

Appendix

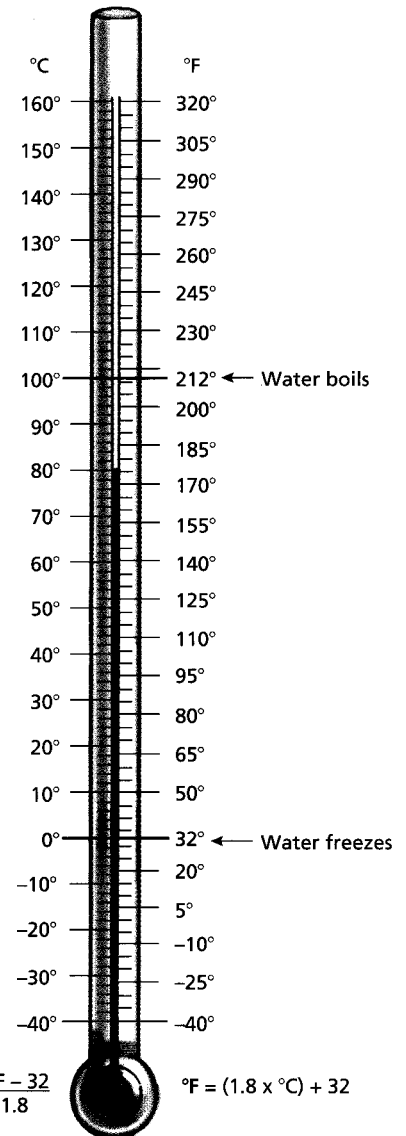
Metric System Conversions

To Convert Metric Units:	Multiply by:	To Get English Equivalent:
Length		
Centimeters (cm)	0.3937	Inches (in)
Meters (m)	3.2808	Feet (ft)
Meters (m)	1.0936	Yards (yd)
Kilometers (km)	0.6214	Miles (mi)
Area		
Square centimeters (cm ²)	0.155	Square inches (in ²)
Square meters (m ²)	10.7639	Square feet (ft ²)
Square meters (m ²)	1.1960	Square yards (yd ²)
Square kilometers (km ²)	0.3831	Square miles (mi ²)
Hectare (ha) (10,000 m ²)	2.4710	Acres (a)
Volume		
Cubic centimeters (cm ³)	0.06	Cubic inches (in ³)
Cubic meters (m ³)	35.30	Cubic feet (ft ³)
Cubic meters (m ³)	1.3079	Cubic yards (yd ³)
Cubic kilometers (km ³)	0.24	Cubic miles (mi ³)
Liters (L)	1.0567	Quarts (qt), U.S.
Liters (L)	0.26	Gallons (gal), U.S.
Mass		
Grams (g)	0.03527	Ounces (oz)
Kilograms (kg)	2.2046	Pounds (lb)
Metric ton (tonne) (t)	1.10	Ton (tn), U.S.
Speed		
Meters/second (mps)	2.24	Miles/hour (mph)
Kilometers/hour (kmph)	0.62	Miles/hour (mph)

To Convert English Units:	Multiply by:	To Get Metric Equivalent:
Length		
Inches (in)	2.54	Centimeters (cm)
Feet (ft)	0.3048	Meters (m)
Yards (yd)	0.9144	Meters (m)
Miles (mi)	1.6094	Kilometers (km)
Area		
Square inches (in ²)	6.45	Square centimeters (cm ²)
Square feet (ft ²)	0.0929	Square meters (m ²)
Square yards (yd ²)	0.8361	Square meters (m ²)
Square miles (mi ²)	2.5900	Square kilometers (km ²)
Acres (a)	0.4047	Hectare (ha) (10,000 m ²)
Volume		
Cubic inches (in ³)	16.39	Cubic centimeters (cm ³)
Cubic feet (ft ³)	0.028	Cubic meters (m ³)
Cubic yards (yd ³)	0.765	Cubic meters (m ³)
Cubic miles (mi ³)	4.17	Cubic kilometers (km ³)
Quarts (qt), U.S.	0.9463	Liters (L)
Gallons (gal), U.S.	3.8	Liters (L)
Mass		
Ounces (oz)	28.3495	Grams (g)
Pounds (lb)	0.4536	Kilograms (kg)
Ton (tn), U.S.	0.91	Metric ton (tonne) (t)
Speed		
Miles/hour (mph)	0.448	Meters/second (mps)
Miles/hour (mph)	1.6094	Kilometers/hour (kmph)

Metric Prefixes

Prefix		Meaning
giga-	G	10 ⁹ = 1,000,000,000
mega-	M	10 ⁶ = 1,000,000
kilo-	k	10 ³ = 1,000
hecto-	h	10 ² = 100
deka-	da	10 ¹ = 10
		10 ⁰ = 1
deci-	d	10 ⁻¹ = 0.1
centi-	c	10 ⁻² = 0.01
milli-	m	10 ⁻³ = 0.001
micro-	μ	10 ⁻⁶ = 0.000001



Answers to Learning the Basics

CHAPTER 1

1. A double blind experiment ensures that participants do not influence the results by reporting what they think is expected based on the hypothesis, and it ensures that data collectors do not err in the measurement of results by emphasizing supportive data and minimizing nonsupportive data.
 2. A statistically significant result is one that shows a difference between the experimental and control groups larger than the difference expected due to chance variations between the groups.
 3. A correlation allows researchers to test hypotheses that are difficult to test via controlled experiments by looking for a relationship between two factors. They have the disadvantage of lacking controls, meaning that not all alternative hypotheses for the relationship can be excluded.
4. b, 5. a, 6. e, 7. b, 8. c, 9. a, 10. c

CHAPTER 2

1. Sugars; amino acids; glycerol and fatty acids.
 2. See Table 2.1
 3. The cell is composed of phospholipids arranged in a bilayer, proteins, and cholesterol
4. b, 5. a, 6. a, 7. d, 8. d, 9. d, 10. d

CHAPTER 3

1. All of the building up and breaking down chemical reactions that occur in a cell. Human metabolism is affected by sex, age, genetics, exercise level, and weight.
 2. Substances that can pass by diffusion include nonpolar molecules and small polar molecules. Carbon dioxide, oxygen, and water can pass. Ions and larger molecules require the help of proteins to pass through membranes.
3. d, 4. c, 5. c, 6. b, 7. d, 8. d, 9. e, 10. b

CHAPTER 4

1. Cellular respiration reactants are glucose and oxygen, products are carbon dioxide and water. Photosynthesis reactants are carbon dioxide and water, products are glucose and oxygen.
2. c, 3. d, 4. c, 5. e, 6. a, 7. c, 8. e, 9. d

CHAPTER 5

1. Proto-oncogenes and tumor suppressor genes.
2. Cell division.
3. d, 4. a, 5. e, 6. d, 7. b, 8. c, 9. d, 10. a diploid; b diploid; c haploid; d haploid

CHAPTER 6

Answers to Learning the Basics:

1. A gene is a segment of DNA containing information about making a protein. A protein is a chemical that either makes up part of the structure of a cell or helps perform an essential function of the cell. A trait is the physical outcome of the activity of proteins.
 2. Quantitative variation can occur when many genes, each with more than one allele, influence a single trait and/or when the environment influences how a trait develops.
 3. We cannot exactly predict the phenotypes of offspring from looking at the phenotypes of their parents, but in many cases we can determine the probability that a particular offspring will have a particular phenotype.
4. a, 5. b, 6. b, 7. b, 8. c, 9. e, 10. d

Answers to Genetics Problems:

1. All have genotype Tt and are tall.
2. 25% have genotype TT and are tall, 50% have genotype Tt and are tall, 25% have genotype tt and are short.
3. Both must be heterozygote (Aa).
4. 50% of their offspring are expected to develop Huntington's disease.
5. (a) 0%; (b) 25%.
6. (a) yellow is dominant; (b) YY (yellow) and yy (green).
7. Yy (yellow) and yy (green).
8. (a) 50%; (b) 50%; (c) 25%; (d) yes.
9. Male parent is $Rrhh$; female parent is $RRHh$. Possible offspring genotypes and phenotypes: $RRHh$ (Red coat, horns), $RRhh$ (Red coat, hornless), $RrHh$ (Roan coat, horns), $Rrhh$ (Roan coat, hornless).
10. (a) $BRCA2$ is dominant; (b) It is unlike the typical pattern because not all individuals with $BRCA2$ have the trait of early breast or ovarian cancer.

CHAPTER 7

1. See Table 7.1
2. DNA is isolated and cut with restriction enzymes. The fragments are loaded on a gel and an electrical current is applied to separate them; DNA fragments are transferred to a filter, and then probed. The probe binds in complementary regions. X-ray film is placed over filter to generate a fingerprint.
3. Females inherit one X chromosome from their mom in the egg cell and one from their dad in the sperm cell. Males inherit an X chromosome from their mom in the egg cell and a Y chromosome from their dad in the sperm cell.
4. $I^A i$ (dad) $I^B i$ (mom)
5. $\frac{1}{4} A+$; $\frac{1}{4} A-$; $\frac{1}{8} AB-$; $\frac{1}{8} AB+$; $\frac{1}{8} B+$; $\frac{1}{8} B-$
6. c, 7. b, 8. b, 9. e, 10. $\frac{1}{4} X^C X^C$ (normal female); $\frac{1}{4} X^C Y$ (normal male); $\frac{1}{4} X^C X^c$ (normal female); $\frac{1}{4} X^c Y$ (colorblind male)

CHAPTER 8

1. GCUAAUGAAU.
2. gln, arg, ile, leu.
3. mRNA, ribosome, amino acids, tRNAs.
4. b, 5. c, 6. b, 7. c, 8. c, 9. b, 10. d

CHAPTER 9

1. The theory of common descent describes that the similarities among living species can be explained as a result of their descent from a common ancestor.
 2. Darwin observed that organisms on different islands in the archipelago were similar, but not identical to each other, and were clearly related to each other and to similar organisms on the South American mainland.
 3. A vestigial structure is one that has little or no function in an organism but appears to be similar to a more useful structure in other organisms. These structures provide support for the theory of common descent because they are best explained as having evolved from a functional structure in a common ancestor.
4. d, 5. d, 6. b, 7. d, 8. e, 9. e, 10. d

CHAPTER 10

1. Fitness is a term that describes the survival and reproductive output of an individual in a population relative to other members of the population.
 2. Artificial selection is a process of selection of plants and animals by humans who control the survival and reproduction of members of a population in order to increase the frequency of human-preferred traits. Artificial selection is like natural selection in that it causes evolution; however, it differs because humans are directly choosing which organisms reproduce. In natural selection, environmental conditions cause one variant to have higher fitness than other variants.
 3. Within a single patient, an HIV population can consist of up to 1 billion different virus variants. These variants differ in a number of traits, including their susceptibility to a particular anti-HIV drug. When the patient takes an anti-HIV drug, the individual viruses that are more resistant to the drug have higher fitness, and natural selection leads to the evolution of a virus population that is resistant to the drug.
4. c, 5. d, 6. e, 7. e, 8. c, 9. d, 10. a

CHAPTER 11

1. The gene pools of populations must become isolated from each other, they must diverge (as a result of natural selection or genetic drift) while they are isolated, and reproductive incompatibility must evolve.
 2. Yes, as long as the gene pools of the populations are isolated. An example is when the timing of reproduction in two populations of a species is different.
 3. Genetic drift can occur as a result of founder's effect, the bottleneck effect, or by the chance loss of alleles from small, isolated gene pools. By changing allele frequencies, all of these events result in the evolution of a population.
4. d, 5. b, 6. a, 7. b, 8. d, 9. c, 10. b

CHAPTER 12

1. Double fertilization, which triggers increased food supply to the embryo; the development of fruit, aiding in dispersal; development of the flower, increasing the probability of fertilization;

the development of defensive compounds, deterring herbivores.

2. Competition between organisms and the risk of predation favors the evolution of defensive chemicals, some of which may be valuable to humans. Organisms that live on or in other living organisms must have some way to evade their host's immune system, another potentially valuable characteristic.
 3. By comparing the DNA sequences of organisms to see if the pattern of similarity and difference matches what is predicted; and by examination of the fossil record, looking for the record of evolutionary change in the group of organisms.
4. b, 5. e, 6. a, 7. d, 8. d, 9. c, 10. b

CHAPTER 13

1. A decrease in death rate, especially a decrease in infant mortality, has led to increasing growth rates. In addition, the process of exponential growth lends itself to these population explosions, as the number of people added in any year is a function of the population of the previous year.
2. In most populations, growth rate declines because death rate increases (or birth rate decreases) as resources are "used up" by the population.
3. Demographic momentum occurs because a population continues to grow in number even if birth rates drop, as large numbers of individuals who have not yet reached reproductive maturity add offspring to the population in subsequent years.

4. b, 5. c, 6. b, 7. b, 8. d, 9. d, 10. e

CHAPTER 14

1. By examining the fossil record and determining the average life span of various species. The most serious problem with these estimates is that the fossil record over-represents long-lived species and thus overestimates the life span of these species.
2. Habitat fragmentation endangers species because it interferes with their ability to disperse from unsuitable to suitable habitat and because it increases their exposure to humans and human-modified environments. Species that have very specialized habitat

requirements, those that cannot move rapidly, and those that are very susceptible to human disturbance are most negatively affected by fragmentation.

3. Mutualism is a relationship among species where all partners benefit. Predation is a relationship among species where one benefits and others are consumed. Competition is a relationship among species where all partners are harmed by the presence of the others.

