

programmed would be most likely to be passed on, and natural selection would refine innate behaviors for foraging, migrating, mating, and care of offspring. The evolution of cognitive ability would help individuals deal with novel situations. Social behaviors and communication increase an individual's fitness. Parental investment and certainty of paternity may result in differences in mating systems and parental care that influence an individual's reproductive success. Altruistic behavior may be explained on the basis of kin selection; the

inclusive fitness of an animal increases if its altruistic behavior benefits related animals who share many genes.

ANSWERS TO TEST YOUR KNOWLEDGE

Multiple Choice:

- | | | | |
|------|-------|-------|-------|
| 1. d | 6. c | 11. a | 16. d |
| 2. b | 7. b | 12. c | 17. e |
| 3. a | 8. a | 13. e | 18. a |
| 4. b | 9. d | 14. d | |
| 5. c | 10. e | 15. c | |

CHAPTER 52: AN INTRODUCTION TO ECOLOGY AND THE BIOSPHERE

INTERACTIVE QUESTIONS

- 52.1 a. organismal: physiological, behavioral, and morphological adaptations of organisms to the environment
 b. population: growth and regulation of population size
 c. community: interactions that affect community structure
 d. ecosystem: energy flow and chemical cycling between biotic and abiotic components
 e. landscape: exchanges among ecosystems of a landscape or seascape
 f. global: relationship of the distribution of organisms and regional energy and material exchanges
- 52.2 a. dispersal: an area may be beyond the dispersal ability of a species
 b. behavior and habitat selection: insect larvae may be able to feed on more plants, but females oviposit on a single type of plant
 c. biotic factors: the presence of predators, parasites, mutualists, or competitors may restrict a species' range
 d. abiotic factors: sunlight, water, temperature, salinity, and soil characteristics may determine whether a species can inhabit an area
- 52.3 a. South-facing slopes in the northern hemisphere receive more sunlight and are warmer and drier than north-facing slopes.
 b. Air temperature drops with an increase in elevation, and high-altitude communities may be similar to communities in higher latitudes.
 c. The windward side of a mountain range receives much more rainfall than the leeward side. The warm, moist air rising over the mountain releases moisture, and the drier, cooler air absorbs moisture as it descends the other side.

- 52.4 a. + - -
 b. - + +
 c. + - -
 d. - + -
 e. - + +
 f. + + +

- 52.5 7 abyssal 2 neritic
6 aphotic 3 oceanic
8 benthic 5 pelagic
1 intertidal 4 photic

- 52.6 a. desert
 b. temperate grassland
 c. tropical forest
 d. temperate broadleaf forest
 e. northern coniferous forest
 f. arctic and alpine tundra

SUGGESTED ANSWERS TO STRUCTURE YOUR KNOWLEDGE

- a. Ecology is the study of the distribution and abundance of organisms and their relationship to the abiotic and biotic environments.
 b. The interactions of organisms with their environment can result in changes in the gene pool of a population, or evolution. Interactions occurring within an ecological time frame translate into adaptations that are evident on the scale of evolutionary time.
- a. Biomes are characteristic communities, usually identified by the predominant vegetation and climate, that range over broad geographic areas.
 b. Convergent evolution, common adaptations of different organisms to similar environments, accounts for similarities in life forms within geographically separated biomes.

ANSWERS TO TEST YOUR KNOWLEDGE

Multiple Choice:

- | | | | |
|------|------|-------|-------|
| 1. b | 5. a | 9. c | 13. e |
| 2. d | 6. b | 10. b | 14. d |
| 3. d | 7. e | 11. d | |
| 4. e | 8. c | 12. e | |

Matching:

- | | | | |
|------|------|------|------|
| 1. C | 3. D | 5. A | 7. B |
| 2. H | 4. E | 6. G | 8. F |

CHAPTER 53: POPULATION ECOLOGY

INTERACTIVE QUESTIONS

53.1 If 10 of the 30 voles in the second trapping were marked, she would estimate that 1/3 of the vole population is marked. Since 25 voles were initially marked, the total population size is estimated at 75 (25/0.333). Another method is to use the formula: $N = (\text{number marked} \times \text{total second catch}) / \text{number marked recaptures}$.

