrophs generate by consuming autotrophs is termed _____.
Answer: secondary production
Diff: 1 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.2 Outline the characteristics of Earth's major subsystems

15) _____, such as soil insects and millipedes, are consumers of nonliving organic matter.
Answer: Detritivores
Diff: 2 Type: SA
Bloom's Taxonomy: 1 - Remembering
Objective: 3.2 Outline the characteristics of Earth's major subsystems

3.4 Multiple-Choice Questions

1) Any network of relationships among a group of components that interact with and influence one another through exchange of matter and/or information is referred to as _____.
A) an interchange
B) a system
C) an ecosystem
D) an environmental collaboration
E) a hierarchy
Answer: B
Diff: 1 Type: MC
Bloom's Taxonomy: 2 - Understanding
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

2) A system receiving inputs and producing outputs without undergoing any changes in size or function is said to be in _____.
A) static control
B) environmental balance
C) harmonic resonance
D) normal balance
E) dynamic equilibrium
Answer: E
Diff: 1 Type: MC
Bloom's Taxonomy: 1 - Remembering
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

3) Cattle on an open range, in some areas, may compact fragile soils while grazing. This can damage plant roots, leading to fewer, smaller plants, which may in turn cause cattle to graze more and work harder to obtain food. This is an example of a _____.
A) positive feedback loop
B) negative feedback loop
C) homeostatic system
D) dynamic equilibrium
E) food web
Answer: A
Diff: 2 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

4) The eutrophication that has taken place in the Gulf of St. Lawrence and other locations appears to be due to _____.
A) global warming from human use of fossil fuels
B) pesticide use along the waterways
C) heavy metals dumped in sewage
D) weather alone, because it is only obvious in the summer
E) excess nutrients from fertilizers
Answer: E
Diff: 2 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

5) The abiotic components of our planet can be divided into the _____.
A) geosphere and atmosphere
B) lithosphere, hydrosphere, and atmosphere
C) lithosphere, biosphere, and atmosphere
D) lithosphere, hydrosphere, biosphere, and atmosphere
E) centrosphere, geosphere, biosphere, and anthroposphere
Answer: B
Diff: 2 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

6) A natural ecosystem, undamaged by human activity, is a(n) _____.
A) mostly closed system of organic materials and energy; everything is recycled
B) open system of organic materials and an open system of energy, everything is recycled
C) mostly closed system of organic and inorganic materials, and an open system of energy
D) mostly closed system of organic and inorganic materials, and a closed system of energy; everything is recycled
E) open system of inorganic materials, and an open system of energy
Answer: C
Diff: 2 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

7) The rainforest of western Vancouver Island where it meets the coastal environment of the Pacific Ocean could be called a(n) _____.
A) coastal superbiome
B) ecotone
C) dead zone
D) closed ecosystem
E) abiotic system
Answer: B
Diff: 2 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.4 Recognize the importance and complexity of the differing spatial and temporal scales of Earth processes

8) Over a year, a small area of prairie grasses produces enough biomass to feed insects, mice, rabbits, birds, deer, antelope, and a host of decomposers. The amount of food potentially available to the herbivores is the _____.
A) net primary production
B) gross primary production
C) secondary production
D) productivity
E) food chain
Answer: A
Diff: 2 Type: MC
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

9) The rate at which biomass becomes available to consumers is termed _____.
A) gross primary productivity
B) ecosystem productivity
C) fertility
D) secondary production
E) net primary productivity
Answer: E
Diff: 2 Type: MC
Bloom's Taxonomy: 1 - Remembering
Objective: 3.2 Outline the characteristics of Earth's major subsystems

10) The biosphere consists of the _____.
A) saltwater and freshwater in surface bodies and the atmosphere
B) solid earth beneath our feet (above the mantle)
C) the regions of the Earth occupied by living organisms
D) air surrounding our planet allowing life to exist
E) abiotic portions of the environment
Answer: C
Diff: 1 Type: MC
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

11) Ecotones are the _____.
A) sounds that animal communities make in ecosystems
B) interactive behaviours leading to communication
C) areas between territories of organisms
D) studies of specific biomes by ecologists
E) transitional zones between ecosystems
Answer: E
Diff: 1 Type: MC
Bloom's Taxonomy: 2 - Understanding
Objective: 3.4 Recognize the importance and complexity of the differing spatial and temporal scales of Earth processes