4. d, 5. c, 6. d, 7. b, 8. a, 9. d, 10. a

CHAPTER 15

1. The tilt of Earth's axis means that as the planet revolves around the sun, the northern hemisphere is tilted toward the sun during part of the year and away during part of the year. The temperature at a given point on Earth's surface is determined in large part by the solar irradiance (i.e. the strength of sunlight) striking the surface. Because the northern hemisphere is tilted away in the winter, solar irradiance is low, as are temperatures. The opposite occurs in the summer.
2. Water is slow to gain and lose heat, so when surrounding land areas cool as a result of declining solar irradiance, warmer air from over the water keeps the temperature high. The opposite is true as the surrounding land warms as a result of increasing solar irradiance.
3. All forests require significant precipitation to support the growth of trees. The major difference between the types is in average temperature. Tropical forests are in climate regions that rarely or never reach freezing. The forests are dominated by broad-leaf evergreens. Temperate forests experience hot/cold seasonality, and are dominated by broad-leafed deciduous trees, which drop their leaves during the freezing (and thus, dry) winters. Boreal forests form where winters are very long and growing seasons short. The evergreen coniferous trees there are able to quickly take advantage of warm weather for photosynthesis, although they can survive long periods of freezing without needing to drop their leaves.

4. c, 5. e, 6. e, 7. e, 8. c, 9. a, 10. d

Glossary

ABO blood system A system for categorizing human blood based on the presence or absence of carbohydrates on the surface of red blood cells. (Chapter 7)

acid A substance that increases the concentration of hydrogen ions in a solution. (Chapter 2)

Acquired Immune Deficiency Syndrome (AIDS) Syndrome characterized by severely reduced immune system function and numerous opportunistic infections. Results from infection with HIV. (Chapter 10)

activation energy The amount of energy that reactants in a chemical reaction must absorb before the reaction can start. (Chapter 3)

activator A protein that enhances the transcription of a gene. (Chapter 8)

active site Substrate-binding region of an enzyme. (Chapter 3)

active transport The ATP-requiring movement of substances across a membrane against their concentration gradient. (Chapter 3)

adaptation Trait that is favored by natural selection and increases an individual's fitness in a particular environment. (Chapters 9, 10)

adaptive radiation Diversification of one or a few species into large and very diverse groups of descendant species. (Chapter 12)

adenine Nitrogenous base in DNA, a purine. (Chapters 2, 4, 5, 8)

adenosine diphosphate (ADP) A molecule composed of adenine, a sugar, and two phosphate groups. Produced by the hydrolysis of the terminal phosphate bond of ATP. (Chapter 4)

adenosine triphosphate (ATP) A molecule composed of adenine, a sugar, and three phosphate groups that can be hydrolyzed to release energy. Form of energy that cells can use. (Chapters 3, 4)

aerobic An organism, environment, or cellular process that requires oxygen. (Chapter 4)

aerobic respiration Cellular respiration that uses oxygen as the electron acceptor. (Chapter 4)

agarose gel A jelly-like slab used to separate molecules on the basis of molecular weight. (Chapter 7)

agribusiness Farming as a large-scale business operation, including the production, processing, and distribution of food as well as manufacture and distribution of agricultural equipment and chemicals. (Chapter 8)

algae Photosynthetic protists. (Chapter 12)

allele frequency The percentage of the gene copies in a population that are of a particular form, or allele. (Chapter 11)

alleles Alternate versions of the same gene, produced by mutations. (Chapters 5, 6, 7)

allopatric Geographic separation of a population of organisms from others of the same species. Usually in reference to speciation. (Chapter 11)

alternative hypotheses Factors other than the tested hypothesis that may explain observations. (Chapter 1)

amenorrhea Cessation of menstruation. (Chapter 3)

amino acid Monomer subunit of a protein. Contains an amino, a carboxyl, and a unique side group. (Chapters 2, 3, 8)

anaerobic An organism, environment, or cellular process that does not require oxygen. (Chapter 4)

anaerobic respiration A process of energy generation that uses molecules other than oxygen as an electron acceptor. (Chapter 4)

anaphase Stage of mitosis during which microtubules contract and separate sister chromatids. (Chapter 5)

anchorage dependence Phenomenon that holds normal cells in place. Cancer cells can lose anchorage dependence and migrate into other tissues or metastasize. (Chapter 5)

anecdotal evidence Information based on one person's personal experience. (Chapter 1)

angiogenesis Formation of new blood vessels. (Chapter 5)

angiosperms Plants in the phyla Angiospermae, which produce seeds borne within fruit. (Chapter 12)

Animalia Kingdom of Eukarya containing organisms that ingest others and are typically motile for at least part of their life cycle. (Chapter 12)

annual growth rate Proportional change in population size over a single year. Growth rate is a function of the birth rate minus the death rate of the population. (Chapter 13)

annuals Plants that complete their life cycle in a single growing season. (Chapter 15)

anorexia Self-starvation. (Chapter 3)

antibiotics Chemicals that kill or disable bacteria. (Chapter 12)

antibody Protein made by the immune system in response to the presence of foreign substances or antigens. Can serve as a receptor on a B cell or be secreted by plasma cells. (Chapters 5, 10)

anticodon Region of tRNA that binds to a mRNA codon. (Chapter 8)

antigen Short for antibody-generating substances, an antigen is a molecule that is foreign to the host and stimulates the immune system to react. (Chapter 10)

antioxidants Substances present in some foods that are thought to protect the body from the damaging effects of oxygen-free radicals. (Chapter 3)

antiparallel Feature of DNA double helix in which nucleotides face "up" on one side of the helix and "down" on the other. (Chapters 2, 5)

antisense nucleotide sequence Nucleotide sequence that, when transcribed, produces a mRNA complementary to the normally transcribed mRNA of another gene. Binding of antisense and sense mRNA decreases gene expression. (Chapter 8)

applied research Research that has an immediate and potentially profitable application. (Chapter 8)

aquaporins A transport protein in the membrane of a plant or animal cell that facilitates the diffusion of water across the membrane (osmosis). (Chapter 3)

aquatic Of, or relating to, water. (Chapter 15)

Archaea Domain of prokaryotic organisms made up of species known from extreme environments. (Chapters 2, 12)

arrector pili Muscles at the base of hairs that raise them above the level of the skin. In humans, stimulation of these muscles results in "goose bumps." (Chapter 9)

artificial insemination The practice of collecting semen from a male and manually injecting it into a female's reproductive tract. (Chapter 6)

artificial selection Selective breeding of domesticated animals and plants to increase the frequency of desirable traits. (Chapters 6, 10)

asexual reproduction A type of reproduction in which one parent gives rise to genetically identical offspring. (Chapters 5, 11)

assortative mating Tendency for individuals to mate with someone who is like themselves. (Chapter 11)

asymptomatic Stage in an infection that is characterized by relatively unnoticeable, or absent symptoms of illness. (Chapter 10)

atom The smallest unit of matter that retains the properties of an element. (Chapter 2)

atomic number The number of protons in the nucleus of an atom. Unique to each element, this number is designated by a subscript to the left of the symbol for the element. (Chapter 2)

ATP synthase Enzyme found in the mitochondrial membrane that helps synthesize ATP. (Chapter 4)

autosomes Non-sex chromosomes, of which there are 22 pairs in humans. (Chapters 5, 6, 7)

AZT Drug that inhibits replication of HIV's genetic material while having relatively little effect on the normal replication and function of a patient's cells. (Chapter 10)

- B lymphocytes (B cells)** White blood cells that develop in bone marrow and recognize and react to small, free-living microorganisms such as bacteria and the toxins they produce. B lymphocytes provide an immune response called humoral immunity. (Chapter 10)
- background extinction rate** The rate of extinction resulting from the normal process of species turnover. (Chapter 14)
- Bacteria** Domain of prokaryotic organisms. (Chapters 2, 4, 8, 12, 14)
- Barr body** Inactivated X chromosome visible in female mammalian cells as a dark body in the nucleus. (Chapter 7)
- basal metabolic rate** Resting energy use of an awake, alert person. (Chapter 3)
- base** A substance that reduces the concentration of hydrogen ions in a solution. (Chapter 2)
- base-pairing rules** In DNA, A pairs with T, and C pairs with G. (Chapters 2, 5)
- basic research** Research for which there is not necessarily a commercial application. (Chapter 8)
- behavioral isolation** Prevention of mating between individuals in two different populations based on differences in behavior. (Chapter 11)
- benign** Tumor that stays in one place and does not affect surrounding tissues. (Chapter 5)
- bias** Influence of research participants' opinions on experimental results. (Chapter 1)
- binomial** Name composed of two parts. (Chapter 9)
- biodiversity** Variety within and among living organisms. (Chapters 12, 14)
- biogeography** The study of the geographic distribution of organisms. (Chapter 9)
- biological classification** Field of science attempting to organize biodiversity into discrete, logical categories. (Chapters 9, 12)
- biological diversity** Entire variety of living organisms. (Chapter 12)
- biological evolution** See evolution. (Chapter 9)
- biological population** Individuals of the same species that live and breed in the same geographic area. (Chapters 9, 11)
- biological race** Populations of a single species that have diverged from each other. Biologists do not agree on a definition of "race." See also subspecies. (Chapter 11)
- biological species concept** Definition of a species as a group of individuals that can interbreed and produce fertile offspring but typically cannot breed with members of another species. (Chapter 11)
- biomass** The mass of all individuals of a species, or of all individuals on a level of a food web, within an ecosystem. (Chapter 14)
- biome** A broad ecological community defined by a particular vegetation type (e.g., temperate, forest, prairie), which is typically determined by climate factors. (Chapter 15)
- biophilia** Humans' innate desire to be surrounded by natural landscapes and objects. (Chapter 14)
- biopiracy** Using the knowledge of the native people in developing countries to discover compounds for use in developed countries. (Chapter 12)
- bioprospecting** Hunting for new organisms and new uses of old organisms. (Chapter 12)
- biopsy** Surgical removal of some cells, tissue, or fluid to determine if cells are cancerous. (Chapter 5)
- bipedal** Walking upright on two limbs. (Chapter 9)
- birth rate** Number of births averaged over the population as a whole. (Chapter 13)
- blind experiments** Tests in which subjects are not aware of exactly what they are predicted to experience. (Chapter 1)
- blood pressure** The force of the blood as it travels through the arteries; partially determined by artery diameter and elasticity. (Chapter 3)
- body mass index (BMI)** Calculation using height and weight to determine a number that correlates to an estimate of a person's amount of body fat with health risks. (Chapter 3)
- boreal forests** A biome type found in regions with long, cold winters and short, cool summers. Characterized by coniferous trees. (Chapter 15)
- botanist** Plant biologist. (Chapter 12)
- bulimia** Binge eating followed by purging. (Chapter 3)
- C₃ plants** Plants that use the Calvin cycle of photosynthesis to incorporate carbon dioxide into a 3-carbon compound. (Chapter 4)
- C₄ plants** Plants that perform reactions incorporating carbon dioxide into a 4-carbon compound that ultimately provides carbon dioxide for the Calvin cycle. (Chapter 4)
- calcium** Nutrient required in plant cells for the production of cell walls and for bone strength and blood clotting in humans. (Chapter 3)
- Calorie** A kilocalorie or 1000 calories. (Chapter 3)
- calorie** Amount of energy required to raise the temperature of one gram of water by 1°C. (Chapter 3)
- Calvin cycle** A series of reactions that occur in the stroma of plants during photosynthesis that utilize NADPH and ATP to reduce carbon dioxide and produce sugars. (Chapter 4)
- CAM plants** Plants that use crassulacean acid metabolism, a variant of photosynthesis during which carbon dioxide is stored in sugars at night (when stomata are open) and released during the day (when stomata are closed) to prevent water loss. (Chapter 4)
- Cambrian explosion** Relatively rapid evolution of the modern forms of multicellular life that occurred approximately 550 million years ago. (Chapter 12)
- cancer** A disease that occurs when cell division escapes regulatory controls. (Chapter 5)
- capillaries** The smallest blood vessels of the circulatory system, connecting arteries to veins and allowing material exchange across their thin walls. (Chapter 5)
- carbohydrate** Energy-rich molecule that is the major source of energy for the cell. (Chapters 2, 3, 4)
- carbon dioxide** Abundant molecule in the atmosphere (CO₂). (Chapters 3, 4)
- carcinogens** Substances that damage DNA or chromosomes. (Chapter 5)
- carrier** Individual who is heterozygous for a recessive disease allele. (Chapters 6, 7)
- carrying capacity** Maximum population that the environment can support. (Chapter 13)
- catalyst** A substance that lowers the activation energy of a chemical reaction, thereby speeding up the reaction. (Chapter 3)
- CD4⁺ cell** Class of immune-system cells that are susceptible to HIV infection. Most are T4 lymphocytes; they are named for the CD4 receptor on the cell surface. (Chapter 10)
- cell** Basic unit of life, an organism's fundamental building-block units. (Chapters 2, 3, 9)
- cell cycle** An ordered sequence of events in the life cycle of a eukaryotic cell from its origin until its division to produce daughter cells. Consists of M, G₁, S, and G₂ phases. (Chapter 5)
- cell division** Process a cell undergoes when it makes copies of itself. Production of daughter cells from an original parent cell. (Chapters 5, 6)
- cell plate** A double layer of new cell membrane that appears in the middle of a dividing plant cell and divides the cytoplasm of the dividing cell. (Chapter 5)
- cell wall** Tough but elastic structure surrounding plant and bacterial cell membranes. (Chapters 2, 4, 5)
- cellular respiration** Process requiring oxygen by which cells use food to make ATP. (Chapter 4)
- cellulose** A structural polysaccharide found in cell walls and composed of glucose molecules. (Chapters 2, 4, 5)
- centriole** A structure in animal cells that helps anchor for microtubules during cell division. (Chapters 2, 5)
- centromere** Region of a chromosome where sister chromatids are attached and to which microtubules bind. (Chapter 5)
- chaparral** A biome characteristic of climates with hot, dry summers and mild, wet winters and a dominant vegetation of aromatic shrubs. (Chapter 15)
- checkpoint** Stoppage during cell division that occurs to verify that division is proceeding correctly. (Chapter 5)