53.2 a. Type I is typical of populations that produce relatively few offspring and provide parental care, such as humans and many large mammals.

b. Type II has a constant death rate over the organism's life span, such as Belding's ground squirrels and some other rodents, some annual plants, various invertebrates, and some lizards.

c. Type III is typical of populations that produce many offspring, most of which die off rapidly, such as many fishes and marine invertebrates, and long-lived plants.

53.3 a. Selection would most likely favor iteroparity, with fewer, larger, better-provisioned or cared-for offspring.

b. An organism has limited resources to divide between growth, survival, and reproduction.

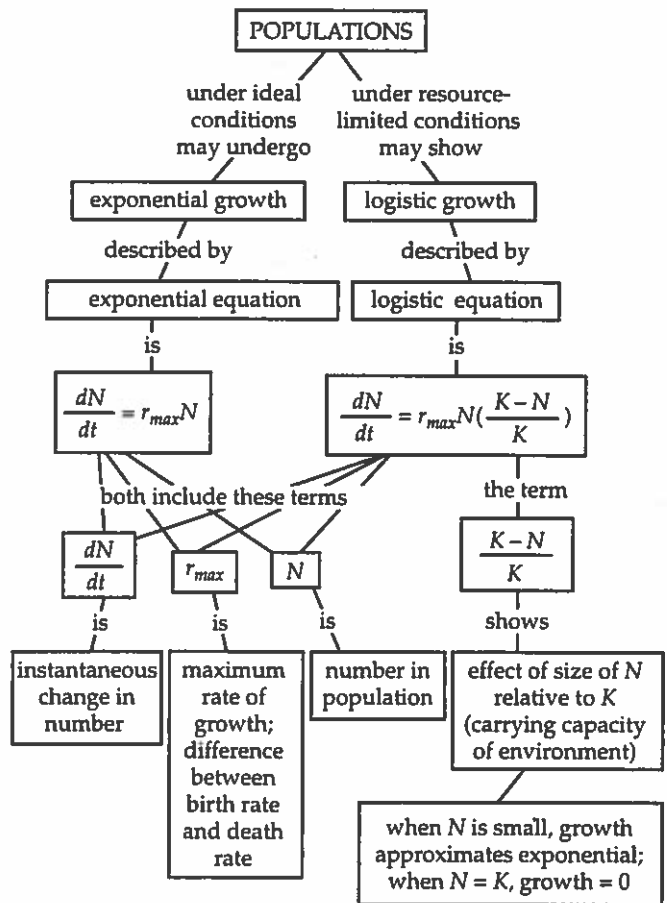
53.4 a. exponential growth; $dN/dt = r_{max}N$
 b. logistic growth; $dN/dt = r_{max}N(K - N)/K$; K is 1,500

53.5 a. r -selected;
 b. K -selected

53.6 a. nutrients, space for nests, accumulation of toxic wastes, predation, intrinsic limiting factors
 b. extremes in weather, natural disasters, fires, sunspot activity (which then influences plants)

SUGGESTED ANSWERS TO STRUCTURE YOUR KNOWLEDGE

1.



2. Reproductive success is measured in the number of offspring that survive and live to reproduce. Many "choices" are available in life history traits: big-bang versus repeated reproduction,

age at first reproduction, number of reproductive episodes, number of offspring, parental investment in size of offspring or care. There are always trade-offs between reproduction and survival due to limited energy budgets. Considering that diverse environments (with both biotic and abiotic factors) and different population densities (*K*- or *r*-selection) create different selection pressures on a population, there is no one "best" reproductive strategy.