12) Examining areas from the landscape scale, termed *landscape ecology*, is useful because _____.
A) humans have not yet caused alterations to landscapes
B) the dynamics of animals result in localized problems
C) the role of ecosystems is often overstated
D) the functioning of ecosystems is strongly affected by their spatial arrangement with other ecosystems and transitional zones
E) it helps to define the entire closed system
Answer: D
Diff: 2 Type: MC
Bloom's Taxonomy: 2 - Understanding
Objective: 3.4 Recognize the importance and complexity of the differing spatial and temporal scales of Earth processes

13) Macronutrients _____.
A) are large molecules necessary for making macromolecules
B) are required in large amounts for organisms to survive
C) are the only nutrients that can be tracked in nutrient cycles
D) can be taken up only by plants from rock cycles
E) are what large predators eat
Answer: B
Diff: 1 Type: MC
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

14) Experiments have demonstrated that primary production in the oceans is usually limited by availability of _____.
A) iron or nitrogen
B) nitrogen
C) phosphorus
D) iron or phosphorus
E) carbon
Answer: A
Diff: 2 Type: MC
Bloom's Taxonomy: 1 - Remembering
Objective: 3.2 Outline the characteristics of Earth's major subsystems

15) Plants conduct photosynthesis, making glucose and other carbohydrates. To do this, they need _____.
A) water from the soil
B) water from the humid atmosphere and carbon dioxide from the soil
C) water from the soil and carbon dioxide from the soil
D) carbon dioxide from the atmosphere
E) water from the soil and carbon dioxide from the atmosphere
Answer: E
Diff: 2 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

16) Which of the major water and nutrients cycles has its largest reservoir in the atmosphere?
A) sulphur
B) carbon
C) nitrogen
D) phosphorus
E) water
Answer: C
Diff: 2 Type: MC
Bloom's Taxonomy: 4 - Analyzing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

17) Nitrogen is made available to plants by _____.
A) photosynthesis
B) volcanic eruptions
C) heterotrophic bacteria converting ammonium to nitrate
D) dissolving in freshwater and in the ocean
E) mutualistic and free−living bacteria
Answer: E
Diff: 2 Type: MC
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

18) Humans have dramatically altered the rate of nitrogen fixation into forms usable by autotrophs _____.
A) by burning fossil fuels to meet our energy needs
B) because of the erosion of farmlands through poor agricultural practices
C) as we produce synthetic fertilizers and apply them to crops, lawns, and parks
D) by using antibiotics to reduce the numbers of denitrifying bacteria
E) by selectively removing leguminous plants
Answer: C
Diff: 3 Type: MC
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

19) The freshwater we depend on for our survival accounts for _____.
A) two-thirds of all water on Earth
B) one-third of all water on Earth
C) 10% of all water on Earth
D) 3% of all water on Earth
E) less than 1% of all water on Earth
Answer: D
Diff: 2 Type: MC
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

20) Aquifers are _____.
A) natural ponds and lakes
B) recharge lakes at water quality facilities
C) underground water reservoirs
D) the result of transpiration
E) oceans
Answer: C
Diff: 2 Type: MC
Bloom's Taxonomy: 1 - Remembering
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

21) By damming rivers and using methods such as flood irrigation, we are _____.
A) increasing evaporation
B) increasing the water table
C) decreasing the water table
D) decreasing transpiration
E) increasing transportation
Answer: A
Diff: 3 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

22) A pond contains 1000 m^3 of water. The water flows into the pond at 5 m^3 per day, flows out of the pond in the form of a stream at 4m^3 per day, and evaporation from the pond's surface is 1 m^3 per day. What is the water turnover time in this lake?
A) 200 days
B) 1000 days
C) 250 days
D) 100 days
E) There is not enough data to answer this question.
Answer: A
Diff: 3 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

23) Which of the major water and nutrients cycles has its largest reservoir in the ocean?
A) sulphur
B) carbon
C) nitrogen
D) phosphorus
E) water
Answer: E
Diff: 2 Type: MC
Bloom's Taxonomy: 4 - Analyzing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

24) Human beings have dramatically altered the flux rate of nitrogen from _____.
A) the atmosphere to various pools on the Earth's surface
B) soils to the atmosphere
C) proteins to inorganic ions in soils
D) oceans to soils
E) producers to consumers through increased wildfires
Answer: A
Diff: 2 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

