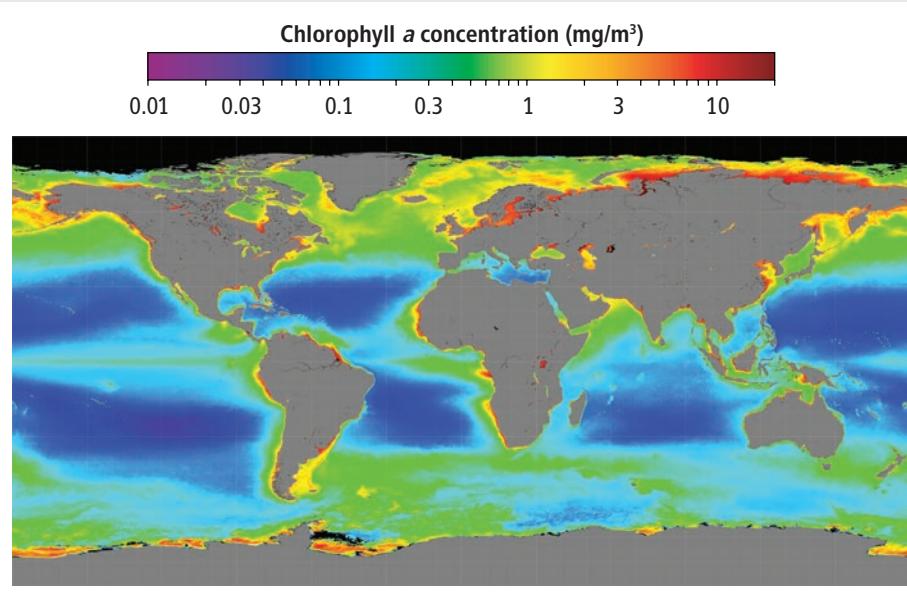


# Lesson Self-Check

## CAN YOU EXPLAIN IT?

**FIGURE 22:** Global Concentration of Chlorophyll *a*



Phytoplankton are tiny photosynthetic organisms that live in marine environments. They serve as the base for the aquatic ecosystem food web and are an integral part in the energy and matter flow in aquatic ecosystems. Through their role in the production of approximately half of Earth's oxygen, phytoplankton are important to terrestrial food webs and pyramids.



**Explain** Refer to your notes in your Evidence Notebook to explain how the flow of energy and matter through an ecosystem is modeled. Using this information, answer the following questions:

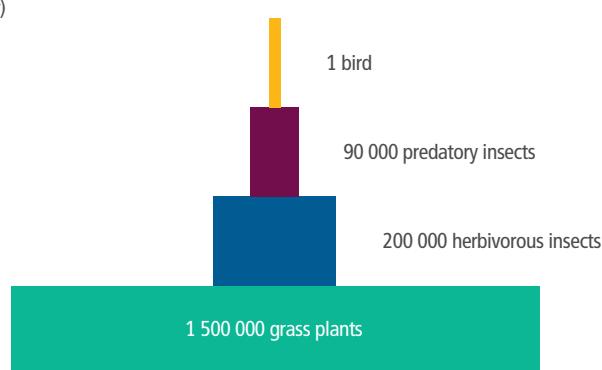
1. Explain the relationship between the phytoplankton population and chlorophyll concentration.
2. How can a decrease in the phytoplankton population affect life on Earth?
3. How might this change affect the flow of energy and matter in the biosphere?

## Pyramid of Numbers

A **pyramid of numbers** shows how many individual organisms are present at each trophic level in an ecosystem. Two examples of a pyramid of numbers are shown in Figure 20. This type of pyramid is effective in showing the vast number of producers required to support even a few top-level consumers. Ecosystems vary in the number and types of organisms in each level. These organisms also vary in their rates of growth and reproduction, as well as in the amount of biomass each species needs to sustain life and growth. A trophic level that contains organisms that reproduce and grow rapidly often has less biomass at any given time than one in which reproduction and growth rates are slow. The size of the organisms also plays a role in the shape of the various pyramids. The larger the individual organism, the fewer that are needed to support the next trophic level.

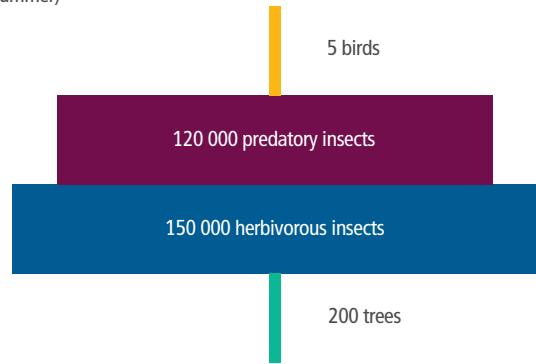
**FIGURE 20:** A pyramid of numbers models how many organisms are at each trophic level.

grassland (summer)



**Analyze** According to the grassland pyramid, how many grass plants would be needed to support 12 birds?

temperate forest (summer)



Think about why a pyramid of numbers or a biomass pyramid might appear in an upside-down or diamond formation. A single tree in a rain forest would be greatly outnumbered by the primary and secondary consumers, such as insects and birds, that live on the tree. The upper layers of the pyramid of numbers would be larger than the bottom layer representing the single tree. If a secondary or tertiary consumer, such as a condor, were added to the top of the pyramid, a diamond shape would result.