- chemotherapy** Using chemicals to try to kill rapidly dividing (cancerous) cells. (Chapter 5)
- chlorophyll** Green pigment found in the chloroplast of plant cells. (Chapter 4)
- chloroplast** An organelle found in plant cells that absorbs sunlight and uses the energy derived to produce sugars. (Chapters 2, 4, 12)
- cholesterol** A steroid found in animal cell membranes that affects membrane fluidity. Serves as the precursor to estrogen and testosterone. (Chapters 2, 3)
- chromosomes** Housed inside the nucleus, subcellular structures composed of a long single molecule of DNA and associated proteins. (Chapters 5, 6, 7, 8, 11)
- circulatory system** The blood vessels which transport blood, nutrients, and waste around the body. (Chapter 5)
- cladistic analysis** A technique for determining the evolutionary relationships among organisms that relies on identification and comparison of newly evolved traits. (Chapter 12)
- classification systems** Methods for organizing biological diversity. (Chapters 9, 12)
- cleavage** Rapid cell division that occurs during animal development. (Chapter 5)
- climate** The average temperature and precipitation as well as seasonality. (Chapter 15)
- climax community** The group of species that is stable over time in a particular set of environmental conditions. (Chapter 15)
- clinical trial** Controlled scientific experiment to determine the effectiveness of novel treatments. (Chapter 5)
- cloning** Making copies of a gene or an organism that are genetically identical. (Chapter 8)
- clumped distribution** A spatial arrangement of individuals in a population where large numbers are concentrated in patches with intervening, sparsely populated areas separating them. (Chapter 13)
- codominant** Alleles that result in a new protein with a different, but not dominant, activity compared to the normal protein. (Chapters 6, 7)
- codons** Three-nucleotide sequences of mRNA that tRNA binds with to add an amino acid to the growing protein. The genetic code is read from the mRNA codon. (Chapter 8)
- coenzyme (or cofactor)** Substances such as vitamins that help enzymes catalyze chemical reactions. (Chapter 3)
- cohesion** The tendency for molecules of the same material to stick together. (Chapter 2)
- combination drug therapy** Treatment with at least three different anti-HIV drugs, from two different classes of drugs. The therapy of choice for HIV patients. (Chapter 10)
- common descent** The theory that all living organisms on Earth descended from a single common ancestor that appeared in the distant past. (Chapter 9)
- community** A group of interacting species in the same geographic area. (Chapter 14)
- competition** Interaction that occurs when two species of organisms both require the same resources within a habitat; competition tends to limit the size of populations. (Chapter 14)
- competitive exclusion** Process of establishing harmless organisms in an ecosystem that serves to reduce levels of harmful organisms. (Chapter 14)
- competitors** Species that survive on the same food source or otherwise compete for the same resources. (Chapter 12)
- complementary base pair** Nitrogenous bases that hydrogen bond to each other. In DNA, adenine is complementary to thymine, and cytosine is complementary to guanine. In RNA, adenine is complementary to uracil and guanine to cytosine. (Chapters 2, 5, 7, 8)
- complete proteins** Dietary proteins that contain all the essential amino acids. (Chapter 3)
- complex carbohydrates** Highly branched polysaccharides. (Chapter 3)
- compound** A substance consisting of two or more elements in a fixed ratio. (Chapter 2)
- coniferous** Pertaining to trees and shrubs that produce cones for reproduction. (Chapter 15)
- consilience** The unity of knowledge. Used to describe a scientific theory that has multiple lines of evidence to support it. (Chapter 9)
- contact inhibition** Property of cells that prevents them from invading surrounding tissues. Cancer cells may lose this property. (Chapter 5)
- continuous variation** A range of slightly different values for a trait in a population. (Chapter 6)
- control** Subject for an experiment who is similar to experimental subject except is not exposed to the experimental treatment. Used as baseline values for comparison. (Chapter 1)
- convergent evolution** Evolution of same trait or set of traits in different populations as a result of shared environmental conditions rather than shared ancestry. (Chapters 9, 11)
- coral reef** Highly diverse biome found in warm, shallow salt water, dominated by the limestone structures created by coral animals. (Chapters 12, 15)
- correlation** Describes a relationship between two factors. (Chapters 1, 6, 11)
- covalent bond** A type of strong chemical bond in which two atoms share electrons. (Chapter 2)
- critical habitat** Defined by the Endangered Species Act as a habitat designated as crucial to the survival of an endangered species. (Chapter 14)
- cross** Mating of two organisms. (Chapter 6)
- crossing over** Exchange of genetic information between members of a homologous pair of chromosomes. (Chapters 5, 6)
- cultural carrying capacity** Maximum human population of Earth that provides not only adequate food for all but an adequate quality of life as well. (Chapter 13)
- cyst** Noncancerous, fluid-filled growth. (Chapter 5)
- cytokinesis** Part of the cell cycle during which two daughter cells are formed by the cytoplasm splitting. (Chapter 5)
- cytoplasm** The entire contents of the cell (except the nucleus) surrounded by the plasma membrane. (Chapters 2, 8)
- cytosine** Nitrogenous base, a pyrimidine. (Chapters 2, 4, 5, 8)
- cytoskeleton** A network of tubules and fibers that branch throughout the cytoplasm. (Chapter 2)
- cytosol** The semifluid portion of the cytoplasm. (Chapters 2, 4)
- data** Information collected by scientists during hypothesis testing. (Chapter 1)
- daughter cells** Offspring cells that are produced by the process of cell division. (Chapter 5)
- death rate** Number of deaths averaged over the population as a whole. (Chapter 13)
- deciduous** Pertaining to woody plants that drop their leaves at the end of a growing season. (Chapter 15)
- decomposers** Organisms, typically bacteria and fungi in the soil, whose action breaks down complex molecules into simpler ones. (Chapter 14)
- decomposition** The breakdown of organic material into smaller molecules. (Chapter 15)
- deductive reasoning** Making a prediction about the outcome of a test; "if . . . then" statements. (Chapter 1)
- deforestation** The removal of forest lands, often to enable the development of agriculture. (Chapters 4, 14)
- degenerative disease** Disease characterized by progressive deterioration. (Chapter 8)
- dehydration** A decrease in an organism's required water level. (Chapter 3)
- deleterious** Causing a negative outcome, especially pertaining to particular alleles. (Chapter 14)
- demographic momentum** Lag between the time that humans reduce birth rates and the time that population numbers respond. (Chapter 13)
- demographic transition** The period of time between when death rates in a human population fall (as a result of improved technology) and when birth rates fall (as a result of voluntary limitation of pregnancy). (Chapter 13)
- denaturation** In proteins, the process where proteins unravel and change their native shape, thus losing their biological activity. For DNA, the breaking of hydrogen bonds between the two strands of the double-stranded DNA helix, resulting in single-stranded DNA (Chapters 4, 7)

density-dependent factors Factors related to a population's size that influence the current growth rate of a population—for example, communicable disease or starvation. (Chapter 13)

density-independent factors Factors unrelated to a population's size that influence the current growth rate of a population—for example, natural disasters or poor weather conditions. (Chapter 13)

deoxyribonucleic acid (DNA) Molecule of heredity that stores the information required for making all of the proteins required by the cell. (Chapters 2, 5, 6, 7, 8, 10, 12)

deoxyribose The five-carbon sugar in DNA. (Chapters 2, 5, 6, 8)

desert The biome found in areas of minimal rainfall. Characterized by sparse vegetation. (Chapter 15)

developed countries Countries that have completed the process of industrial development and have a high per capita income level. (Chapter 13)

developing world Countries beginning the process of industrial development. (Chapter 13)

development All of the progressive changes that produce an organism's body. (Chapter 12)

diabetes Disorder of carbohydrate metabolism characterized by impaired ability to produce or respond to the hormone insulin. (Chapter 3)

diastolic blood pressure The lowest blood pressure in the arteries, occurring during diastole of the cardiac cycle. (Chapter 3)

diffusion The spontaneous movement of substances from a region of their own high concentration to a region of their own low concentration. (Chapter 3)

dihybrid cross A genetic cross involving two different genes. For example, $AABB \times aabb$. (Chapter 6)

diploid cell A cell containing homologous pairs of chromosomes ($2n$). (Chapters 5, 6)

directional selection Natural selection for individuals at one end of a range of phenotypes. (Chapter 10)

disaccharide A double sugar consisting of two monosaccharides joined together by a glycosidic linkage. (Chapter 2)

diverge (or, divergence) In evolution, divergence occurs when gene flow is eliminated between two populations. Over time, traits found in one population begin to differ from traits found in the other population. (Chapters 9, 11, 12)

diversifying selection Natural selection for individuals at both ends of a range of phenotypes but against the "average" phenotype. (Chapter 10)

dizygotic twins Fraternal twins (non-identical) that develop from separate zygotes. (Chapter 6)

DNA See deoxyribonucleic acid. (Chapters 2, 5, 6, 7, 8, 10, 12)

DNA fingerprinting Powerful identification technique that takes advantage of differences in

DNA sequence by utilizing electrophoresis and single-stranded probes. (Chapter 7)

DNA polymerase Enzyme that facilitates base pairing during DNA synthesis. (Chapter 5)

DNA replication The synthesis of two daughter DNA molecules from one original parent molecule. Takes place during the S phase of interphase. (Chapters 5, 7)

DNA sequence The linear order of nucleotides in a DNA molecule. (Chapters 7, 8, 9, 12)

domain Most inclusive biological category. Life is grouped by many biologists into three major domains. (Chapters 9, 12)

dominant Applies to an allele with an effect that is visible in a heterozygote. (Chapter 6)

double blind Experimental design protocol when both research subjects and scientists performing the measurements are unaware of either the experimental hypothesis or who is in the control or experimental group. (Chapter 1)

drug resistance In pathogens, it occurs when the pathogen is no longer susceptible to the effects of a drug; thus, infections are no longer controlled by drug treatment. (Chapter 10)

ecological footprint A measure of the natural resources used by a human population or society. (Chapter 15)

ecology Field of biology that focuses on the interactions between organisms and their environment. (Chapters 12, 13)

ecosystem All of the organisms and natural features in a given area. (Chapter 14)

ecosystem services Proper functioning of the natural world's ecosystems. (Chapter 14)

ecotourism The visitation of specific geographical sites by tourists interested in natural attractions, especially animals and plants. (Chapter 14)

egg cell Gamete produced by a female organism. (Chapters 5, 6, 7, 11, 12)

electron A negatively charged subatomic particle. (Chapters 2, 4)

electron transport chain A series of proteins in the mitochondrial and chloroplast membranes that move electrons during the redox reactions that release energy to produce ATP. (Chapter 4)

element A substance that cannot be broken down into any other substance. (Chapter 2)

embryo Developing individual. (Chapters 6, 7, 8, 12)

Endangered Species Act (ESA) U.S. law intended to protect and encourage the population growth of threatened and endangered species enacted in 1973. (Chapter 14)

endocytosis The uptake of substances into cells by a pinching inward of the plasma membrane. (Chapter 3)

endoplasmic reticulum (ER) A network of membranes in eukaryotic cells. When rough, or studded with ribosomes, functions as a workbench for protein synthesis. When devoid of ribosomes, or smooth, it functions in phospholipid and steroid synthesis and detoxification. (Chapter 2)

endosymbiotic theory Theory that organelles such as mitochondria and chloroplasts in eukaryotic cells evolved from prokaryotic cells that took up residence inside ancestral eukaryotes. (Chapter 12)

energy shell Different states of energy for electrons in an atom. (Chapter 2)

enzyme Protein that catalyzes and regulates the rate of metabolic reactions. (Chapters 2, 3, 4, 10)

equator The circle around Earth that is equidistant to both poles. (Chapter 15)

essential amino acids The 8 amino acids that humans cannot synthesize and thus must be obtained from the diet. (Chapter 3)

essential fatty acids Fatty acids that animals cannot synthesize and must be obtained from the diet. (Chapter 3)

estuary An aquatic biome that forms at the outlet of a river into a larger body of water such as a lake or ocean. (Chapter 15)

eugenics Science of "improving" the human species through selective breeding. (Chapter 6)

eukaryotes (eukaryotic cells) Cells that have a nucleus and membrane-bounded organelles. (Chapters 2, 8, 12)

eutrophication Process resulting in periods of dangerously low oxygen levels in water, sometimes caused by high levels of nitrogen and phosphorus from fertilizer runoff that result in increased growth of algae in waterways. (Chapter 14)

evolution Changes in the features (traits) of individuals in a biological population that occur over the course of generations. See also theory of evolution. (Chapters 1, 2, 9, 10)

evolutionary classification System of organizing biodiversity according to the evolutionary relationships among living organisms. (Chapter 12)

exocytosis The secretion of molecules from a cell via fusion of membrane-bounded vesicles with the plasma membrane. (Chapter 3)

experiments Contrived situations designed to test specific hypotheses. (Chapter 1)

exponential growth Growth that occurs in proportion to the current total. (Chapter 13)

extinction Complete loss of a species. (Chapter 14)

facilitated diffusion The spontaneous passage of molecules, through membrane proteins, down their concentration gradient. (Chapter 3)

falsifiable Able to be proved false. (Chapter 1)

fat Hydrophobic molecule composed of a 3-carbon glycerol skeleton bonded to three fatty acids. Energy source that contains more calories than an equal weight of carbohydrates or proteins. (Chapters 2, 3, 4)

fatty acid A long acidic chain of hydrocarbons bonded to glycerol. Fatty acids vary on the basis of their length and on the number and placement of double bonds. (Chapters 2, 3)

