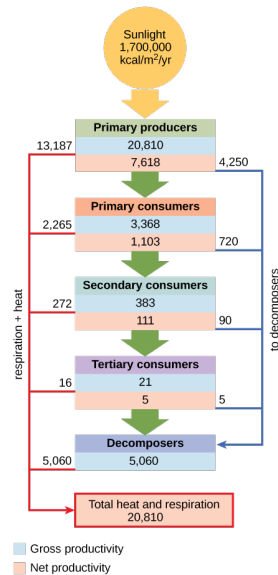


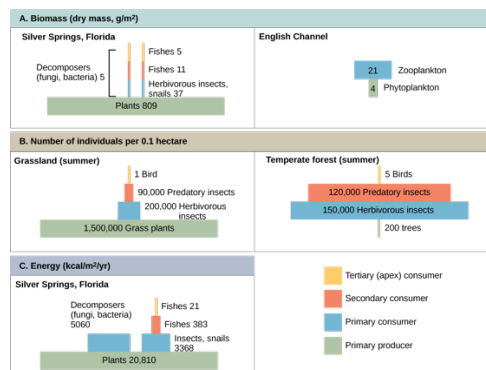
**Biology 2e**Unit 8: **Ecology**Chapter 46: **Ecosystems****Visual Connection Questions**

1. Why do you think the value for gross productivity of the primary producers is the same as the value for total heat and respiration ( $20,810 \text{ kcal/m}^2/\text{yr}$ )?



According to the first law of thermodynamics, energy can neither be created nor destroyed. Eventually, all energy consumed by living systems is lost as heat or used for respiration, and the total energy output of the system must equal the energy that went into it.

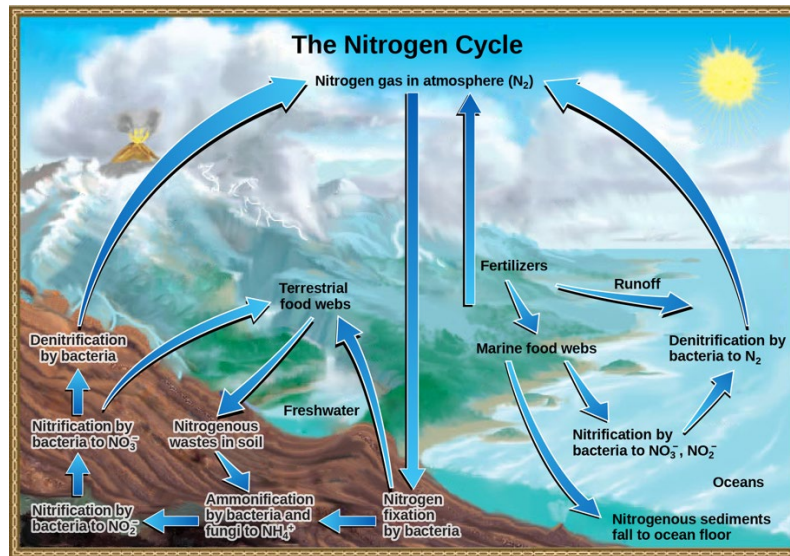
2. Pyramids depicting the number of organisms or biomass may be inverted, upright, or even diamond-shaped. Energy pyramids, however, are always upright. Why?



Pyramids of organisms may be inverted or diamond-shaped because a large organism, such as a tree, can sustain many smaller organisms. Likewise, a low biomass of organisms can sustain a

larger biomass at the next trophic level because the organisms reproduce rapidly and thus supply continuous nourishment. Energy pyramids, however, must always be upright because of the laws of thermodynamics. The first law of thermodynamics states that energy can neither be created nor destroyed; thus, each trophic level must acquire energy from the trophic level below. The second law of thermodynamics states that, during the transfer of energy, some energy is always lost as heat; thus, less energy is available at each higher trophic level.

3. Which of the following statements about the nitrogen cycle is false?



c. Nitrification by bacteria converts nitrates ( $NO_3^-$ ) to nitrites ( $NO_2^-$ ).