ANSWERS TO TEST YOUR KNOWLEDGE

Multiple Choice:

- | | | | |
|------|-------|-------|-------|
| 1. a | 6. a | 11. e | 16. e |
| 2. c | 7. c | 12. e | 17. d |
| 3. d | 8. d | 13. b | 18. c |
| 4. b | 9. c | 14. a | |
| 5. e | 10. d | 15. a | |

CHAPTER 54: COMMUNITY ECOLOGY

INTERACTIVE QUESTIONS

- 54.1 The realized niche of species I is smaller than its fundamental niche when it is in competition with species II. In these trees, species II's fundamental and realized niches are the same.
- 54.2 a. Batesian mimicry
b. Müllerian mimicry
- 54.3 a. mutualism: mycorrhizae, flowering plants and pollinators, ants on acacia trees, cellulose-digesting microorganisms in termites and ruminants
b. commensalism: cattle egrets and cattle that flush insects (although cattle may benefit when ectoparasites are eaten or when the birds warn of predators)
c. competition: weeds and garden plants compete for nutrients and water
d. predation: animal predators killing prey
e. herbivory: herbivores eating parts of plants
f. parasitism: endo- and ectoparasites feed in or on host
- 54.4 Pool 2 has more species and thus a greater species richness. Pool 1 has the higher diversity index.
- Pool 1: $H = -[(0.4)(\ln 0.4) + (0.3)(\ln 0.3) + (0.3)(\ln 0.3)] = -(-0.37 + -0.36 + -0.36) = 1.09$
- Pool 2: $H = -(-0.25 + -0.23 + -0.23 + 0.23) = 0.94$
- 54.5 energetic hypothesis
- 54.6 The +/- cascade that would be needed to end with a decrease in algae would require an increase in zooplankton, which would require a decrease in primary predators caused by an increase in top predators. More top predators could be added to the lake or primary predators could be removed.

- 54.7 a. Soil nitrogen levels begin quite low, but rise due to the symbiotic nitrogen-fixing bacteria of alder.
b. The soil pH changes from about 7.0 to 4.0 as the acid spruce leaves decompose.
- 54.8 More interspecific interactions would have had time to develop, and this longer span of evolutionary time would allow for more speciation events to have occurred.
- 54.9 a. immigration—large island
b. immigration—small island
c. extinction—small island
d. extinction—large island
- The small island equilibrium number of species is projected down from the intersection of lines b and c. The large island equilibrium number is higher and is projected down from the intersection of a and d.
- 54.10 They are testing for the presence of the H5N1 strain of avian flu virus in migrating waterfowl to monitor when the disease enters North America.

SUGGESTED ANSWERS TO STRUCTURE YOUR KNOWLEDGE

1. a. competition (-/-)
b. resource partitioning and character displacement
c. slightly different niches
d. keystone predator
e. herbivory
f. mutualism (+/+)
g. food chain or food web
2. a. No two species with the same niche can coexist in a habitat; the more competitive species will cause the local elimination of the other.

- b. Food chains are limited to a few links because of the inefficiency of energy transfer (only about 10%) from one trophic level to the next.
- c. Food chains are more stable with fewer links because the effect of environmental disruptions becomes magnified in higher trophic levels.
- d. Each trophic level controls the next higher level; adding nutrients will increase the biomass of all other trophic levels.
- e. Community organization is controlled from the top by predation, with a cascade of +/- effects down the trophic levels with changes in predator numbers.
- f. Most communities are constantly changing in composition due to the effects of disturbances.

g. The rates of immigration and extinction on "islands" of habitat are affected by the size of the island, the closeness to the "mainland," and the number of species currently on the island. When these rates are equal, an equilibrium of species is reached.