- fermentation** A process that makes a small amount of ATP from glucose without using an electron transport chain. Ethyl alcohol and lactic acid are produced by this process. (Chapter 4)
- fertilization** The fusion of haploid gametes (egg and sperm) to produce a diploid zygote. (Chapters 5, 6, 7)
- fitness** Relative survival and reproduction of one variant compared to others in the same population. (Chapters 10, 14)
- flowering plants** Division of the kingdom Plantae containing members that produce flowers and fruit. (Chapter 12)
- fluid mosaic model** The accepted model for how membranes are structured with proteins bobbing in a sea of phospholipids. (Chapter 2)
- follicle** Structure in the ovary that contains the developing ovum and secretes estrogen. (Chapter 5)
- food chain** The linear relationship between trophic levels from producers to primary consumers, and so on. (Chapter 14)
- food web** The feeding connections between and among organisms in an environment. (Chapter 14)
- foramen magnum** Hole in the skull that allows for passage of the spinal cord. (Chapter 9)
- forests** Terrestrial communities characterized by the presence of trees. (Chapter 15)
- fossil fuels** Nonrenewable resources consisting of the buried remains of ancient plants that have been transformed by heat and pressure into coal and oil. (Chapters 4, 14)
- fossil record** Physical evidence left by organisms that existed in the past. (Chapter 9)
- fossils** Remains of plants or animals that once existed, left in soil or rock. (Chapters 9, 12, 14)
- founder effect** Type of sampling error that occurs when a small subset of individuals emigrates from the main population to found a new population. Results in differences in the gene pools of source population and the new population. (Chapter 11)
- founder hypothesis** The hypothesis that the diversity of unique forms in isolated habitats results from divergence of different species from a single founding population. (Chapter 11)
- frameshift mutation** A mutation that occurs when the number of nucleotides inserted or deleted from a DNA sequence is not a multiple of three. (Chapter 8)
- free radical** A substance containing an unpaired electron that is therefore unstable and highly reactive, causing damage to cells. (Chapter 3)
- Fungi** Kingdom of eukaryotes made up of members that are immobile, rely on other organisms as their food source, and are made up of hyphae that secrete digestive enzymes into the environment and that absorb the digested materials. (Chapters 9, 12, 14)
- galls** Tumor growths on a plant. (Chapter 8)
- gamete** Specialized sex cells (sperm and egg in humans) that contain half as many chromosomes as other body cells and are therefore haploid. (Chapters 5, 6)
- gamete incompatibility** An isolating mechanism between similar species in which sperm from one species cannot fertilize eggs from another. (Chapter 11)
- gel electrophoresis** The separation of biological molecules on the basis of their size and charge by measuring their rate of movement through an electric field. (Chapter 7)
- gene** Discrete unit of hereditary information consisting of a sequence of DNA that contains information about genetic traits; thus they code for specific proteins. (Chapters 5, 6)
- gene expression** Turning a gene on or off. A gene is expressed when the protein it encodes is synthesized. (Chapter 8)
- gene flow** Spread of an allele throughout a species' gene pool. (Chapter 11)
- gene gun** Device used to shoot DNA-coated pellets into plant cells. (Chapter 8)
- gene pool** All of the alleles found in the individuals of a species. (Chapter 11)
- gene therapy** Replacing defective genes (or their protein products) with functional ones. (Chapter 8)
- genealogical species concept** A scheme that identifies as separate species all populations with a unique lineage. (Chapter 11)
- Generally Recognized As Safe (GRAS)** A modified food that does not need to undergo FDA testing because it contains substances that have already been tested. (Chapter 8)
- genetic code** Table showing which mRNA codons code for which amino acids. (Chapters 8, 9)
- genetic drift** Change in allele frequency that occurs as a result of chance. (Chapters 11, 14)
- genetic engineering** Using technology to change one or more genes in an organism. (Chapter 8)
- genetic variability** All of the forms of genes, and the distribution of these forms, found within a species. (Chapter 14)
- Genetically Modified Organisms (GMOs)** Transgenic organisms or organisms that have been genetically engineered. (Chapter 8)
- genome** Entire suite of genes present in an organism. (Chapter 8)
- genotype** Genetic composition of an individual. (Chapters 6, 7)
- genus** Broader biological category to which several similar species may belong. (Chapters 9, 11)
- germ line gene therapy** Gene therapy that changes genes in a zygote or early embryo, thus the embryo will pass on the engineered genes to their offspring. (Chapter 8)
- germ theory** The scientific theory that all infectious diseases are caused by microorganisms. (Chapter 1)
- global warming** Increases in average temperatures as a result of the release of increased amounts of carbon dioxide and other greenhouse gases into the atmosphere. (Chapters 4, 14)
- glycolysis** The splitting of glucose into pyruvate, which helps drive the synthesis of a small amount of ATP. (Chapter 4)
- Golgi apparatus** An organelle in eukaryotic cells consisting of flattened membranous sacs that modify and sort proteins and other substances. (Chapter 2)
- gonads** The male and female sex organs; testicles in human males or ovaries in human females. (Chapter 5)
- gradualism** The hypothesis that evolutionary change occurs in tiny increments over long periods of time. (Chapter 11)
- grana** Stacks of thylakoids in the chloroplast. (Chapters 2, 4)
- grasslands** Biomes characterized by the dominance of grasses, usually found in regions of lower precipitation. (Chapter 15)
- greenhouse effect** The retention of heat by carbon dioxide and other greenhouse gases. (Chapter 4)
- growth factor** Protein that stimulates cell division. (Chapter 5)
- growth rate** Annual death rate in a population subtracted from the annual birth rate. A species' growth rate is influenced by how long the species takes to reproduce, how often it reproduces, the number of offspring produced each time, and the death rate of individuals under ideal conditions. (Chapter 13)
- guanine** Nitrogenous base in DNA, a purine. (Chapters 2, 4, 5, 6, 8)
- guard cells** Paired cells encircling stomata that serve to regulate the size of the stomatal pore, helping to minimize water loss under dry conditions and maximize carbon dioxide uptake under wet conditions. (Chapter 4)
- habitat** Place where an organism lives. (Chapter 14)
- habitat destruction** Modification and degradation of natural forests, grasslands, wetlands, and waterways by people; primary cause of species loss. (Chapter 14)
- habitat fragmentation** Threat to biodiversity caused by humans that occurs when large areas of intact natural habitat are subdivided by human activities. (Chapter 14)
- half-life** Amount of time required for one-half the amount of a radioactive element that is originally present to decay into the daughter product. (Chapter 9)
- haploid** Cells containing only one member of each homologous pair of chromosomes (n); e.g., sex cells. (Chapter 5)
- Hardy-Weinberg theorem** Theorem that holds that allele frequencies remain stable in populations that are large in size, randomly

mating, and experiencing no migration or natural selection. Used as a baseline to predict how allele frequencies would change if any of its assumptions were violated. (Chapter 11)

heart attack An acute condition, during which blood flow is blocked to a portion of the heart muscle, causing part of the muscle to be damaged or die. (Chapter 3)

heat The total amount of energy associated with the movement of atoms and molecules in a substance. (Chapter 4)

helper T cells Immune-system cells that enhance cell-mediated immunity and humoral immunity by secreting a substance that increases the strength of the immune response. Also, see T4 cell. (Chapter 10)

hemophilia Rare genetic disorder caused by a sex-linked recessive allele that prevents normal blood clotting. (Chapter 7)

heritability The amount of variation for a trait in a population that can be explained by differences in genes among individuals. (Chapter 6)

heterozygote Individual carrying two different alleles for a particular gene. (Chapters 11, 14)

heterozygous Genotype containing two different alleles for a gene. (Chapter 6)

high-density lipoproteins (HDL) A cholesterol carrying particle in the blood that is high in protein and low in cholesterol. (Chapter 3)

HIV See Human Immunodeficiency Virus. (Chapter 10)

homeostasis The steady state or condition that an organism works to maintain. (Chapter 2)

hominins Humans and human ancestors. (Chapters 9, 11)

homologous pairs Sets of two chromosomes of the same size and shape with centromeres in the same position. Homologous pairs of chromosomes carry the same genes in the same locations but may carry different alleles. (Chapters 5, 6)

homology Similarity in characteristics as a result of common ancestry. (Chapter 9)

homozygous Genotype containing identical alleles for a gene. (Chapters 6, 14)

host Organism infected by a pathogen or parasite. (Chapter 10)

Human Genome Project Effort to determine the nucleotide base sequences and chromosomal locations of all human genes. (Chapter 8)

Human Immunodeficiency Virus (HIV) Agent identified as causing the transmission and symptoms of AIDS. (Chapter 10)

hybrid Offspring of two different strains of an agricultural crop (see also interspecies hybrid). (Chapter 11)

hybridization and assimilation

hypothesis Hypothesis about the origin of modern humans stating that *Homo sapiens* evolved in Africa and spread around the world, interbreeding with *H. erectus* populations already present in Asia and Europe. (Chapter 11)

hydrocarbon A molecule consisting of carbons and hydrogens. (Chapters 2, 3)

hydrogen atom One negatively charged electron and one positively charged proton. (Chapters 2, 4)

hydrogen bond A type of weak chemical bond. In DNA, this type of bond forms between nitrogenous bases across the width of the helix. (Chapters 2, 4)

hydrogen ion A single proton with a charge of +1. (Chapter 2)

hydrogenation Adding hydrogen gas under pressure to make liquid oils more solid. (Chapter 3)

hydrophilic Water-loving molecule. (Chapter 2)

hydrophobic Water-hating molecule. (Chapter 2)

hypertension High blood pressure. (Chapter 3)

hyphae Thin filaments that make up the body of a fungus. (Chapter 12)

hypothesis Tentative explanation for an observation that requires testing to validate. (Chapters 1, 9, 11)

IDDM (insulin-dependent diabetes mellitus) Type of diabetes that requires insulin injections, Type I. (Chapter 3)

immortal Property of cancer cells that allows them to divide more times than normal cells, possibly due to the activation of a telomerase gene. (Chapter 5)

immune deficiency Poor immune-system function, usually resulting in increased opportunistic infections. (Chapters 8, 10)

immune response Ability of the immune system to respond to an infection resulting from increased production of B cells and T cells. (Chapters 6, 10)

immune system The organ system that produces cells and cell products, such as antibodies, that help remove pathogenic organisms. (Chapters 8, 10)

In vitro fertilization Fertilization that takes place when sperm and egg are combined in glass or a test tube. (Chapter 8)

inbreeding Mating between related individuals. (Chapter 14)

inbreeding depression Negative effect of homozygosity on the fitness of members of a population. (Chapter 14)

incomplete dominance A type of inheritance where the heterozygote has a phenotype intermediate between both homozygotes. (Chapters 6, 7)

independent assortment See law of independent assortment. (Chapter 6)

induced fit A change in shape of the active site of an enzyme so that it binds tightly to a substrate. (Chapter 3)

inductive reasoning A logical process that argues from specific instances to a general conclusion. (Chapter 1)

infant mortality Death rate of infants and children under the age of 5. (Chapter 13)

insulin A hormone secreted by the pancreas that lowers blood glucose levels by promoting

the uptake of glucose by cells and the storage of glucose as glycogen in the liver. (Chapter 3)

insulin-dependent diabetes mellitus (IDDM). See IDDM. (Chapter 3)

intermembrane space Space between two membranes. (Chapters 2, 4)

interphase Part of the cell cycle when a cell is preparing for division and the DNA is duplicated. Consists of G₁, S and G₂. (Chapter 5)

interspecies hybrid Organism with parents from two different species. (Chapter 11)

intertidal zone The biome that forms on ocean shorelines between the high tide elevation and the low tide elevation. (Chapter 15)

introduced species A nonnative species that was intentionally or unintentionally brought to a new environment by humans. (Chapter 14)

invertebrates Animals without backbones. (Chapter 12)

ionic bond A chemical bond resulting from the attraction of oppositely charged ions. (Chapter 2)

IQ test Tool for measuring intelligence that compares an individual's performance with that of peers. (Chapter 6)

karyotype Picture of chromosomes prepared from blood cells that organizes the chromosomes in homologous pairs. (Chapters 5, 7)

keystone species A species that has an unusually strong effect on the structure of the community it inhabits. (Chapter 14)

kingdom In some classifications, the most inclusive group of organisms; usually five or six. In other classification systems, the level below domain on the hierarchy. (Chapters 9, 12)

Krebs cycle A chemical cycle occurring in the matrix of the mitochondria that breaks the remains of sugars down to produce carbon dioxide. (Chapter 4)

lactase The enzyme that cleaves the disaccharide lactose into glucose and galactose. Missing or deficient in people with lactose intolerance. (Chapter 3)

lactose intolerance Inability to digest lactose resulting in bloating, gas, and diarrhea. (Chapter 3)

lakes An aquatic biome that is completely land locked. (Chapter 15)

laparoscope A thin tubular instrument inserted through an abdominal incision and used to view organs in the pelvic cavity and abdomen. (Chapter 5)

law of independent assortment The pattern, in genetic inheritance, in which each chromosomal member of a homologous pair is inherited independently of the other member of the homologous pair. (Chapter 6)

law of segregation The pattern, in genetic inheritance, in which alleles for the same gene are separated before being passed on to the next generation. (Chapter 6)

leptin A substance produced by fat cells that may be involved in the regulation of appetite. (Chapter 3)

