



Name _____ Period _____

Chapter 55: Ecosystems

Overview:

1. What is an *ecosystem*?
Is the sum of all organisms living in a given area and the abiotic factors with which they interact.
2. Where does energy enter most ecosystems? How is it converted to chemical energy and then passed through the ecosystem? How is it lost? Remember this: *energy cannot be recycled.*
Energy enters most ecosystems as sunlight.
3. Besides the energy flow that you described in question 2, chemicals such as carbon and nitrogen *cycle* through ecosystems. So energy flows through an ecosystem and matter cycles within and through them.

Concept 55.1 Physical laws govern energy flow and chemical cycling in ecosystems

4. Both energy and matter can be neither created nor destroyed.
5. We can measure the efficiency of energy conversion in an ecosystem, as well as whether a given nutrient is being gained or lost from an ecosystem. Let us take a second look at *trophic levels*. What trophic level supports all others?
Autotrophs or primary producers.
6. List three groups of organisms that are *photosynthetic autotrophs*.
 1. *Plants.*
 2. *Algae.*
 3. *Photosynthetic prokaryotes.*
7. What are the *primary producers* of the deep-sea vents?
Chemosynthetic prokaryotes.
8. This concept reviews trophic relationships. Know all terms in your textbook that are bolded. What are *trophic levels*? What is always at the first trophic level?
Trophic levels are feeding levels. Autotrophs are always at the first trophic level.

9. What are *detritivores*? What is their importance in chemical cycling? Give some examples of detritivores.

Are decomposers that eat nonliving organic material.

10. State the trophic level of each of the following:

cow primary consumer grass primary producer man secondary consumer mushroom detritivore

Concept 55.2 Energy and other limiting factors control primary production in ecosystems

11. What is *primary production*? Distinguish between *gross primary production* and *net primary production*.

Is the amount of light energy converted into chemical energy.

12. Write an equation here that shows the relationship between gross and net primary production.

$$NPP = GPP - R_a$$

13. You may recall from Chapter 54 that *biomass* is the total mass of all individuals in a trophic level. Another way of defining net primary production is as the amount of *new* biomass added in a given period of time. Why is net primary production, or the amount of new biomass/unit of time, the key measurement to ecologists?

To ecologists, net primary production is the key measurement because it represents the storage of chemical energy that will be available to consumers in the ecosystem.

14. Which ecosystem would tend to have a greater biomass/unit area, a prairie or a tropical rain forest? Explain.

The tropical rain forest will have the greater biomass/unit area. The rate of photosynthesis will be higher due to more light and available water.

15. Describe a technique for measuring net primary production in an aquatic environment. (We will use this technique for AP Lab 12, *Dissolved Oxygen and Aquatic Primary Productivity*.)

Primary productivity in an aquatic environment is often measured using dissolved oxygen tests.

16. What are some factors that limit primary productivity in aquatic ecosystems?

Light limitation and nutrient limitation are factors that limit primary productivity in aquatic ecosystems.

17. What is a *limiting nutrient*? What is the limiting nutrient off the shore of Long Island, New York? In the Sargasso Sea?

A limiting nutrient is an element that must be added for production to increase.

18. Phytoplankton growth can be increased by additional nitrates and phosphates. What are common sources of each of these?

Sewage and fertilizer runoff from farms and lawns are a common source of additional nutrients.

19. What is *eutrophication*? What are factors that contribute to eutrophication?

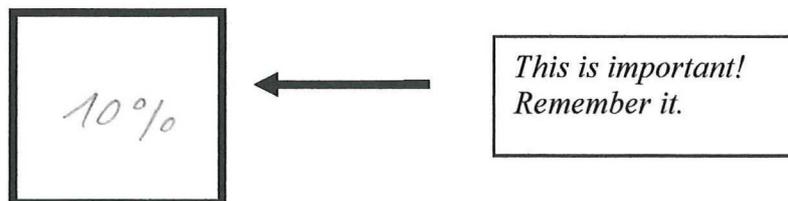
Is where a body of water receives excess nutrients that enhance algal and bacterial growth.

Concept 55.3 Energy transfer between trophic levels is typically only 10% efficient

20. What is *trophic efficiency*?

Is the percentage of production transferred from one trophic level to the next.