**Explain** Compare and contrast the different ways to model energy and matter flow in an ecosystem. If you were a scientist studying an ecosystem, explain how you would use each type of pyramid and what information you could gain from each one.

## CHECKPOINTS

## Check Your Understanding

1. In a prairie ecosystem, which of the following populations has the most stored energy for use by other organisms?
  - a. hawks
  - b. buffalo
  - c. prairie dogs
  - d. prairie grasses
  
2. Which food chain correctly shows the direction that energy and matter flow through a forest ecosystem?
  - a. fruit—insect—sparrow—hawk
  - b. hawk—fruit—insect—sparrow
  - c. insect—sparrow—hawk—fruit
  - d. insect—hawk—fruit—sparrow
  
3. Which of the following terms are in the correct order, from smallest to largest?
  - a. population, organism, community, ecosystem, biome, Earth, biosphere
  - b. organism, community, population, ecosystem, biome, biosphere, Earth
  - c. organism, population, community, ecosystem, biome, biosphere, Earth
  - d. ecosystem, organism, population, community, biome, biosphere, Earth
  
4. Consider a pyramid model with a producer level, a primary consumer level, a secondary consumer level, and a tertiary consumer level. Which of the following statements are correct?
  - a. The sun is the ultimate source of energy in an ecosystem.
  - b. Matter cycles and is generally conserved within or among ecosystems.
  - c. Energy flows through ecosystems, but only a certain amount of energy is transformed into biomass.
  - d. Energy flows through ecosystems, but some is lost to the environment as heat.
  - e. Matter and energy are completely conserved and transformed into biomass within an ecosystem.

5. What is the relationship between a food chain and trophic levels?
  - a. A food chain demonstrates how the organisms at the highest trophic levels have the most energy.
  - b. Food chains illustrate the flow of energy from one trophic level to the next.
  - c. A food chain models the energy flow within a single trophic level.
  
6. A consumer eats 1500 J of food energy. The consumer uses 15 percent of the food energy for new biomass and the rest for cellular respiration and waste. Use this information to answer the following questions:
  - a. How many joules of food energy were converted into new biomass?
  - b. How many joules of food energy are converted to heat and excreted as waste?
  - c. What percentage of the food energy was converted to heat and excreted as waste?

**FIGURE 23:** Desert

7. Why is a desert in North America, such as Arizona's Sonoran Desert (Figure 23), considered to be the same biome as a desert in Africa?
  
8. What biotic and abiotic factors influence the flow of matter and energy in different biomes?
  
9. Do you think it is possible for a biome to change from one type to another due to human activities? Explain a situation in which this might happen.

## MAKE YOUR OWN STUDY GUIDE

- 10.** A student thinks that populations higher in a food chain are larger because they deplete the populations of organisms lower in the chain. Using evidence from this lesson, explain why this student's thinking is incorrect.

**FIGURE 24:** Rabbits are herbivorous and hawks are carnivorous.



**a** Primary Consumer



**b** Tertiary Consumer

- 11.** Think about the trophic efficiency, or percentage of transferred energy between trophic levels, in an ecosystem. Why is an herbivorous diet more energy efficient than a carnivorous diet? Use the example of the rabbit and the hawk shown in Figure 24 to help explain your answer.
- 12.** An aquatic ecosystem contains 10,000 freshwater shrimp, 1000 sunfish, 100 perch, 10 northern pike, and 1 osprey. Draw a pyramid of numbers that represents this ecosystem.
- 13.** Describe how energy and matter flow, interact, and change forms throughout the Earth system.
- 14.** In your Evidence Notebook, make a model that explains the relationship between river, estuary, and ocean ecosystems. How do matter and energy flow within and among these ecosystems?



In your Evidence Notebook, design a study guide that supports the main ideas from this lesson:

**Life in an ecosystem requires a source of energy. The flow of energy and matter in an ecosystem can be demonstrated by food chains, food webs, and pyramid models.**

Remember to include the following information in your study guide:

- Use examples that model main ideas.
- Record explanations for the phenomena you investigated.
- Use evidence to support your explanations. Your support can include drawings, data, graphs, laboratory conclusions, and other evidence recorded throughout the lesson.

Consider how food chains, food webs, and pyramid models show the flow of energy and matter through trophic levels in an ecosystem.