ANSWERS TO TEST YOUR KNOWLEDGE

Multiple Choice:

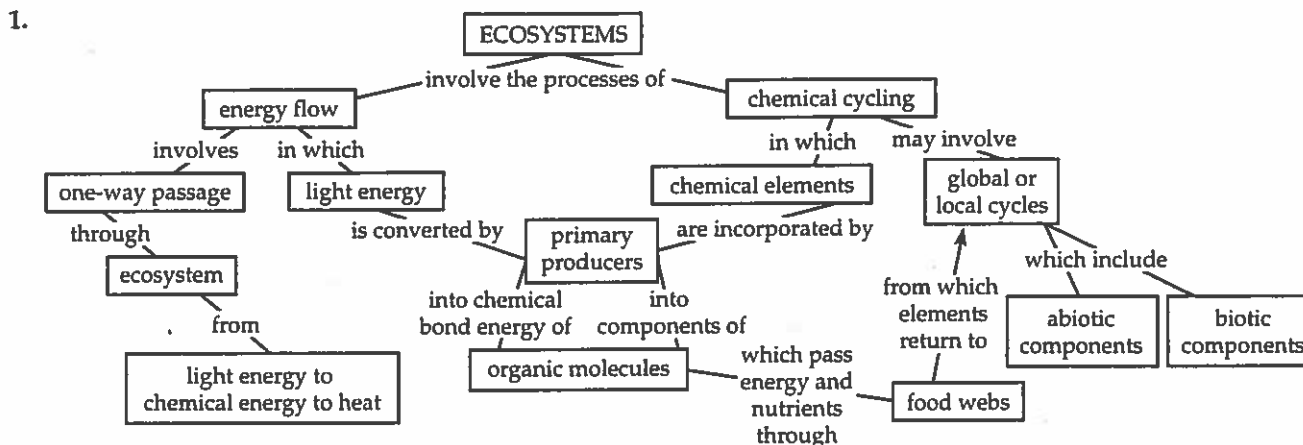
- | | | | | |
|------|------|-------|-------|-------|
| 1. d | 5. b | 9. d | 13. a | 17. e |
| 2. d | 6. b | 10. c | 14. a | 18. c |
| 3. b | 7. e | 11. d | 15. d | |
| 4. c | 8. b | 12. d | 16. b | |

CHAPTER 55: ECOSYSTEMS

INTERACTIVE QUESTIONS

- 55.1 The element may limit production in that ecosystem.
- 55.2 Whereas energy makes a one-way trip through ecosystems, chemical elements move through the trophic levels and are then recycled back to producers.
- 55.3 a. tropical rain forest, coral reef, swamp and marsh, estuary
b. desert, tundra, lake and stream, open ocean
c. The open ocean covers 65% of Earth's surface area.
d. Upwellings in these cold seas bring nitrogen and phosphorus to the surface. The lack of these nutrients limits production in many tropical waters.
- 55.4 a. Much of a bird or a mammal's assimilated energy is used to maintain a warm body temperature and is not available for net secondary production (growth and reproduction).
b. $\frac{1}{1000}$ (10% of 10% of 10%) or 0.1%
- 55.5 a. nitrogen-fixing bacteria in root nodules
b. nitrogen-fixing soil bacteria
c. decomposers
d. ammonium (NH_4^+)
e. nitrifying bacteria
- f. nitrates (NO_3^-)
g. denitrifying bacteria
- 55.6 Water is essential to all organisms and its availability influences primary production and decomposition. Carbon forms the backbone for all organic molecules. Nitrogen is a component of amino acids and nucleic acids. Phosphorus is found in nucleic acids, phospholipids, and ATP.
- 55.7 a. tropical rain forests, because decomposition proceeds rapidly in the warm, wet climate, and nutrients are rapidly assimilated by new growth
b. lakes and oceans; lack of oxygen slows decomposition and, unless there are upwellings, nutrients are not available to producers
c. Nutrients are not recycled and may leave the ecosystem through runoff.
- 55.8 melting of ice caps and flooding of coastlines; change in precipitation patterns such that many currently important agricultural areas may become arid; changes in species composition or increased extinction rate as temperatures rise faster than communities can adjust and species (particularly plants) can migrate