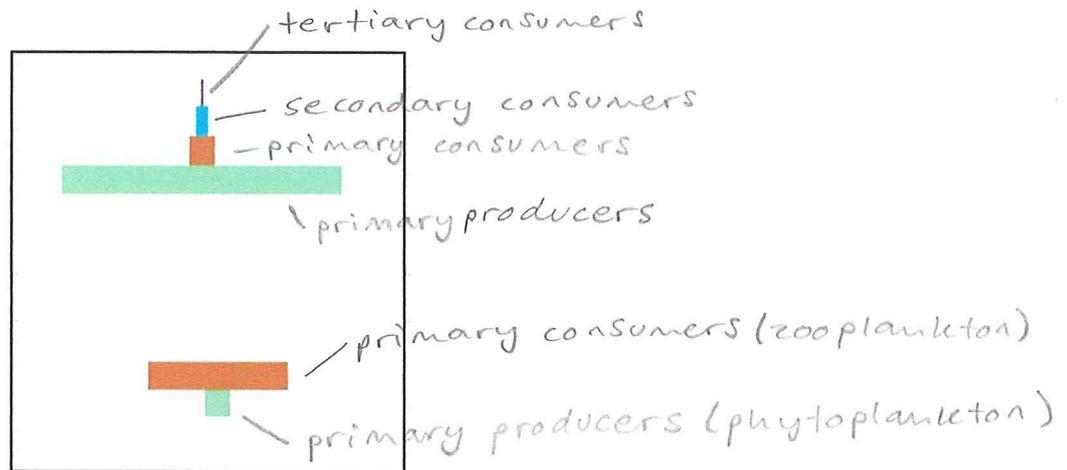
21. Generally, what percentage of energy available at one trophic level is available at the next?



22. Consider a food chain with 1,000 *joules* (an energy unit) available at the producer level. If this food chain is grass → grasshopper → lizard → crow, how much energy is found at the level of the crow? (See answer at the end of this Reading Guide.) Show your work here.

Grass (1000 J) → grasshopper (100 J) → lizard (10 J) → crow (1 J)

23. Notice that most biomass pyramids have greatest biomass on the bottom of the pyramid. Label the trophic levels on the figure. Explain why the second pyramid of biomass is inverted.



24. Why do people who have limited diets in overpopulated parts of the world eat low on the food chain?

If people eat the plant material rather than meat, there will be 10 times more energy available.

Concept 55.4 Biological and geochemical processes cycle nutrients between organic and inorganic parts of an ecosystem

Pay particular attention to the nutrient cycles in Figure 55.14. Note the key processes in each cycle.

25. Use the figure below to describe the water cycle. Specify the roles of *evaporation*, *transpiration*, and *rainfall*.

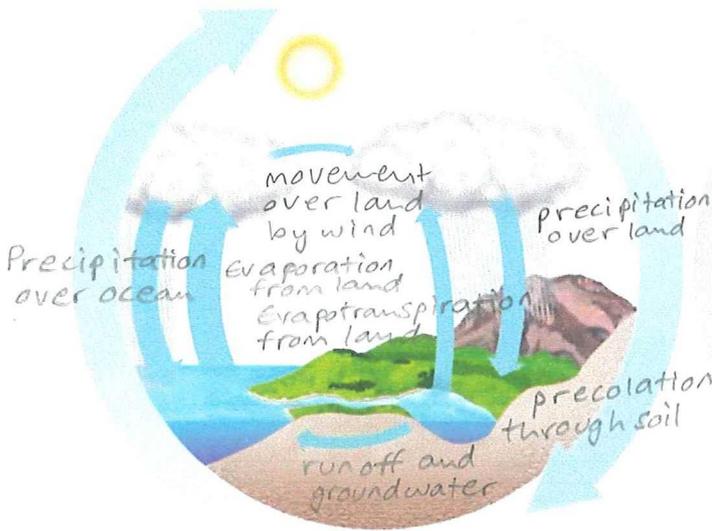
The main processes driving the water cycle are evaporation of liquid water by solar energy, condensation of water vapor into clouds and precipitation.

26. Use the second figure on the following page to describe the carbon cycle. In doing so, explain how carbon enters the living system and how it leaves, indicate the role of microorganisms in the cycle, and identify the reservoir for carbon.