25) During a year, the gross photosynthesis of grass growing on a 2000 m^2 parcel of land was 10 000 kg of carbon (kg C) per year. A farmer harvested this grass to feed it to her animals. The grass contained 1000 kg of carbon. The animals that ate the grass gained 100 kg of carbon in their meat. What was the secondary productivity of this piece of land?
A) 5 $kgC/m^2/yr$
B) 0.5 $kgC/m^2/yr$
C) 0.05 $kgC/m^2/yr$
D) 5 kgC/yr
E) 0.5 kgC/yr
Answer: C
Diff: 3 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

26) Secondary consumers obtain their nutrients from _____.
A) primary producers and/or detritivores and decomposers
B) primary producers only
C) detritivores and decomposers only
D) primary and/or tertiary consumers
E) tertiary producers and/or detritivores and decomposers
Answer: A
Diff: 1 Type: MC
Bloom's Taxonomy: 3 - Applying
Objective: 3.2 Outline the characteristics of Earth's major subsystems

3.5 True/False Questions

1) Ecosystems that convert solar energy to biomass rapidly are said to have low primary productivity.
Answer: FALSE
Diff: 1 Type: TF
Bloom's Taxonomy: 2 - Understanding
Objective: 3.2 Outline the characteristics of Earth's major subsystems

2) Biogeochemical cycles are one example of a positive feedback loop.
Answer: FALSE
Diff: 3 Type: TF
Bloom's Taxonomy: 3 - Applying
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

3) Excess carbon dioxide in the atmosphere is most easily taken up by producers in photosynthesis and by the ocean.
Answer: TRUE
Diff: 3 Type: TF
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

4) Most ecosystems are limited by nitrogen as phosphorus is weathered from rock at relatively high rates.
Answer: FALSE
Diff: 1 Type: TF
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

5) Producers and primary consumers can take up phosphorus dissolved in water; higher-level consumers must obtain phosphorus from organisms below them in the food web.
Answer: TRUE
Diff: 3 Type: TF
Bloom's Taxonomy: 4 - Analyzing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

6) Humans have tremendously accelerated the flux rate of carbon from the earth to the atmosphere by burning fossil fuels.
Answer: TRUE
Diff: 1 Type: TF
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

7) Denitrifying bacteria convert atmospheric nitrogen gas directly to nitrate ions.
Answer: FALSE
Diff: 1 Type: TF
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

3.6 Essay Questions

1) Compare and contrast positive and negative feedback loops. Give an example of each. Which are more common in natural systems and why?
Answer: A system's output can serve as an input to that same system, a circular process described as a feedback loop. In a negative feedback loop, output pushing the system in one direction acts as input that moves the system in the opposite direction. The output and input essentially neutralize one another and stabilize the system. An example would be the regulation of our body temperature. In a positive feedback loop, inputs don't stabilize a system but drive them further toward one extreme or another. An example of this process is the melting of glaciers and sea ice because of global warming.

Negative feedback loops are more common in nature because they enhance stability and, in the long run, only stable systems persist. Positive feedbacks, because they are inherently unstable, are relatively rare in nature but are common in natural systems disturbed by human actions.
Diff: 3 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

2) Differentiate between an open and a closed system. Provide a specific example of each. Do both exist in nature? Why or why not?
Answer: A closed system is one that is isolated and self-contained. It is hypothetical and allows scientists to grapple with complex systems. An open system is one that exchanges energy, matter, and information with another system. The St. Lawrence River is an open system that interacts with all aquatic systems, terrestrial systems, and atmospheric systems from the river's origin in Lake Ontario to its termination in the Gulf of St. Lawrence. It is affected by all sources of pollution, fertilizer, temperature change, and other human impacts that can access its waters. Completely closed systems do not exist in nature. Even a system as closed as a desktop computer becomes an open system when plugged into the wall socket that is in contact with the electricity that runs through an entire local community. Matter may recycle through a system, but energy must be constantly input from an external source, such as the Sun.
Diff: 3 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