SUGGESTED ANSWERS TO STRUCTURE YOUR KNOWLEDGE



2. a. Deforestation can cause an increase in water runoff with an accompanying loss of soil and minerals. Clear-cutting of tropical forests results in loss of species diversity and a reduction in productivity of the area.
- b. Dumping of wastes and runoff from agricultural lands has resulted in eutrophication of many lakes, killing fish and other organisms.
- c. Toxic chemicals introduced into the environment have been incorporated into the food chain. As a result of biological magnification, these substances pose threats to top-level consumers.
- d. An increase in atmospheric CO₂ from fossil fuel and wood combustion adds to the greenhouse effect. The resulting increase in temperature may have far-reaching effects on climate, sea level, and species composition.
- e. Agriculture interrupts nutrient cycling and requires the addition of synthetic fertilizers,

which upset the nitrogen cycle, can cause eutrophication, and add to the greenhouse effect, ozone depletion, and acid precipitation.

f. Acid precipitation, caused by fossil fuel combustion, is harming forests and lakes.

g. Chlorine-containing pollutants are thinning the ozone layer, allowing more harmful UV radiation to reach Earth.

ANSWERS TO TEST YOUR KNOWLEDGE

Multiple Choice:

- | | | | |
|------|------|-------|-------|
| 1. e | 5. d | 9. d | 13. e |
| 2. c | 6. e | 10. a | 14. d |
| 3. c | 7. b | 11. e | 15. b |
| 4. e | 8. c | 12. c | 16. d |

CHAPTER 56: CONSERVATION BIOLOGY AND RESTORATION ECOLOGY

INTERACTIVE QUESTIONS

56.1 Many examples are provided in the text.

- a. Coral reefs have been damaged by human activities; 40–50% of the reefs could be lost in the next few decades. About a third of all marine fish species utilize these reefs.
- b. The introduction of the brown tree snake to Guam resulted in the extinction of multiple species of birds and lizards.
- c. Commercial harvest or illegal hunting have reduced populations of whales, the African elephant, and numerous fishes.

56.2 Smaller, because usually not all individuals in a population successfully breed. Thus, the MVP should refer to the number of reproductively active individuals in a population.

56.3 The loss of genetic variation within a small population due to inbreeding and genetic drift can force it into an extinction vortex in which the population grows smaller and smaller. Promoting migration between small populations or introducing individuals from other populations to increase genetic variation is proposed as an urgent conservation need.

- 56.4 This proactive approach relies on early detection of population decline, identification of the species' habitat needs, testing to determine which factor is contributing to the decline, recommending corrective measures, and monitoring results.
- 56.5 Corridors promote dispersal between populations and may be essential to species that migrate between different habitats. However, they may also contribute to the spread of diseases.
- 56.6 Large preserves are required for large, far-ranging animals that require extensive habitats. They also have proportionally less border area and thus have fewer edge effects. An advantage of smaller preserves that collectively have the same area as a large one is the slower spread of disease within a population.
- 56.7 Prokaryotes that can metabolize uranium are being used to treat contaminated groundwater. Plants that can fix nitrogen are often used in biological augmentation to enrich nutrient-poor soils and facilitate the recolonization of native species.
2. Biodiversity is a natural resource from which we obtain medicines, crops, fibers, and other products; many potentially valuable species will become extinct before they are known to scientists. A loss of biodiversity may disrupt ecosystem processes in harmful ways. Humans have evolved within the context of living communities and may be affected in unknown ways by changes in our ecosystem.
3. Fragmentation of habitats produces more interfaces or *edges* between different ecosystems (between forests and cleared areas, between deserts and housing developments). The species that inhabit edges are able to use both types of ecosystems. As edges proliferate, edge-adapted species may become more dominant than the species in the adjoining habitats. Strips of quality habitat that connect fragmented habitat patches may serve as *movement corridors* that promote dispersal between isolated populations and help maintain genetic variation.

SUGGESTED ANSWERS TO STRUCTURE YOUR KNOWLEDGE

1. habitat destruction, introduced species, and overexploitation of wild species

ANSWERS TO TEST YOUR KNOWLEDGE

Multiple Choice:

- | | | | |
|------|------|------|-------|
| 1. e | 4. b | 7. e | 10. d |
| 2. b | 5. d | 8. a | 11. b |
| 3. c | 6. a | 9. c | 12. c |