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Chapter 55: Ecosystems

Overview:

1. What is an *ecosystem*?
   The sum of all organisms and abiotic factors they interact with in a given area.
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 through sunlight, is converted by autotrophs, passed to heterotrophs, and lost as heat.
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.

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?
   Primary Producers
6. List three groups of organisms that are *photosynthetic autotrophs*.
   Plants, algae, 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?
   The first trophic level always consists of autotrophs. Trophic levels are the different stages that energy passes through; the organisms that produce and consume it.

9. What are *detritivores*? What is their importance in chemical cycling? Give some examples of detritivores.
Detritivores get their energy from nonliving organic material, like fungi do. They play a critical role in chemical cycling because they recycle elements & make them usable again.

10. State the trophic level of each of the following:
cow ~~secondary~~ consumer (primary) grass producer man consumer mushroom producer decomposer

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*.
Primary production is the amount of light energy converted to chemical energy by autotrophs. GPP is the total amount of this converted energy, NPP is the GPP minus energy used by producers themselves.

12. Write an equation here that shows the relationship between gross and net primary production.
$NPP = GPP - R_a$ * R_a = autotrophic respiration

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?
NPP is the key measurement because it is the measure of chemical energy 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.
A tropical rainforest would have greater biomass because grasses and herbs in a prairie are consumed rapidly and also decompose more quickly than trees.

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*.)
Measuring the flow of CO_2 and/or O_2 entering or leaving the ecosystem.

16. What are some factors that limit primary productivity in aquatic ecosystems?
Light and nutrient availability, such as nitrogen and phosphorus.

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 present for production. In the Sargasso Sea, it's iron, in NY it's nitrogen.

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

Fertilizers and animal wastes

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

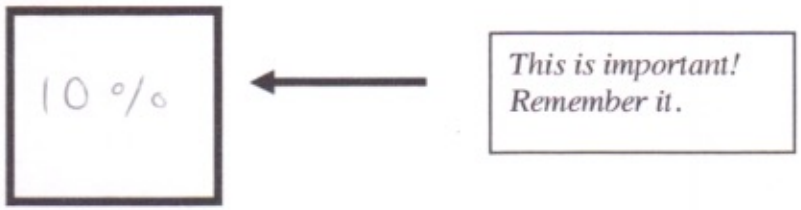
Eutrophication is when nutrients become highly concentrated in water and promote more algae or cyanobacteria ~~pro~~ expansion. This can be detrimental. Sewage & fertilizer runoff cause it.

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

20. What is *trophic efficiency*?

The percentage of production transferred from one level to the next.

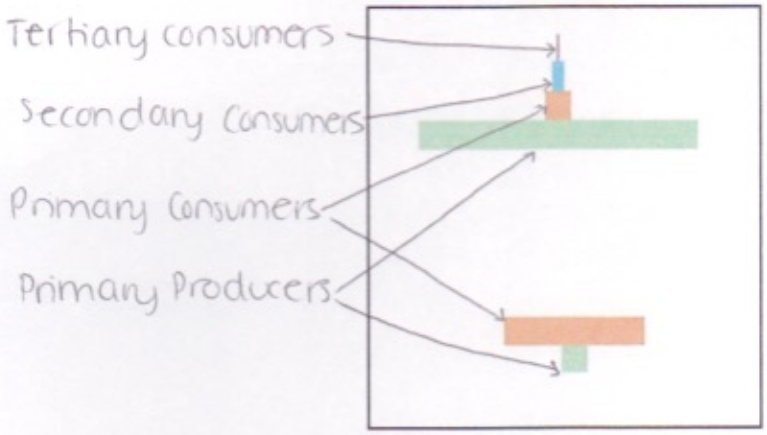
21. Generally, what percentage of energy available at one trophic level is available at the next?



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
~~lizard ⟶ 100 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.



The second pyramid is inverted because the primary producers have a short turnover time and can still support the primary consumers because they replenish so quickly.

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

Because it is the most efficient way to obtain energy. Eat more plants. Go vegan. Join the rev.

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*.

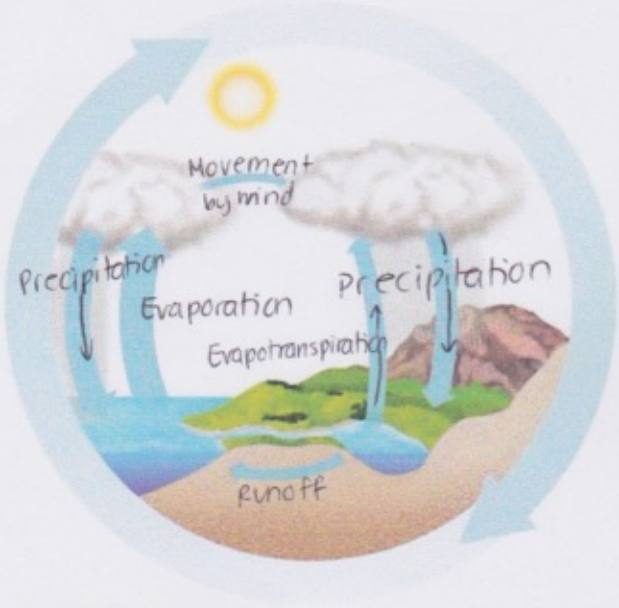
water evaporates from the ocean and also transpires from organisms on land. This condenses into clouds which then allow for rainfall and a repeated cycle.