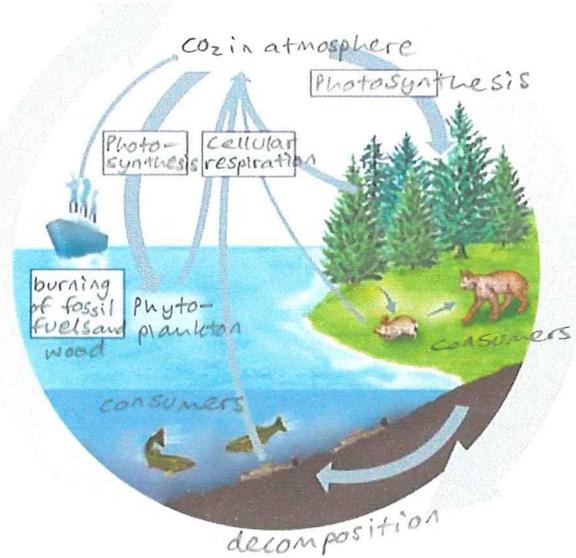
Photosynthesis by plants and phytoplankton removes substantial amounts of atmospheric CO_2 each year.

Write the equation for photosynthesis here: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Write the equation for cellular respiration here: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$

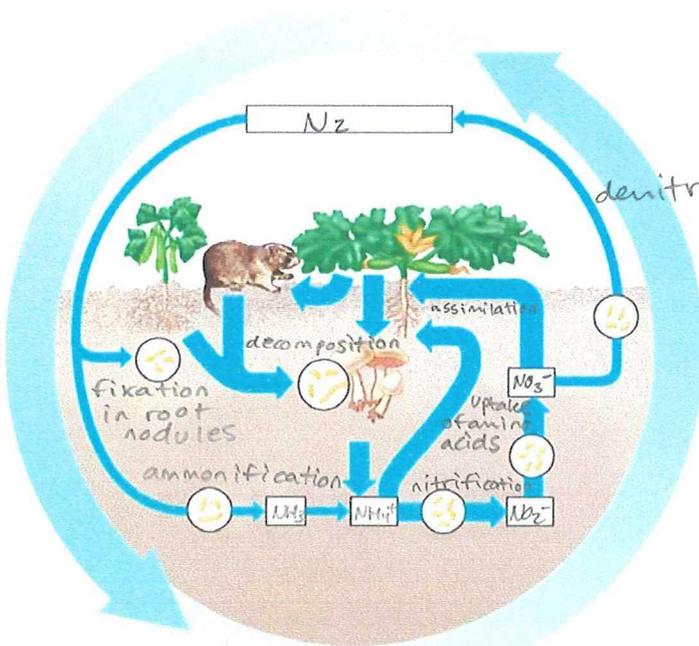


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27. Use the diagram below to describe the nitrogen cycle. In doing so, indicate the role of microorganisms in *nitrogen fixation*, *nitrification*, and *denitrification*.



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The major pathway for nitrogen to enter an ecosystem is via nitrogen fixation, the conversion of N₂ to forms that can be used to synthesize organic nitrogen compounds.

28. Review the *Case Study: Nutrient Cycling in the Hubbard Brook Experimental Forest*. What effect has deforestation been shown to have on chemical cycling?

Experimental deforestation of a watershed dramatically increased the flow of water and minerals leaving the watershed.

Concept 55.5 Human activities now dominate most chemical cycles on Earth

This section looks at human impact on ecosystems.

29. How has agriculture affected nitrogen cycling? What are some negative consequences of nutrient enrichment?

Agricultural practices have increased the amount of nitrogenous materials in the soil.

30. In what ways have human activities contributed to acid precipitation? What are some negative consequences of acid precipitation?

Humans release an immense variety of toxic chemicals, including thousands of synthetic compounds previously unknown in nature, with little regard for the ecological consequences.

31. Explain the process of biological magnification. Discuss at least one example.

Accumulated toxins become more concentrated in successive trophic levels of a food web.

32. What is meant by the *greenhouse effect*? What would life on Earth be like without this effect?

Much of the solar radiation that strikes the planet is reflected back into space.

33. What is contributing to the great increase in atmospheric carbon dioxide? What are potential effects of this increase?

Fossil fuel burning could contribute to the warming of the earth.

34. How is atmospheric ozone depleted? What are projected effects of this depletion?

The destruction of atmospheric ozone results primarily from the accumulation of CFCs, chemicals once used

Testing Your Knowledge: Self-Quiz Answers widely in refrigeration and manufacturing.

Now you should be ready to test your knowledge. Place your answers here:

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____

Solution to Question 22: Grass (1,000 J) → grasshopper (100 J) → lizard (10 J) → crow (1 J)