- life cycle** Description of the growth and reproduction of an individual. (Chapter 6)
- light reactions** A series of reactions that occur on thylakoid membranes during photosynthesis and serve to convert energy from the sun into the energy stored in the bonds of ATP and evolve oxygen. (Chapter 4)
- linked genes** Genes located on the same chromosome. (Chapter 5)
- lipids** Hydrophobic molecules including fats, phospholipids, and steroids. (Chapters 2, 3)
- lipid bilayer** The plasma membrane that surrounds cells, following cells composed two layers of lipids. (Chapter 3)
- lipoproteins** Cholesterol-carrying proteins. (Chapter 3)
- logistic growth** Pattern of growth seen in populations that are limited by resources available in the environment. A graph of logistic growth over time typically takes the form of an S-shaped curve. (Chapter 13)
- low-density lipoproteins (LDLs)** Cholesterol-carrying substance in the blood that is high in cholesterol and low in protein. (Chapter 3)
- lymph nodes** Organs located along lymph vessels that filter lymph and help defend against bacteria and viruses. (Chapter 5)
- lymphatic system** A system of vessels and nodes that return fluid and protein to the blood. (Chapter 5)
- lymphocyte** White blood cells that make up part of the immune system. (Chapter 10)
- lysosome** A membrane-bounded sac of hydrolytic enzymes found in the cytoplasm of many cells. (Chapter 2)
- macromolecules** Large molecules including polysaccharides, proteins, and nucleic acids, composed of subunits joined by dehydration synthesis. (Chapters 2, 4)
- macronutrients** Nutrients required in large quantities. (Chapter 3)
- malignant** Tumor that invades surrounding tissues. (Chapter 5)
- marine** Of, or pertaining to, salt water. (Chapter 15)
- mark-recapture method** A technique for estimating population size, consisting of capturing and marking a number of individuals, releasing them, and recapturing more individuals to determine what proportion are marked. (Chapter 13)
- mass extinctions** Losses of species that are rapid, global in scale, and affect a wide variety of organisms. (Chapter 14)
- mass number** The sum of the number of protons and neutrons in an atom's nucleus. (Chapter 2)
- matrix** In a mitochondrion, it is the semi-fluid substance inside the inner mitochondrial membrane, which houses the enzymes of the Krebs cycle. (Chapters 2, 4)
- mean** The average value of a set of numbers. (Chapter 1)
- mechanical isolation** A form of reproductive isolation between species that depends on the incompatibility of the genitalia of individuals of different species. (Chapter 11)
- meiosis** Process that diploid sex cells undergo in order to produce haploid daughter cells. Occurs during gametogenesis. (Chapters 5, 7, 11)
- messenger RNA (mRNA)** Complementary RNA copy of a DNA gene, produced during transcription. The mRNA undergoes translation to synthesize a protein. (Chapters 8, 10)
- metabolic rate** Measure of an individual's energy use. (Chapter 3)
- metabolism** All chemical reactions occurring in the body. (Chapters 2, 3, 4)
- metaphase** Stage of mitosis during which duplicated chromosomes align across the middle of the cell. (Chapters 5, 11)
- metastasis** When cells from a tumor break away and start new cancers at distant locations. (Chapter 5)
- microbe** Microscopic organism, especially Bacteria and Archaea. (Chapter 12)
- microbiologists** Scientists who study microscopic organisms, especially referring to those who study prokaryotes. (Chapter 12)
- microevolution** Changes that occur in the characteristics of a population. (Chapter 9)
- micronutrients** Nutrients needed in small quantities. (Chapter 3)
- microorganism** See microbe. (Chapter 12)
- microtubules** Protein structures that move chromosomes around during mitosis and meiosis. (Chapters 2, 5)
- mineral** Inorganic nutrient essential to many cell functions. (Chapter 3)
- mitochondria** Organelles in which products of the digestive system are converted to ATP. (Chapters 2, 4, 12)
- mitosis** The division of the nucleus that produces daughter cells that are genetically identical to the parent cell. Also, portion of the cell cycle in which DNA is apportioned into two daughter cells. (Chapter 5)
- model organisms** Nonhuman organisms used in the Human Genome Project that are easy to manipulate in genetic studies and help scientists understand human genes because they share genes with humans. (Chapters 1, 8)
- mold** A fungal form characterized by rapid, asexual reproduction. (Chapters 9, 12)
- molecular clock** Principle that DNA mutations accumulate in the genome of a species at a constant rate, permitting estimates of when the common ancestor of two species existed. (Chapter 9)
- molecule** Two or more atoms held together by covalent bonds. (Chapter 2)
- monomer** Individual subunit. (Chapter 2)
- monosaccharide** Simple sugar. (Chapter 2)
- monosomy** A chromosomal condition in which only one member of a homologous pair is present. (Chapter 7)
- monozygotic twins** Identical twins that developed from one zygote. (Chapter 6)
- morphological species concept** Definition of species that relies on differences in physical characteristics among them. (Chapter 11)
- morphology** Appearance or outward physical characteristics. (Chapter 11)
- multicellular** The condition of being composed of many coordinated cells. (Chapter 12)
- multiple allelism** A gene for which there are more than 2 alleles segregating in the population. (Chapter 7)
- multiple hit model** The notion that many different genetic mutations are required for a cancer to develop. (Chapter 5)
- multiregional hypothesis** Hypothesis about the origin of modern humans that states that *Homo sapiens* evolved from *H. erectus* separately in Africa, Asia, and Europe. (Chapter 11)
- mutagens** Substances that increase the likelihood of mutation occurring; increases the likelihood of cancer. (Chapter 5)
- mutations** Changes to DNA sequences that may result in the production of altered proteins. (Chapters 5, 6, 8, 10)
- mutualism** Interaction between two species that provides benefits to both species. (Chapter 14)
- mycologists** Scientists who specialize in the study of fungi. (Chapter 12)
- NAD (nicotinamide adenine dinucleotide)** Molecule that helps transfer enzymes during oxidation reduction reactions. (Chapter 4)
- natural experiments** Situations where unique circumstances allow a hypothesis test without prior intervention by researchers. (Chapter 6)
- natural landscape** Landscape that is not strongly modified by humans. (Chapter 14)
- natural selection** Process by which individuals with certain traits have greater survival and reproduction than individuals who lack these traits, resulting in an increase in the frequency of successful alleles and a decrease in the frequency of unsuccessful ones. (Chapters 9, 10, 11)
- net primary production (NPP)** Amount of solar energy converted to chemical energy by plants, minus the amount of this chemical energy plants need to support themselves. A measure of plant growth, typically over the course of a single year. (Chapter 13)
- neutral mutation** A genetic mutation that confers no selective advantage or disadvantage. (Chapter 8)
- neutrons** An electrically neutral particle found in the nucleus of an atom. (Chapter 2)
- NIDDM (non-insulin-dependent diabetes mellitus)** Type of diabetes that does not require insulin injections, Type II. (Chapter 3)

- nitrogen-fixing bacteria** Organisms that convert nitrogen gas from the atmosphere into a form that can be taken up by plant roots; some species live in the root nodules of legumes. (Chapter 14)
- nitrogenous bases** Nitrogen-containing bases found in DNA: A, C, G, and T, and RNA: U. (Chapters 2, 4, 5, 6, 8)
- nondisjunction** The failure of members of a homologous pair of chromosomes to separate from each other during meiosis. (Chapter 7)
- non-insulin-dependent diabetes mellitus** See NIDDM. (Chapter 3)
- nonrenewable resources** Resources that are a one-time supply and cannot be easily replaced. (Chapter 13)
- normal distribution** Bell-shaped curve, as for the distribution of quantitative traits in a population. (Chapters 6, 7)
- nuclear envelope** The double membrane enclosing the nucleus in eukaryotes. (Chapters 2, 5)
- nuclear transfer** Transfer of a nucleus from one cell to another cell that has had its nucleus removed. (Chapter 8)
- nucleases** Enzymes that cleave DNA and RNA into their component nucleotides. (Chapter 8)
- nucleic acids** Polymers of nucleotides that comprise DNA and RNA. (Chapters 2, 4, 5)
- nucleotides** Building blocks of nucleic acids that include a sugar, a phosphate, and a nitrogenous base. (Chapters 2, 4, 5, 6, 7, 8, 10)
- nucleus** Cell structure that houses DNA; found in eukaryotes. (Chapters 2, 5, 8, 10)
- nutrient cycling** Process by which nutrients become available to plants. Nutrient cycling in a natural environment relies upon a healthy community of decomposers within the soil. (Chapter 14)
- nutrients** Atoms other than carbon, hydrogen, and oxygen that must be obtained from a plant's environment for photosynthesis to occur. (Chapter 3)
- obesity** Condition of having a BMI of 30 or greater. (Chapters 3, 5)
- objective** Without bias. (Chapter 1)
- observations** Measurements of nature. (Chapters 1, 10)
- observer bias** Systematic errors in measurement and evaluation of results made by researchers. (Chapter 1)
- ocean** A biome consisting of open stretches of salt water. (Chapter 15)
- oncogenes** Mutant versions of proto-oncogenes. (Chapter 5)
- opportunistic infection** Diseases that only occur when a weakened immune system allows access. (Chapter 10)
- organelle** Subcellular structure found in the cytoplasm of eukaryotic cells that performs a specific job. (Chapters 2, 4)
- organic chemistry** The chemistry of carbon-containing substances. (Chapter 2)
- organic** Carbon-containing compound. Alternatively, a fertilizer consisting of complex molecules made up of the partially decomposed waste products of plants and animals. (Chapters 2, 8, 14)
- osmosis** The diffusion of water across a selectively permeable membrane. (Chapter 3)
- osteoporosis** A condition resulting in elevated risk of bone breakage from weakened bones. (Chapter 3)
- out-of-Africa hypothesis** Hypothesis about the origin of modern humans that states that modern *Homo sapiens* evolved in Africa and replaced *H. erectus* populations. (Chapter 11)
- ovary** The structure in animals that produces gametes. Also the structure in plants in which egg-containing ovules develop. (Chapter 5)
- overexploitation** Threat to biodiversity caused by humans that encompasses overhunting and overharvesting. Overexploitation occurs when the rate of human destruction or use of a species outpaces the ability of the species to reproduce. (Chapter 14)
- overshoot** Occurs when a population exceeds the carrying capacity of the environment. Typically followed by a population crash. (Chapter 13)
- oviduct** Egg-carrying duct that brings egg cells from the ovaries to the uterus. (Chapter 5)
- ovulation** Release of an egg cell from the ovary. (Chapter 5)
- paleontologist** Scientist who searches for, describes, and studies ancient organisms. (Chapter 9)
- parasites** Organisms that feed on other living organisms. (Chapter 14)
- passive transport** The diffusion of substances across a membrane with their concentration gradient and not requiring an input of ATP. (Chapter 3)
- pectinase** An enzyme that breaks down cell wall constituents, resulting in ripening of fruit. (Chapter 8)
- pedigree** Family tree that follows the inheritance of a genetic trait for many generations. (Chapter 7)
- peer review** The process by which reports of scientific research are examined and critiqued by other researchers before they are published in scholarly journals. (Chapter 1)
- peptide bond** Chemical bond that joins adjacent amino acids. (Chapter 2)
- perennials** Plants that live for many years. (Chapter 15)
- permafrost** Permanently frozen soil. (Chapter 15)
- pH** A measure of the hydrogen ion concentration ranging from 0 to 14 with lower numbers equaling higher hydrogen ion concentrations. (Chapter 2)
- phenotype** Physical and physiological traits of an individual. (Chapters 6, 7)
- phosphate group** A functional group important in energy transferring reactions. (Chapters 2, 4, 5, 8)
- phosphodiester bond** Chemical bond that joins nucleotides in DNA. (Chapter 6)
- phospholipid bilayer** The membrane that surrounds cells and organelles and is composed of phospholipids (along with proteins and sometimes cholesterol). (Chapter 2)
- phospholipid** Molecule that makes up the plasma membrane, with a hydrophilic head and a hydrophobic tail. (Chapter 2)
- phosphorylation** Addition of a phosphate group, thereby energizing some other substance. (Chapter 4)
- photorespiration** A series of reactions triggered by the closing of stomatal openings to prevent water loss. (Chapter 4)
- photosynthesis** Process by which plants, along with algae and some bacteria, transform light energy to chemical energy. (Chapter 4)
- phyla** (singular: **phylum**) The taxonomic category below kingdom and above class. (Chapters 9, 12)
- phylogeny** Evolutionary history of a group of organisms. (Chapter 12)
- pituitary dwarfism** Lack of normal growth due to a malfunction of the growth-hormone-producing pituitary gland. (Chapter 8)
- pituitary gland** Gland located at the base of the skull that secretes growth hormone in addition to other hormones. (Chapter 8)
- placebo** Sham treatments in experiments. (Chapter 1)
- Plantae** Multicellular photosynthetic eukaryotes, excluding algae. (Chapter 12)
- plasma membrane** Structure that encloses a cell, defining the cell's outer boundary. (Chapters 2, 3)
- plasmid** Circular piece of bacterial DNA that normally exists separate from the bacterial chromosome and can make copies of itself. (Chapter 8)
- pleiotropy** The ability of one gene to affect many different functions. (Chapter 7)
- polar molecule** A molecule that carries opposite charges on opposite sides. Water is a polar molecule.
- poles** Opposite ends of a sphere, such as of a cell (Chapter 5) or of a planet such as Earth. (Chapter 15)
- pollen** The male gametophyte of seed plants. (Chapters 11, 12, 14)
- pollinators** Organisms, such as bees, that transfer sperm (pollen grains) from one flower to the female reproductive structures of another flower. (Chapter 14)
- pollution** Human-caused threat to biodiversity involving the release of poisons, excess