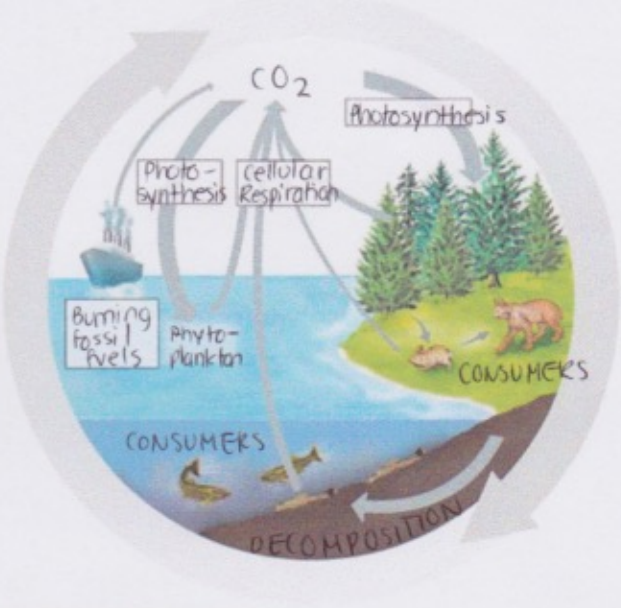
26. Use the second figure on the following page to describe the carbon cycle. In doing so, explain how carbon enters the living system and how it leaves, indicate the role of microorganisms in the cycle, and identify the reservoir for carbon.

Carbon enters the living system through photosynthesis and leaves through cellular respiration.
Reservoirs for carbon include fossil fuels, soil, sediments, oceans, plant and animal biomass, as well as the atmosphere. Plants and phytoplankton remove CO_2 from the atmosphere. Burning fossil fuel and wood adds significant amounts of CO_2.

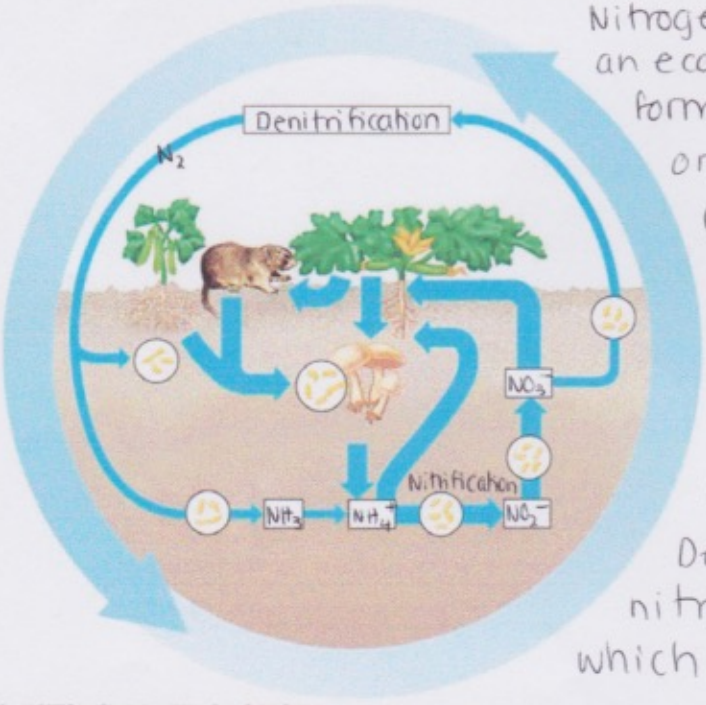
Write the equation for photosynthesis here: $6CO_2 + 6H_2O + light \longrightarrow C_6H_{12}O_6 + 6O_2$

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





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



Nitrogen fixation allows nitrogen to enter an ecosystem when N_2 is converted to forms that can be used to make organic nitrogen compounds. Certain bacteria and lightning do this naturally, however fertilizer and legume crops fix nitrogen as well. Bacteria does it in root nodules and in soil, also converting it to different forms. Denitrification occurs when nitrate is reduced to nitrogen gases, which is released into the atmosphere.

28. Review the *Case Study: Nutrient Cycling in the Hubbard Brook Experimental Forest*. What effect has deforestation been shown to have on chemical cycling?
Deforestation increases outflow of chemicals from the system.

Concept 55.5 Human activities now dominate most chemical cycles on Earth

This section looks at human impact on ecosystems.
↳ ehh not really

* this section actually only focuses on bioremediation and biological augmentation...

29. How has agriculture affected nitrogen cycling? What are some negative consequences of nutrient enrichment?
Agriculture has probably affected nitrogen cycling negatively. Nutrient enrichment can lead to imbalances and runoff/waste from farms becomes concentrated and also toxic.

30. In what ways have human activities contributed to acid precipitation? What are some negative consequences of acid precipitation?
Burning fossil fuels contributes to acid precipitation, which can damage life in lakes, streams, and soil chemistry

31. Explain the process of biological magnification. Discuss at least one example.
I am not sure what biological magnification is. Maybe I should look it up. * toxins accumulate, becoming more concentrated in successive trophic levels

32. What is meant by the *greenhouse effect*? What would life on Earth be like without this effect?
The greenhouse effect allows warmth to be trapped within the atmosphere. Without it, there would be no life.

33. What is contributing to the great increase in atmospheric carbon dioxide? What are potential effects of this increase?
Burning fossil fuels, but more importantly agriculture, are contributing to an increase in atmospheric carbon dioxide, leading to a global change in average temperatures with many effects.

34. How is atmospheric ozone depleted? What are projected effects of this depletion?
Ozone is also depleted through human activity, such as fossil fuel combustion. Warmer globe, less balanced climate, melting ice.

Testing Your Knowledge: Self-Quiz Answers

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

1. E 2. C 3. O 4. L 5. O 6. G 7. Y

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