

## Checking Concepts

1. Decomposers break down waste and dead organisms and make the usable nutrients available for the rest of the ecosystem.
2. Plants change solar energy into chemical energy in the form of carbohydrates. A primary consumer, such as a deer, eats the grass, and some of the energy is stored in its body. A secondary consumer, such as a wolf, eats the deer to obtain energy. Ninety percent of the energy is lost between the grass and the deer, and 90 percent of the energy is lost between the deer and the wolf.
3. Most of the energy from the Sun that is trapped by plants is lost as heat to the environment.
4. The two major life processes that involve both carbon and oxygen are photosynthesis and cellular respiration.
5. The process of cellular respiration can be represented by the following equation:  
$$C_6H_{12}O_6 \text{ (carbohydrates)} + 6O_2 \rightarrow 6CO_2 + 6H_2O$$
6. (a) The nutrient cycle shown in the illustration is the carbon cycle.  
(b) A: cellular respiration; B: photosynthesis; C: decomposition; D: sea surface gas exchange
7. Nitrogen is fixed by bacteria and by lightning.
8. (a) The product formed as a result of nitrification is nitrate.  
(b) The product formed as a result of denitrification is nitrogen gas.
9. Weathering releases phosphate from rock through chemical processes and mechanical processes.
10. (a) The photograph shows land being cleared for agriculture.  
(b) This activity affects the phosphorus cycle as phosphates are released from the trees in the form of ash, which accumulates in the soil. The phosphate then leaches from the ash and runs off into the water supply to settle on the bottom of lakes and is now unavailable for organisms.
11. An example in which carbon moves from the abiotic to the biotic part of an ecosystem is photosynthesis.
12. Shelled marine organisms contribute to the carbon cycle when their shells form into sedimentary rock, which traps carbon in stores.
13. (a) Carbon enters long-term stores in the form of carbonate in shells, which eventually forms sedimentary rock, and in the form of hydrocarbon compounds forming fossil fuels.  
(b) Carbon leaves long-term stores as carbon dioxide when fossil fuels are burned.
14. (a) The phosphorus cycle differs from the carbon cycle because no phosphorus is stored in the atmosphere.  
(b) The phosphorus cycle differs from the nitrogen cycle since phosphorus is not in the atmosphere.
15. (a) Green plants would contain the greatest biomass since a large amount is needed for energy as there is a 90 percent energy loss to the consumers.  
(b) The organisms in this food web that would contain the least biomass would be the top carnivore, the hawk, as there has been a loss of energy moving up the energy pyramid.
16. Bacteria enable plants to take up nitrogen as they convert ammonia into nitrates which the plants can take up in their roots.
17. (a) The two largest stores of carbon are sedimentary rock and fossil fuels.  
(b) These carbon stores have become substantial as dead marine and land organisms have accumulated over time.
18. Heavy metals are harmful to the environment because they are toxic at low concentrations.
19. PCBs harm orcas because the chemical bioaccumulates in blubber and is released when the organism uses the fat for energy.
20. Effects of persistent organic pollutants on organisms are that they cause nervous system, immune system, and reproductive disorders.

## Understanding Key Ideas

21. The flow of energy through an ecosystem differs from the cycle of nutrients in an ecosystem because energy flows out of the ecosystem as heat but nutrients are retained and recycled within the ecosystem.
22. (a) The species most likely to consist of herbivores is species A because they are at the second trophic level and they have obtained energy from the largest biomass source plants.  
(b) The species most likely to consist of carnivores is species B because they are secondary consumers and require many organisms to support their energy requirements as there is a 90 percent loss of energy between trophic levels.
23. You would not gain 450 g if you were to eat a 450 g meal as the energy in the meal is used to fuel cellular respiration for body growth and repair. Most of the energy in the 450 g is lost as heat.
24. An increase in agricultural activity might affect a local fishery as chemical fertilizers might leach into the watershed. Animal waste may also leach chemicals into the watershed. Eutrophication may occur, which may kill fish.
25. (a) Volcanic activity is involved in the carbon cycle as carbon dioxide can be released from an active volcano.  
(b) Volcanic activity is involved in the nitrogen cycle as ash containing ammonia can be released from an active volcano.
26. The role of decomposers in the carbon cycle is to convert organic molecules, such as cellulose, back into carbon dioxide.
27. Farmers often add nitrogen and phosphorus to their crops but not carbon since carbon is obtained from the atmosphere in the form of carbon dioxide while nitrogen and phosphorus enter through plant roots.
28. Organisms are most affected by biomagnification at higher trophic levels as the chemicals bioaccumulate in the tissues of producers and lower consumers.
29. (a) If the secondary consumers in a food chain use 4200 kcal of energy, the amount of energy used by the producers in that food chain was 42 000 kcal.  
(b) The amount of energy available to the tertiary consumers would be 420 kcal.
30. Zooplankton and phytoplankton in a water ecosystem can contain low levels of a chemical while adult fish living in the same ecosystem contain high levels because the chemicals bioaccumulate and biomagnify up the food chain.

## Applying Your Understanding

31. (a) The evidence that cadmium bioaccumulates in humans is that it is found in the lungs and kidneys.  
(b) Individuals exposed to second-hand smoke are at risk since the small particles released into the air from a smouldering cigarette are very high in cadmium.  
(c) If a person smoked 15 cigarettes per day and 50 percent of the cadmium in each cigarette was absorbed, the cadmium intake would be between 7 to 15 micrograms per day.  
(d) Since cadmium has a half-life of 30 years, the person will never be rid of the cadmium.