nutrients, and other wastes into the environment. (Chapter 14)

polygenic traits Traits influenced by many genes. (Chapters 6, 7)

polymer Combination of monomers. (Chapters 2, 8)

polymerase chain reaction (PCR) A laboratory technique that allows the production of many identical DNA molecules. (Chapter 7)

polyploidy A chromosomal condition involving more than two sets of chromosomes. (Chapter 11)

polysaccharide Complex carbohydrate. (Chapter 2)

polyunsaturated A property of fatty acids resulting from carbon-to-carbon double bonding of fatty acid tails. (Chapter 3)

pond An aquatic biome that is completely land locked. (Chapter 15)

populations Subgroup of a species that is somewhat independent from other groups. (Chapters 11, 13)

population bottleneck Dramatic but short-lived reduction in population size followed by an increase in population. (Chapter 11)

population crash Steep decline in number that may occur when a population grows larger than the carrying capacity of its environment. (Chapter 13)

population cycle In some populations, the tendency to increase in number above the environment's carrying capacity, resulting in a crash, followed by an overshoot of the carrying capacity and another crash, continuing indefinitely. (Chapter 13)

population goal Defined by the Endangered Species Act to be the population of an endangered species that would allow it to be removed from the endangered species list. (Chapter 14)

population pyramid A visual representation of the number of individuals in different age categories in a population. (Chapter 13)

post-fertilization (postzygotic) Barrier to reproduction that occurs when fertilization results from a mating between two members of different species, but the resulting offspring does not survive or is sterile. (Chapter 11)

prairie A grassland biome. (Chapter 15)

precipitation When water vapor in the atmosphere turns to liquid or solid form and falls to Earth's surface. (Chapter 15)

predation Act of capturing and consuming an individual of another species. (Chapter 14)

predator Organism that eats other organisms. (Chapter 14)

prediction Result expected from a particular test of a hypothesis when the hypothesis is true. (Chapter 1)

pre-fertilization (prezygotic) Barrier to reproduction that occurs when individuals from different species either do not attempt to mate, or if

they do mate, fail to produce a fertilized egg. (Chapter 11)

primary consumers Organisms that eat plants. (Chapter 14)

primary sources Articles written by researchers and reviewed by the scientific community. (Chapter 1)

probe Single-stranded nucleic acid that has been radioactively labeled. (Chapter 7)

producers Organisms that produce carbohydrates from inorganic carbon; typically via photosynthesis. (Chapter 14)

products The results of a chemical reaction. (Chapter 2)

prokaryotes (prokaryotic cells) Cells that do not have a nucleus or membrane-bound organelles. (Chapters 2, 8, 12)

promoter Sequence of nucleotides to which the polymerase binds to start transcription. (Chapter 8)

prophase Stage of mitosis during which duplicated chromosomes condense. (Chapter 5)

protein Cellular constituents made of amino acids coded for by genes. Proteins can have structural, transport, or enzymatic roles. (Chapters 2, 3, 4, 8, 10, 14)

protein synthesis Joining amino acids together, in an order dictated by a gene, to produce a protein. (Chapter 8)

Protista Kingdom in the domain Eukarya containing a diversity of eukaryotic organisms, most of which are unicellular. (Chapter 12)

proton A positively charged subatomic particle. (Chapters 2, 4)

proto-oncogenes Genes that encode proteins that regulate the cell cycle. Mutated proto-oncogenes (oncogenes) can lead to cancer. (Chapter 5)

punctuated equilibrium The hypothesis that evolutionary changes occur rapidly and in short bursts, followed by long periods of little change. (Chapter 11)

Punnett square Table that lists the different kinds of sperm or eggs that parents can produce relative to the gene or genes in question and predicts the possible outcomes of a cross between these parents. (Chapter 6)

purine Nitrogenous base (A or G) with a two-ring structure. (Chapter 2)

pyrimidine Nitrogenous base (C, T, or U) with a single-ring structure. (Chapter 2)

pyruvic acid The 3-carbon molecule produced by glycolysis. (Chapter 4)

qualitative traits Traits that come in distinct categories. (Chapter 6)

quantitative traits Traits that have many possible values. (Chapter 6)

race See biological race. (Chapter 11)

racism Idea that some groups of people are naturally superior to others. (Chapter 11)

radiation therapy Focusing beams of reactive particles at a tumor to kill the dividing cells. (Chapter 5)

radioactive decay Natural, spontaneous breakdown of radioactive elements into different elements, or "daughter products." (Chapter 9)

radioimmunotherapy Experimental cancer treatment with the goal of delivering radioactive substances directly to tumors without affecting other tissues. (Chapter 5)

radiometric dating Technique that relies on radioactive decay to estimate a fossil's age (Chapters 9, 14)

random alignment When members of a homologous pair line up randomly with respect to maternal or paternal origin during metaphase I of meiosis, thus increasing the genetic diversity of offspring. (Chapters 5, 7)

random assignment Placing individuals into experimental and control groups randomly to eliminate systematic differences between the groups. (Chapter 1)

random distribution The dispersion of individuals in a population without pattern. (Chapter 13)

random fertilization The unpredictability of exactly which gametes will fuse during the process of sexual reproduction. (Chapter 6)

reactants The starting materials in a chemical reaction. (Chapter 2)

reading frame The grouping of mRNAs into 3 base codons for translation. (Chapter 8)

receptor Protein on the surface of a cell that recognizes and binds to a specific chemical signal. (Chapters 5, 9)

recessive Applies to an allele with an effect that is not visible in a heterozygote. (Chapter 6)

recombinant Produced by manipulating a DNA sequence. (Chapter 8)

recombinant bovine growth hormone (rBGH) Growth hormone produced in a laboratory and injected into cows to increase their size and ability to produce milk. (Chapter 8)

recovery plan Defined by the Endangered Species Act as the plan of action put in place to remove a species from the endangered species list. (Chapter 14)

red blood cells Primary cellular component of blood, responsible for ferrying oxygen throughout the body. (Chapters 5, 7)

remission The period during which the symptoms of a disease subside. (Chapter 5)

repressors Proteins that suppress the expression or transcription of a gene. (Chapter 8)

reproductive isolation Prevention of gene flow between different biological species due to failure to produce fertile offspring; can include premating and postmating barriers. (Chapter 11)

resources Food, water, shelter, and area required for the survival of a population. (Chapter 13)

- restriction enzymes** Enzymes that cleave DNA at specific nucleotide sequences. (Chapters 7, 8)
- restriction fragment length polymorphisms (RFLP)** Differences among members of a population in the number and size of DNA fragments generated by cutting DNA with restriction enzymes. (Chapter 7)
- reverse transcriptase** Enzyme in RNA viruses that participates in copying the viral DNA. It performs the reverse of transcription by producing DNA from RNA. (Chapter 10)
- Rh factor** Surface molecule found on some red blood cells. (Chapter 7)
- ribose** The five-carbon sugar in RNA. (Chapters 5, 8)
- ribosomal RNA (rRNA)** RNA that makes up part of the structure of ribosomes. (Chapters 8, 12)
- ribosomes** Cellular structures that help translate genetic material into proteins by anchoring and exposing small sequences of mRNA. (Chapters 2, 8, 12)
- risk factors** Exposures or behaviors that increase the likelihood of disease. (Chapter 5)
- river** Aquatic biome characterized by flowing water. (Chapter 15)
- RNA (ribonucleic acid)** Information-carrying molecule composed of nucleotides. (Chapters 8, 10)
- RNA polymerase** Enzyme that synthesizes mRNA from a DNA template during transcription. (Chapter 8)
- rubisco** Ribulose biphosphate carboxylase oxygenase, the enzyme that catalyzes the first step in the Calvin cycle of photosynthesis. (Chapter 4)
- safer sex** Practice of minimizing contact with a partner's bodily fluids during sexual activity as prevention against the transmission of HIV and other sexually transmitted diseases. (Chapter 10)
- sample** Small subgroup of a population used in an experimental test. (Chapter 1)
- sample size** Number of individuals in both the experimental and control groups. (Chapter 1)
- sampling error** Effect of chance on experimental results. (Chapter 1)
- saturated fatty acid** Fatty acid in which carbons are bound to as many hydrogens as possible and therefore no carbon-to-carbon double bonds occur. (Chapters 2, 3)
- savanna** Grassland biome containing scattered trees. (Chapter 15)
- scientific theory** Body of scientifically accepted general principles that explain natural phenomena. (Chapters 1, 9)
- secondary consumers** Animals that eat primary consumers; predators. (Chapter 14)
- secondary sources** Books, news, media, and advertisements as sources of scientific information. (Chapter 1)
- seed** A plant embryo packaged with a food source and surrounded by a seed coat. (Chapter 12)
- segregation** See Law of segregation. (Chapter 6)
- selective breeding** Controlling the breeding of individual organisms to influence the phenotype of the next generation. (Chapter 8)
- semipermeable membrane** A biological membrane that allows some substances to pass but prohibits the passage of others. (Chapter 2)
- sense strand** DNA strand of the double helix that codes for a protein. (Chapter 8)
- separate types hypothesis** Hypothesis that numerous types of organisms (e.g., birds, cats, ferns) appeared on Earth separately, and each type diversified into many species via evolutionary processes. (Chapter 9)
- Severe Combined Immunodeficiency Disorder (SCID)** Illness caused by a genetic mutation that results in the absence of an enzyme and a severely weakened immune system. (Chapter 8)
- sex chromosomes** The X and Y chromosomes in humans. (Chapters 5, 7)
- sex determination** Determining the biological sex of an offspring. Humans have a chromosomal mechanism of sex determination in which two X chromosomes produce a female and an X and a Y chromosome produce a male. (Chapter 7)
- sex-linked genes** Genes linked to and inherited along with the X and Y chromosomes. (Chapter 7)
- sexual reproduction** Reproduction involving two parents that give rise to offspring that have unique combinations of genes. (Chapters 5, 12)
- sexual selection** Form of natural selection that occurs when a trait influences the likelihood of mating. (Chapter 11)
- shaman** Indigenous healer. (Chapter 12)
- side group** Of an amino acid, varies from one amino acid to the next and gives an amino acid its particular chemistry. (Chapters 2, 3)
- sister chromatids** Duplicated identical copies of a chromosome. (Chapter 5)
- smog** Products of fossil fuel combustion in combination with sunlight, producing a brownish haze in still air. (Chapter 15)
- social construct** Product of history and learned attitudes. (Chapter 11)
- solar irradiance** The amount of solar energy hitting Earth's surface at any given point. (Chapter 15)
- solid waste** Garbage. (Chapter 15)
- solstice** When the sun reaches its maximum and minimum elevation in the sky. (Chapter 15)
- solute** A substance that is dissolved in a solution. (Chapter 2)
- solvent** A liquid, such as water, that a solute is dissolved in. (Chapter 2)
- somatic cell gene therapy** Changes to malfunctioning genes in somatic or body cells. These changes will not be passed to offspring. (Chapter 8)
- somatic cells** The body cells in an organism. All cells that are not gametes. (Chapter 5)
- spatial isolation** A mechanism for reproductive isolation that depends on the geographic separation of populations. (Chapter 11)
- special creation** The hypothesis that all organisms on Earth arose as a result of the actions of a supernatural creator. (Chapter 9)
- speciation** Evolution of one or more species from an ancestral form; macroevolution. (Chapter 11)
- species** A group of individuals that regularly breed together and are generally distinct from other species in appearance or behavior. In Linnaeus' classification system, a group in which members have the greatest resemblance. (Chapters 2, 9, 11, 12, 14)
- species-area curve** Graph describing the relationship between the size of a natural landscape and the relative number of species it contains. (Chapter 14)
- specificity** Phenomenon of enzyme shape determining the reaction that the enzyme catalyzes. (Chapter 3)
- sperm** Gametes produced by males. (Chapters 5, 6, 7, 12)
- spores** Reproductive cells in plants and fungi that are capable of developing into an adult without fusing with another cell. (Chapter 12)
- SRY** Sex determining region of Y chromosome. (Chapter 7)
- stabilizing selection** Natural selection that favors the average phenotype and selects against the extremes in the population. (Chapter 10)
- static model** Discarded hypothesis about the origin of living organisms that states that they appeared in the recent past and have not changed over time. (Chapter 9)
- statistical tests** Tests that help scientists evaluate whether the results of a single experiment demonstrate the effect of treatment. (Chapter 1)
- statistically significant** Low probability that experimental groups differ simply by chance. (Chapter 1)
- statistics** Specialized branch of mathematics used in the evaluation of experimental data. (Chapter 1)
- stem cell** Cells that can divide indefinitely and can differentiate into other cell types. (Chapter 8)
- steppe** Biome characterized by short grasses, found in regions with relatively little annual precipitation. (Chapter 15)
- steroids** Fat-soluble hormones that can cross cell membranes readily. (Chapter 2)
- stomata** Pores on the photosynthetic surfaces of plants that allow air into the internal structure of leaves and green stems. Stomata also provide portals through which water can escape. (Chapter 4)
- stop codon** A mRNA codon that does not code for an amino acid and causes the amino acid chain to be released into the cytoplasm. (Chapter 8)

stream Biome characterized by flowing water, sometimes seasonal. Typically smaller than rivers. (Chapter 15)

stroke Acute condition caused by a blood clot that blocks blood flow to an organ or other region of the body. (Chapter 3)

stroma The fluid inside a chloroplast. (Chapters 2, 4)

strong inference A strong statement about the truth of a given hypothesis that is possible when an experimental protocol greatly minimizes the number of alternative hypotheses that can explain a result. (Chapters 1, 10)

subject expectation Conscious or unconscious modeling of behavior that the subject thinks a researcher expects. (Chapter 1)

subspecies Subdivision of a species that is not reproductively isolated but represents a population or set of populations with a unique evolutionary history. See also biological race. (Chapter 11)

substrate The chemicals metabolized by an enzyme-catalyzed reaction. (Chapter 3)

succession Replacement of ecological communities over time since a disturbance, until final reaching a stable state. (Chapter 15)

sugar-phosphate backbone Series of alternating sugars and phosphates along the length of the DNA helix. (Chapters 2, 5, 6)

superfamily Taxonomic category between family and order. (Chapter 9)

supernatural Not constrained by the laws of nature. (Chapter 1)

sympatry A relationship between two species. (Chapter 12)

sympatric In the same geographic region. (Chapter 11)

systematist Biologist who specializes in describing and categorizing a particular group of organisms. (Chapter 12)

systolic blood pressure Force of blood on artery walls when heart is contracting. Highest blood pressure in arteries. (Chapter 3)