## Review Questions

4. The ability of an ecosystem to return to its equilibrium state after an environmental disturbance is called \_\_\_\_\_.

d. resilience

5. A re-created ecosystem in a laboratory environment is known as a \_\_\_\_\_.

c. microcosm

6. Decomposers are associated with which class of food web?

b. detrital

7. The primary producers in an ocean grazing food web are usually \_\_\_\_\_.

d. phytoplankton

8. What term describes the use of mathematical equations in the modeling of linear aspects of ecosystems?

a. analytical modeling

**9.** The position of an organism along a food chain is known as its \_\_\_\_\_.

c. trophic level

**10.** The loss of an apex consumer would impact which trophic level of a food web?

d. All of the above (Primary producers, Primary consumers, Secondary consumers)

**11.** A food chain would be a better resource than a food web to answer which question?

a. How does energy move from an organism in one trophic level to an organism on the next trophic level?

**12.** The weight of living organisms in an ecosystem at a particular point in time is called:

d. biomass

**13.** Which term describes the process whereby toxic substances increase along trophic levels of an ecosystem?

b. biomagnification

**14.** Choose the term that encompasses all organisms that can make their own food using inorganic molecules:

d. chemoautotrophs

**15.** In the English Channel ecosystem, the number of primary producers is smaller than the number of primary consumers because \_\_\_\_\_.

c. the primary producers have a high turnover rate

**16.** What law of chemistry determines how much energy can be transferred when it is converted from one form to another?

b. the second law of thermodynamics

**17.** The mussels that live at the NW Eifuku volcano are examples of \_\_\_\_\_.

d. Primary consumers

**18.** The movement of mineral nutrients through organisms and their environment is called a \_\_\_\_\_ cycle.

c. biogeochemical

**19.** Carbon is present in the atmosphere as \_\_\_\_\_.

a. carbon dioxide

**20.** The majority of water found on Earth is:

d. salt water

**21.** The average time a molecule spends in its reservoir is known as \_\_\_\_\_.

a. residence time

**22.** The process whereby oxygen is depleted by the growth of microorganisms due to excess nutrients in aquatic systems is called \_\_\_\_\_.

b. eutrophication

**23.** The process whereby nitrogen is brought into organic molecules is called \_\_\_\_\_.

c. nitrogen fixation

**24.** Which of the following approaches would be the most effective way to reduce greenhouse carbon dioxide?

b. Plant more environmentally-suitable plants.

**25.** How would loss of fungi in a forest effect biogeochemical cycles in the area?

d. Carbon would accumulate in dead organic matter and waste.

### Critical Thinking Questions

**26.** Compare and contrast food chains and food webs. What are the strengths of each concept in describing ecosystems?

Food webs show interacting groups of different species and their many interconnections with each other and the environment. Food chains are linear aspects of food webs that describe the succession of organisms consuming one another at defined trophic levels. Food webs are a more accurate representation of the structure and dynamics of an ecosystem. Food chains are easier to model and use for experimental studies.

**27.** Describe freshwater, ocean, and terrestrial ecosystems.

Freshwater ecosystems are the rarest, but have great diversity of freshwater fish and other aquatic life. Ocean ecosystems are the most common and are responsible for much of the photosynthesis that occurs on Earth. Terrestrial ecosystems are very diverse; they are grouped based on their species and environment (biome), which includes forests, deserts, and tundras.

**28.** Compare grazing and detrital food webs. Why would they both be present in the same ecosystem?

Grazing food webs have a primary producer at their base, which is either a plant for terrestrial ecosystems or a phytoplankton for aquatic ecosystems. The producers pass their energy to the various trophic levels of consumers. At the base of detrital food webs are the decomposers, which pass this energy to a variety of other consumers. Detrital food webs are important for the health of many grazing food webs because they eliminate dead and decaying organic material, thus, clearing space for new organisms and removing potential causes of disease. By breaking down dead organic matter, decomposers also make mineral nutrients available to primary producers; this process is a vital link in nutrient cycling.

**29.** How does the microcosm modeling approach differ from utilizing a holistic model for ecological research?

In a microcosm model, an ecologist recreates an ecosystem in a controlled environment. Since the ecologist is populating the environment, he can control the variables and the different species involved in the study to ask specific questions.