3) Give a brief overview of the carbon cycle. Include the source of carbon that enters ecosystems, how it moves through ecosystems, what it is used for, and where it is ultimately deposited. What part of this cycle is believed to contribute to global warming?
Answer: Plants take up carbon dioxide (CO_2) from the atmosphere and then incorporate the carbon into their tissue. Animals then eat plants and gain carbon. Carbon is used for all the tissues and molecules of living organisms, such as carbohydrates, fats, and proteins, and as an essential ingredient in DNA. When animals and plants die, their tissues are metabolized by decomposers and much partially degraded biomass (especially from plants) is then deposited into soils. At each stage along the way, some carbon is released back to the atmosphere as carbon dioxide. The atmospheric carbon is exchanged with the carbon pool in the ocean. The use of fossil fuels (previously undecomposed organic materials) causes stored carbon to be released to the atmosphere. It is this increase in the atmospheric concentration of carbon in the form of CO_2 and methane that is a major force behind global warming.
Diff: 3 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

4) Human activity has affected every aspect of the nitrogen cycle. List the ways that humans have altered nitrogen content starting with how nitrogen becomes available to producers, where it goes, and what impacts it has. What are the related concerns for the future?
Answer: Humans have spent a great deal of money on producing and distributing nitrogen and have doubled the amount of nitrogen available for use by plants. The Haber-Bosch process allows us to fix nitrogen into usable molecules. We have increased the amount of nitrogen that makes its way into waterways, mostly as runoff from fertilizer. This has caused alterations in terrestrial community composition and eutrophication in water systems. We have also increased the distribution of nitrogen through atmospheric pollution, primarily from nitrogen oxides resulting from burning fossil fuels, that then comes down as acid rain. Concerns for the future include climate change through increased concentrations of nitrous oxide (a greenhouse gas), depleted nutrients from soils, and acidified surface water and soils.
Diff: 3 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

5) Human activity has affected every aspect of the water cycle. List four ways that humans have altered the water cycle. What are the major concerns for the future?
Answer: First, humans have dammed rivers to create reservoirs, resulting in increased evaporation and infiltration of surface water into aquifers. Second, we have removed vegetation from many areas so infiltration into the soil, transpiration, and return of water to the atmosphere have all slowed, increasing runoff and erosion. Third, our agricultural methods, such as flood irrigation, have resulted in the depletion of surface waters. Finally, we emit pollutants into the atmosphere that subsequently come down in rainwater.

The greatest concern for the future will be shortages of potable water. Shortages in specific areas of many countries are already evident. Groundwater is being removed at high rates because of agriculture and manufacturing. Water tables in previously plentiful aquifers are dropping at rapid rates and may ultimately limit agricultural production and manufacturing, as well as the availability of clean, fresh water supplies for people worldwide.
Diff: 3 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

6) Explain eutrophication in coastal waters. Name one geographic location where this problem occurs.
Answer: River waters carry nutrients from land to coastal waters. The surplus nutrients stay in the surface layer, which, being less salty and warmer, has lower density than the deeper waters. Nutrients cause algal bloom. Algae die and sink into deeper waters, where they are decomposed by bacteria, in a process that uses oxygen. The oxygen cannot be brought from the surface layer because the fresh and warm surface water does not mix well with much denser deep waters. The oxygen also cannot be locally produced in deep waters because algae in the surface layer block sunlight, thus preventing photosynthesis from occurring in deeper waters. The resulting shortage of oxygen creates hypoxic conditions, which suffocates or drives away bottom-dwelling animals. Example locations where this problem occurs include the Gulf of St. Lawrence, the Gulf of Mexico, and the Baltic Sea
Diff: 3 Type: ES
Bloom's Taxonomy: 2 - Understanding
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

7) Define the term *emergent properties* and give an example from a natural system.
Answer: Emergent properties are characteristics that are not evident in the system's components (the whole is greater than the sum of its parts; a cake is more than the sum of its ingredients). The component parts of a tree (leaves, branches, roots, bark) do not add up to the whole tree's emergent properties, such as a source of shade for understory vegetation, a home for birds and insects, a rich resource filled with nectar and pollen during flowering season, a source of food for many organisms in the form of fruits or nuts, a carbon dioxide sink, a source of oxygen, etc.
Diff: 3 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

8) What is GIS software and how is it used by landscape ecologists?
Answer: GIS (geographic information system) software is used by landscape ecologists to analyze and visualize how various geographic, biological, and anthropogenic elements of a landscape are arranged spatially. The elements can be arranged as layers to form a composite map; they are useful for mapping geology, hydrology, soils, vegetation, niches of various species, and human development. It is used to establish management strategies for any landscape, natural or urban.
Diff: 2 Type: ES
Bloom's Taxonomy: 6 - Synthesizing
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

3.7 Scenario-Based Questions

Read the following scenario and answer the questions below.