T4 cell Immune-system cell that helps coordinate the body's specific response to a pathogen; also called a helper T cell. (Chapter 10)

Taq polymerase A polymerase enzyme that can withstand high temperatures and is used in PCR reactions. (Chapters 7, 12)

telomerase An enzyme that helps prevent the degradation of the tips of chromosomes, active during development and sometimes reactivated during cancer. (Chapter 5)

telophase Stage of mitosis during which the nuclear envelope forms around the newly produced daughter nucleus, and chromosomes decondense. (Chapter 5)

temperate forest Biome dominated by deciduous trees. (Chapter 15)

temperature A measure of the intensity of heat or kinetic energy. (Chapters 4, 15)

temporal isolation Reproductive isolation between populations maintained by differences in the timing of mating or emergence. (Chapter 11)

testable Possible to evaluate through observations of the measurable universe. (Chapter 1)

testimonial Statement made by an individual asserting the truth of a particular hypothesis because of personal experience. (Chapter 1)

theory of evolution Theory that all organisms on earth today are descendants of a single ancestor that arose in the distant past. See also evolution. (Chapters 1, 2, 9)

theory See scientific theory. (Chapters 1, 9)

therapeutic cloning Using early embryos as donors of stem cells for the replacement of damaged tissues and organs in another individual. (Chapter 8)

thylakoids Flattened membranous sacs located in the chloroplast stroma that function in photosynthesis. (Chapters 2, 4)

thymine Nitrogenous base in DNA, a pyrimidine. (Chapters 2, 4, 5, 8)

Ti plasmid Tumor-inducing plasmid used to genetically modify crop plants. (Chapter 8)

totipotent The ability of a cell to specialize into any cell type. (Chapter 8)

trait A genetically inherited feature of an organism. See also phenotype. (Chapter 6, 7, 10, 11)

transcription Production of an RNA copy of the protein encoding DNA gene sequence. (Chapter 8)

transfer RNA (tRNA) Amino-acid-carrying RNA structure with an anticodon that binds to a mRNA codon. (Chapter 8)

transformation hypothesis Hypothesis about the origin of living organisms stating that each arose separately in the past and has changed over time but not into new species. (Chapter 9)

transgenic organism Organism whose genome incorporates genes from another organism; also called genetically modified organism (GMO). (Chapter 8)

translation Process by which a mRNA sequence is used to produce a protein. (Chapters 8, 10)

transpiration Movement of water from the roots to the leaves of a plant, powered by evaporation of water at the leaves and the cohesive and adhesive properties of water. (Chapter 4)

trisomy A chromosomal condition in which three copies of a chromosome exist instead of the two copies of a chromosome normally present in a diploid organism. (Chapter 7)

trophic level Feeding level or position on a food chain; e.g., producers, primary consumers, etc. (Chapter 14)

trophic pyramid Relationship among the mass of populations at each level of a food web. (Chapter 14)

tropical forest Biome dominated by broad-leaved, evergreen trees; found in areas where temperatures never drop below the freezing point of water. (Chapter 15)

tumor Mass of tissue that has no apparent function in the body. (Chapter 5)

tumor suppressors Proteins that stop tumor formation by suppressing cell division but when mutated lead to increased likelihood of cancer. (Chapter 5)

tundra Biome that forms under very low temperature conditions. Characterized by low-growing plants. (Chapter 15)

undifferentiated A cell that is not specialized. (Chapter 8)

unicellular Made up of a single cell. (Chapter 12)

uniform distribution Occurs when individuals in a population are dispersed in a uniform manner across a habitat. (Chapter 13)

uniformitarianism The principle that processes occurred in the past in the same way and at the same rate as they occur currently. (Chapter 9)

unsaturated fatty acid Fatty acid with many carbon-to-carbon double bonds. (Chapter 3)

uracil Nitrogenous base in RNA, a pyrimidine. (Chapters 2, 6, 8)

urban sprawl The tendency for the boundaries of urban areas to grow over time as people build housing and commercial districts farther and farther from an urban core. (Chapter 15)

vacuole A membrane-enclosed sac in a plant cell that functions to store many different substances. (Chapter 2)

valence shell The outermost energy shell of an atom containing the valence electrons, which are most involved in the chemical reactions of the atom. (Chapter 2)

variable number tandem repeats (VNTRs) DNA sequences that vary in number to make the restriction fragments in a variety of lengths. They are nucleotide sequences that all organisms carry but in different numbers. These VNTRs are used during the process of DNA fingerprinting. (Chapter 7)

variance Mathematical term for the amount of variation in a population. (Chapter 6)

variant An individual in a population that differs genetically from other individuals in the population. (Chapter 10)

variety Subgroup of a species with unique traits relative to other subgroups of the species. Equivalence of this term to biological race or subspecies is disputed by biologists. (Chapter 11)

vascular tissue Cells that transport water and other materials within a plant. (Chapter 12)

vertebrates Animals with backbones. (Chapters 7, 12)

vestigial traits Modified with no, or relatively minor function compared to the function in other descendants of the same ancestor. (Chapter 9)

virus Infectious, intracellular parasite composed of a strand of genetic material and a protein or fatty coating that can only reproduce by forcing its host to make copies of it. (Chapters 1, 8, 10)

vitamin Organic nutrient needed in small amounts. Most vitamins function as coenzymes. (Chapter 3)

wastewater Liquid wastes produced by humans. (Chapter 15)

water One molecule of water consists of one oxygen and two hydrogen atoms. (Chapters 2, 3, 4, 15)

weather Current temperature and precipitation conditions. (Chapter 15)

wetlands Biome characterized by standing water, shallow enough to permit plant rooting. (Chapter 15)

whole foods Foods that have not undergone processing. (Chapter 3)

X inactivation The inactivation of one of two chromosomes in the XX female. (Chapter 7)

X-linked genes Genes located on the X chromosome. (Chapter 7)

yeast Single-celled eukaryotic organisms found in bread dough. Often used as model organisms and in genetic engineering. (Chapters 4, 9, 12)

Y-linked genes Genes located on the Y chromosome. (Chapter 7)

zoologists Scientists who specialize in the study of animals. (Chapter 12)

zygote Single cell resulting from the fusion of gametes (egg and sperm). (Chapters 5, 7)

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Index

Page references that refer to figures are in **bold**. Page references that refer to tables are in *italics*.

A

- A. *See* Adenine (A)
- ABO blood system, 169
- Acidic pH, 27
- Acquired, 258
- Acquired immune deficiency syndrome (AIDS), 258–262, **262**
 - causes of, 259
 - evidence linking HIV to, 259–262
 - evolution preventing, 273–279
 - prevention of, 277–279
- Activation energy, 54
- Activators, 203
- Active site, 54, 55
- Active transport, 59, **59**
- Adaptations, 265, **265**
- Adaptive radiation, 334
- Adenine (A), 34
- Adenosine diphosphate (ADP), 78
- Adenosine triphosphate (ATP), 56, **56**
 - regenerating, 79
 - structure and function of, 77–80
 - structure of, 77
 - synthase, 85
- ADP. *See* Adenosine diphosphate (ADP)
- Aequorea victoria*, 330
- Aerobic, 79
- Aerobic respiration, 79
- African
 - characteristics of, **295**
- Agarose gel, 183
- Age
 - as cancer risk factor, 118
 - metabolic rate, 56
- Agribusiness, 210
- Agriculture
 - clearing for, **402**
- Agrobacterium tumefaciens*, 210
- AIDS. *See* Acquired immune deficiency syndrome (AIDS)
- Air pollution, 417
- Alcohol consumption
 - as cancer risk factor, 118
- Algae, 326
- Allele frequency, 298
 - relationship with gamete frequency, **305**
 - similar in populations within races, 300
- Alleles, 125, **141**, 142, **148**
 - dominant, 148
 - recessive, 148
- Allopatric, 290
- Aloe vera
 - source of, **333**
- Alternative hypotheses, 4
- Ambiguity, 198
- Amenorrhea, **66**
- American Indian
 - characteristics of, **295**
- Amino acids, 30, **31**
 - essential, 47, 48, **48**
- Amish population, 310
- Anaerobic, 81
- Anaerobic respiration, 82
- Anaphase, 110

Anaximander, 229
 Anchorage dependence, 116, **116**
 Anderson, Anna, 186, **186**
 Anecdotal evidence, 16
 Angiogenesis, 116
 Animal cells, **39**
 Animalia, 321, 328–331
 phyla, 329
 Annelids, 329
 Annual herbs, 407
 Anorexia, **45**, 66, 66–67
 Ant (*Pseudomyrmex triplarinus*), 330, **330**
 Antibiotics, 324
 from fungi, **332**
 Antibodies, 261
 Anticholesterol drugs, 332
 Anticodon, 198
 Antigen, 261
 Antioxidants, 53, 53
 Antisense RNA, 208
 Antophyta, **333**
 Apes, **234**
 classification of, 236–237
 Ape-to-human transition, **249**
 Apple flies, **291**
 Apple maggot flies, 290–291
 Applied research, 207
 Aquaporins, 59
 Aquatic biomes, 409–414
 Aquatic systems, 409
 Archaea, 323–324
 Arctic ocean, **365**
Ardepithecus ramidus, 247
 Argument from design, 232
 Aristotle, 3
 Arthritis treatment, **330**
 Arthropods, 329
 Artificial selection, **156**, 156–157, 266
 causing evolution, 266, **266**
 Ascomycota, **331**
 Asexual reproduction, 105, **105**, 291
 Asiatic
 characteristics of, **295**
 Aspirin, 335
 source of, **333**
 Assembly
 in HIV life cycle, **260**
 Assortative mating, 312–313
 Asymptomatic phase
 HIV, **262**
 Atomic number, 27
 Atoms, 25
 ATP. *See* Adenosine triphosphate (ATP)
Australopithecus africanus, 246
 Autosomes, 124, **124**, 172

Average, 154
 Azidothymidine (AZT), 274
 drug resistance, **274**
 AZT. *See* Azidothymidine (AZT)

B

Bacillus thuringiensis, 213
 Background extinction rate, 362
 Bacteria, 323–324
 and cloning genes, **205**
 Bacterial cell, **82**
 being engulfed by human immune system cell,
 35
 Bacterial plasmid, 206
 Bantu nose, **307**
 Basal metabolic rate, 56
 Base, 27
 Base-pairing rule, 34
 Basic pH, 27
 Basic research, 207
 Basidiomycota, **331**
 B cell, **261**
 B cells, 261
 Beauty
 perception of, **61**
 Behavioral isolation, 285
 Behavioral pre-fertilization barrier
 to reproduction, **285**
 Behe, Michael, 232
Bell Curve, 160, 161
 Benign, 103
 Benign ovarian tumor, **121**
 Benzene, 417
 Beta-carotene, 53
 BGH. *See* Bovine growth hormone (BGH)
 Bias, 9
 Bible, 231
 Binet, Alfred, 157
 Biodiversity, 318, 360
 vs. meeting human needs, 386–387
 preservation of, 387
 Biogeography, 243
 evidence from, 242–244
 Biological address, **391**
 Biological classification, 318–323, 320
 challenge of, **338**
 suggests evolutionary relationships, 234–237
 Biological collections, **319**
 Biological diversity, **319**
 Biological evolution, 226
 Biological populations, 226

Biological race, 293
Biological riches
 source of, 319
Biological species
 comparison of, 296
 reproductively isolated, 284–285
Biological species concept, 284–288
Biomass, 366
Biome, 400
Biomes
 distribution of, 401
Biophilia, 378
Biopiracy, 341
Bioprospecting, 318
Bioprospectors, 319
Biopsy, 117–121, 121
Bioregion
 fitting human needs into, 418
Biotin, 51
Bipedalism, 245
Birds
 mating dance, 285, 285
Black-capped chickadees
 homeostasis, 24
Black gene, 301
Blind experiment, 9
Blood group genetics, 171–172
Blood pressure
 diastolic, 64–65
 systolic, 64–65
Blood protein
 source of, 330
Blood transfusion, 171
Blood type analysis, 169, 171
Blood types
 map of, 303
Blood typing, 172
Blue crab, 413
BMI. *See* Body mass index (BMI)
Body fat, 60–67
 healthful, 62
Body mass index (BMI), 62, 63
Bolshevik Revolution, 167
Boobies
 courting dance, 285
 pointing display, 285
Boom or bust cycle, 353
Boreal forest, 401, 403–404
 diversity in, 404
Botanists, 334
Bovine growth hormone (BGH), 195
 gene, 205, 206
BRCA1, 242
BRCA2
 in ovarian cancer, 115, 115