**30.** How do conceptual and analytical models of ecosystems compliment each other?

Conceptual models allow ecologists to see the “big picture” of how different components of the ecosystem interact with each other, energy sources, and resources. However, this approach is more descriptive than quantitative, so it is difficult to make conclusions about the resistance or resilience of a system. Analytical modeling creates a model that can predict how the ecosystem’s relationships will change in response to disturbances, but does not convey the complexity of the relationships seen with conceptual modeling.

**31.** Compare the three types of ecological pyramids and how well they describe ecosystem structure. Identify which ones can be inverted and give an example of an inverted pyramid for each.

Pyramids of numbers display the number of individual organisms on each trophic level. These pyramids can be either upright or inverted, depending on the number of the organisms. Pyramids of biomass display the weight of organisms at each level. Inverted pyramids of biomass can occur when the primary producer has a high turnover rate. Pyramids of energy are usually upright and are the best representation of energy flow and ecosystem structure.

**32.** How does the amount of food a warm blooded-animal (endotherm) eats relate to its net production efficiency (NPE)?

NPE measures the rate at which one trophic level can use and make biomass from what it attained in the previous level, taking into account respiration, defecation, and heat loss. Endotherms have high metabolism and generate a lot of body heat. Although this gives them advantages in their activity level in colder temperatures, these organisms are 10 times less efficient at harnessing the energy from the food they eat compared with cold-blooded animals, and thus have to eat more and more often.

**33.** A study uses an inverted pyramid to demonstrate the relationship between sharks, their aquatic prey, and phytoplankton in an ocean region. What type of pyramid must be used? What does this convey to readers about predation in the area?

An inverted ecological pyramid describing the relationship between the three groups must be a biomass pyramid. This model suggests that the area is subject to heavy predation, with the prey species feeding heavily on the phytoplankton, and in turn being consumed by the sharks.

**34.** Describe what a pyramid of numbers would like if an ecologist models the relationship between bird parasites, blue jays, and oak trees in a hectare. Does this match the energy flow pyramid?

In this ecological model, the oak trees (producers) would be at the bottom, the blue jays would be in the middle level (primary consumer of acorns), and the parasites would be at the top level

(secondary consumer). However, the pyramid would be inverted since each bird could support several parasites, and each tree could support several birds. This pyramid would appear to be the opposite of the energy flow pyramid.

**35. Describe nitrogen fixation and why it is important to agriculture.**

Nitrogen fixation is the process of bringing nitrogen gas from the atmosphere and incorporating it into organic molecules. Most plants do not have this capability and must rely on free-living or symbiotic bacteria to do this. As nitrogen is often the limiting nutrient in the growth of crops, farmers make use of artificial fertilizers to provide a nitrogen source to the plants as they grow.

**36. What are the factors that cause dead zones? Describe eutrophication, in particular, as a cause.**

Many factors can kill life in a lake or ocean, such as eutrophication by nutrient-rich surface runoff, oil spills, toxic waste spills, changes in climate, and the dumping of garbage into the ocean. Eutrophication is a result of nutrient-rich runoff from land using artificial fertilizers high in nitrogen and phosphorus. These nutrients cause the rapid and excessive growth of microorganisms, which deplete local dissolved oxygen and kill many fish and other aquatic organisms.

**37. Why are drinking water supplies still a major concern for many countries?**

Most of the water on Earth is salt water, which humans cannot drink unless the salt is removed. Some fresh water is locked in glaciers and polar ice caps, or is present in the atmosphere. The Earth's water supplies are threatened by pollution and exhaustion. The effort to supply fresh drinking water to the planet's ever-expanding human population is seen as a major challenge in this century.

**38. Discuss how the human disruption of the carbon cycle has caused ocean acidification.**

Human activity has greatly increased the amount of carbon dioxide gas in the Earth's atmosphere. The oceanic and atmospheric levels of carbon dioxide are linked so that when atmospheric carbon dioxide levels increase, the amount of dissolved carbon dioxide in the ocean also increases (partial pressure of oxygen). When carbon dioxide dissolves in water it produces the weak acid bicarbonate. Since the Industrial Revolution the pH of the ocean has dropped 0.1 pH units, a 30% increase in acidity.