In the early years of the twentieth century there were lush stands of tall grasses in the valley on the east side of the Chiricahua Mountains in Arizona, stretching to Mexico in the south and New Mexico in the east. Dramatic summer rainstorms dumped huge amounts of water very quickly on the rocky upper slopes. The water ran down the slopes and into the grasslands, where it quickly soaked into the soft, porous soil. Cattle ranching was in full swing, utilizing the rich grasses, but the ranchers did not appreciate the multitudes of prairie dogs that lived in the grasslands. Cattle would stumble in the holes, break legs, and die of starvation. In addition, many ranchers were convinced that the prairie dogs would destroy the grasses because they directly competed with the cattle for food. The ranchers had already done away with most predators that might possibly affect cattle, so they turned their attention to the prairie dogs. The ranchers become a part of a new federally sponsored movement to poison the grassland prairie dogs. This movement took root and spread through the 1920s and 1930s. In Canada, the Richardson Ground Squirrel is a close relative of the prairie dogs and has a similar lifestyle. Grain farmers, cattle ranchers, and golf-club owners currently tend to adopt a zero-tolerance approach toward these rodents for the same reasons that the Arizona ranchers were determined to exterminate the prairie dog in the 1920s and 1930s.

1) Prairie dogs constantly dig through the soil to make new burrows. They also eat the grasses, roots and all. This probably contributes to _____.
A) the grass roots being subject to diseases
B) the soil being loose with too little nutrient cycling, causing grasses to fall over
C) the soil hardening during rains and too little nutrient cycling, causing grasses to die
D) the soils eroding and losing nutrients over time, causing the grasses to die
E) the soil being loose with good nutrient cycling, allowing new grass roots to grow and prosper
Answer: E
Diff: 2 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

2) When the rains came down on the rocky mountainsides, the water ran down into the grasslands where the prairie dogs were active and _____.
A) quickly ran off the loose soil and eroded it
B) quickly evaporated, drying the loose soil
C) quickly soaked into the loose soil, watering the grasses
D) gathered atop the loose soil, forming large muddy spots
E) formed ponds
Answer: C
Diff: 3 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

3) In the late 1800s and early 1900s farmers and ranchers slaughtered coyotes, bobcats, wolves, mountain lions, eagles, and rattlesnakes, trying to protect their cattle. One direct result may have been a(n) _____.
A) decrease in soil quality
B) increase in predation
C) increase in soil quality
D) increase in the prairie dog population
E) decrease in the prairie dog population
Answer: D
Diff: 2 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.3 Discuss how living and nonliving entities interact and how energy and matter move around in ecosystems

4) Once the prairie dogs were poisoned and no longer a part of the ecosystem, which of the following probably occurred?
A) Soils slowly became looser because of the cattle, so soil moisture increased.
B) Soils slowly compacted because of the cattle, so soil moisture decreased.
C) Soils slowly became looser because of the cattle, so fewer nutrients were recycled.
D) Soils slowly compacted because of the cattle, so soil moisture increased.
E) Soils slowly became looser because of the cattle, so soil moisture decreased.
Answer: B
Diff: 2 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.5 Summarize the main global biogeochemical cycles and their human impacts, especially the global water, carbon, nitrogen, and phosphorus cycles

5) The ranchers now want to bring back the prairie dogs because they realize that _____.
A) the prairie dogs kept the soil loose so rain sank in and grasses grew
B) the prairie dogs didn't eat grass
C) the predators depended on the prairie dogs
D) the cattle also ate the prairie dogs when grass was scarce
E) the prairie dogs were part of the net secondary productivity
Answer: A
Diff: 3 Type: MC
Bloom's Taxonomy: 5 - Evaluating
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems

6) Some of the conclusions that can be drawn from this scenario include that _____.
A) cattle improved the soils, contributing to this ecosystem
B) predators were unimportant components of this ecosystem; their removal caused no subsequent problems
C) prairie dogs were unimportant components of this ecosystem; their removal caused no subsequent problems
D) once humans change one thing in an ecosystem, they may find unexpected results occurring elsewhere in the ecosystem
E) prairie dogs were part of a negative feedback loop once they were removed
Answer: D
Diff: 3 Type: MC
Bloom's Taxonomy: 4 - Analyzing
Objective: 3.1 Describe the fundamental properties of systems, and the importance of linkages and flows of matter and energy among environmental systems