Breast cancer
 risk factors of, 119
Breathing
 and cellular respiration, 80
Brown tree snake, 365
Bryophyta, 333
Budding
 in HIV life cycle, 260
Bulimia, 66, 66–67

C

C. *See* Cytosine (C)
Calcitriol, 50, 51
Calcium, 52
Calories, 56–57
Calvin cycle, 90–92, 92
CAM. *See* Crassulacean acid metabolism (CAM)
Cambrian explosion, 328
CAM plants, 93–94
 photosynthesis, 95
Cancer, 103
 chemotherapy of, 122
 definition of, 103, 103–106
 detection of, 117–121
 in nonhuman organisms, 114
 radiation of, 122–123
 risk factors of, 118–120, 119–120
 treatment of, 121–123
 warning signs of, 117
Canola oil
 genetically modified, 211
Canopy, 402
Capillary, 57, 103
Caporael, Linda, 332
Carageenan, 327, 327
Carbohydrates, 30
 breakdown, 61
 complex, 47
 as nutrients, 46–47
 stored, 47
 structure and function of, 29–30
Carbon, 28
 flow of, 73
Carbon bonding, 29
Carbon dioxide, 73–74
 from Antarctic ice cores, 76
 increases in atmospheric, 75
 per capita emissions, 96
Carcinogens, 113
Carrier, 151, 151, 176
Carrying capacity, 350–351

- Catalyze, 54, **193**
- Catharanthus roseus*, 369, **369**
- Cathartes aura*, **338**
- Catolaccus grandis*, **369**, 370
- CD4⁺ receptor
 - and HIV, 261
- Cell components, 36–38
- Cell cycle, 108–112, **109**, **128–129**
 - control of, 112–113, **113**
- Cell cycle control genes
 - mutations to, 113–114
- Cell division, 103, **105**
 - in animal cells, **110**
- Cell plate, 112
- Cell structure, 35–38
- Cellular respiration, 74, 77–88, **80**, **86**
 - as controlled burn, **88**
- Cellular work
 - and ATP, **79**
- Cellulose, **30**, **61**, 112
- Cell wall, 38, 39, 111
- Cenozoic era, 335
- Central vacuole, 38
- Centrioles, 37, 39, 109
- Centromere, 105
- Cervical cancer
 - risk factors of, **119**
- Changed ecosystems, 376–378
- Chaparral, **404**, 404–405
- Checkpoints, 112
- Chemicals
 - flow of, **74**
- Chemical work, 79
- Chemotherapy, 122
- Chimpanzees
 - anatomical differences with humans, **245**
- Chlamydomonas, 79
- Chloride, 52
- Chlorophyll, 89
- Chloroplast, 36
- Chloroplasts, 39, 89, **89**
- Cholesterol, **32**, 65
- Chondrus crispus*, **327**
- Chordate embryos
 - similarity among, **240**
- Chordates, 329
- Chromosomal anomalies, 174–175, 175
- Chromosome 8, allele 4
 - frequency of, **302**
- Chromosomes, 105, 139–142, **141**, **145**
 - homologous pair, 140
- Chromosome walking, **216**
- Circulatory system, 104
- Cladistic analysis, 339
- Class, **235**
- Classification
 - implying common ancestry, **236**
- Classification systems, 234–235
- Claviceps purpurea*, 332
- Climate, 392
- Climax community, 405
- Cloning
 - humans, 218–219
- Cloning genes
 - using bacteria, **205**
- Clotting factor VIII, 169
- Clumped distribution, 347
- Cnidaria, 329
- Cobalamin, 51
- Codominance, 149, 169, 170
- Codons, 198
- Coenzymes, 50
- Cohesion, 26
- Cold-causing virus, 6
- Colon cancer
 - risk factors of, **120**
- Combination drug therapy
 - creating drug resistance, 277
 - HIV evolution, **276**
 - problems with, 276–277
 - slowing HIV evolution, 275–276
- Common ancestor
 - divergence from, **231**
- Common ancestry
 - classification implying, **236**
- Common cold
 - cure for, 19
- Common descent, 230, **233**, **243**, 247, 250–251
 - evidence for, 231–232
 - hypothesis development of, 230–231
 - theory of, **228**
- Community, 371
- Comparative anatomy, 238–239
- Competition, 373–374, **374**
- Competitive exclusion, 374
- Complementary, 34
- Complete proteins, 47–48
- Complex carbohydrates, 47
- Compound, 28
- Coniferophyta, **333**
- Coniferous trees, 403, **403**
- Consumers, 366
- Contact inhibition, 116, **116**
- Continuous variation, 153, 155
- Control, 7
- Controlled experiments, 7–8, **8**
- Convergence, **308**
- Convergent evolution, 243, 308–309
- Convergent species, **243**
- Copernicus, Nicolai, 4
- Coral reef, **330**, **413**

- Coral reefs, 412
- Corn
genetically modified, 211
- Correlations, 10
not signifying causation, 11
- Cotton
genetically modified, 212
- Covalent bond, 28
- C₃ plants, 93–94
photosynthesis, 95
- C₄ plants, 93–94
photosynthesis, 95
- Crash, population, 353
- Crassulacean acid metabolism (CAM), 94
- Crick, Francis, 34
- Crop plants
genetically modification of, 208–210
- Crossing over, 130, 130–131, 144, 145
- Cyclosporin, 332
- Cystic fibrosis, 301
as recessive condition, 149
risks of accepting sperm from carrier of, 151
- Cytokinesis, 108, 111–112
in animal cells, 112
in plant cells, 112
- Cytoplasm, 39
- Cytosine (C), 34
- Cytoskeletal elements, 37
- Cytosol, 39
- D**
- Darwin, Charles, 7, 229, 229–231, 262
- Darwin, Erasmus, 230
- Darwin's Black Box*, 232
- Data, 5
- Decomposers, 377
- Decomposition, 402
- Deductive reasoning, 4
- Deforestation, 92–93
- Degenerative diseases, 220
- Dehydration, 46, 66
- Deleterious, 383
- Demographic momentum, 354, 354
- Demographic transition, 349, 349–350
- Denaturation, 87
- Denatured, 182
- Density-dependent factors, 350–351
- Density-independent factors, 351
- Deoxyribonucleic acid. *See* DNA
(deoxyribonucleic acid)
- Desert, 406–407
- Development, 328
- Diabetes, 64, 64, 66
- Diastolic blood pressure, 64–65
- Dietary fiber, 47
- Diffusion, 58, 59
facilitated, 58, 59
- Digitalis, 335
source of, 333
- Dihybrid cross, 152, 153
- Diploid, 126
- Directional selection, 270, 271
- Disaster avoidance, 355–356
- DiSilva, Ashi, 218
- Diverge, 288
- Divergence, 288
genetic evidence of, 298–299
- Diversifying selection, 271, 271
- Diversity, 251, 251–252
in gametes, 145
in offspring, 142–144
- Diversity hotspots, 379
- Diversity of body form, 41
- Diversity of life, 323–334
- Dizygotic twins, 145, 146
- DNA (deoxyribonucleic acid), 32–34, 105, 105, 196
and HIV, 261
structure of, 33, 106
testing evolutionary hypothesis, 242
three-dimensional model of, 34
- DNA detective, 167–189
- DNA fingerprinting, 181–189, 184
hypothetical, 185, 186
parents and child, 185
- DNA insertion
in HIV life cycle, 260
- DNA molecule
denatured, 182
- DNA polymerase, 107
- DNA replication, 106–108, 107
- DNA sequences
similarities, 241
- Dolly, 219, 219
- Domain, 235
- Domain archaea, 325
- Domain bacteria, 324
- Domains, 320–321
- Dominant alleles, 146, 148
- Donkeys, 287
- Double-blind, 9
- Double-blind experiments, 9
- Double fertilization, 336
- Down syndrome, 175
- Drought
adaptations to, 407
- Drug resistance
single drug therapy selecting for, 273–274
- Drug resistant, 274

E

Early human embryo
 in petri dish, 220
Earth's human carrying capacity, 351–352
Earth's land surface
 human modification of, 414
Echinacea purpurea, 7, 7
Echinacea tea, 1
Echinoderms, 329
Ecological communities
 disruption of, 370–371
Ecological footprint, 415
Ecology, 337–338, 346
Ecosystems, 376
 function changes, 378
Ecotourism, 380
Ediacaran fauna, 328
Edward syndrome, 175
Eggs, 138, 139, 141, 143, 146
Ekaterinburg, 168
Electron carriers, 84
Electrons, 25
Electron transport, 80–81
Electron transport chain, 85, 85–86
Elements, 27
Elephants
 producing more offspring than will survive, 264, 264
Ellis-van Creveld syndrome, 310
Endangered Species Act (ESA), 360, 386–387
Endocytosis, 60, 60
Endoplasmic reticulum (ER), 37, 39
Endosymbiotic theory, 325
Energy, 414–415
 expenditure for activities, 56
 flow of, 74
 in food, 56
Energy flow, 376–377
Energy shell, 28
Energy use, 415
Environmental disasters
 protection from, 381–382
Environmental Protection Agency (EPA)
 genetically modified foods, 212
Enzymes, 30, 54–57, 55
EPA. *See* Environmental Protection Agency (EPA)
Equator, 394
ER. *See* Endoplasmic reticulum (ER)
Ergot, 332
ESA. *See* Endangered Species Act (ESA)
Escherichia coli, 215
Essential amino acids, 47, 48, 48
Estuaries, 412–414, 413, 413
Ethiopian child, 345

Ethiopian nose, 307
Eukaryotes, 42, 324, 325
Eukaryotic cells, 35
 protein synthesis in, 202
European
 characteristics of, 295
European corn borer, 213
Eutrophication, 368
Evolution, 224–253, 225
 early views of, 229
 process of, 226–227, 227
 theory of, 227–228
Evolutionary classification, 338–339
 testing, 340
Evolutionary history
 reconstructing, 338–340, 339
Evolutionary relationship, 322
Exercise, 56, 118
Exocytosis, 60, 60
Experimental design
 minimizing bias in, 9
Experimental method, 5–6
Experiments, 5
Exponential growth, 348
Extinction, 360
 causes of, 365
 consequences of, 368–378
 rate of, 363
Extinction rates
 measuring, 361–362
Extinct species, 361
Eye color
 in *Drosophila melanogaster*, 177

F

Facilitated diffusion, 58, 59
Fairfax Cryobank, 137, 150, 162
Falsifiable, 3
Family, 235
Fats, 32, 32, 48–49
 breakdown, 61
Fat-soluble vitamins, 51
Fat storage, 48
Fatty acid tails, 32
FDA regulations
 genetically modified foods, 212
 genetic engineering, 207
Fermentation, 82
Fertilization, 138, 139, 172
 random, 144–145
Fiber, 47
Fire, 404

Fitness, 265
 Fleming, Alexander, 332
 Flowering plants, 333
 chemical defenses in, 335
 diversity of, 333
 evolutionary history of, 239
 gamete production in, 126
 sexual reproduction in, 335
 Flower petals, 336
 Flowers
 individuals varying within populations, 263
 Fluid mosaic
 of lipids and proteins, 38–39
 Fluorescent protein
 source of, 330
 Folic acid, 51
 Food chain, 366
 Food Guide Pyramid, 67
 Food web, 371
 Forest biomes, 401
 Forests, 400–401
 Fossil ancestor, 246
 Fossil fuel extraction, 415
 Fossil fuels, 74, 74
 Fossilization, 244
 Fossil records, 244–249
 of horses, 249
 Fossils, 334
 Founder effect, 309–310, 310
 in plants, 311
 Founder hypothesis, 289, 289
 Foxglove, 335
 Frameshift mutation, 201, 201
 Fraternal twins, 145, 146
 Free radicals, 53
 Frequency of an allele, 268
 Freshwater, 409
 Frogs, 365
 Fructose, 30, 55
 Fruit, 336
 Fuhlrott, Johann, 246
 Fungal diversity, 331
 Fungi, 321, 331, 331–332

G

G. *See* Guanine (G)
 Galapagos, 267
 Galapagos Islands
 giant tortoises, 230, 230
 Galápagos Islands
 giant tortoises, 230
 Galilei, Galileo, 3–4

Gallo, Robert, 259
 Gamete incompatibility, 286
 Gametes, 123, 138, 139
 diversity, 145
 Garbage, 416–417
 Garbage disposal, 416
 Gas exchange, 93
 Gel electrophoresis, 183–185
 Genealogical species, 294
 comparison of, 296
 Genealogical species concept, 294
 Gene cloning
 through bacteria, 204–206, 205
 Gene expression
 chromosome condensation, 203
 mRNA degradation, 204
 protein degradation, 204
 translation, 204
 Gene expression regulation, 202–203, 203
 Gene flow, 285
 Gene gun, 210, 211
 Gene pool, 285
 Gene pools
 isolation and divergence of, 289–290
 Generally recognized as safe (GRAS), 207, 212
 Genes, 105, 136–162
 on chromosomes, 140
 and environment, 159–162
 importance of, 162
 as words in instruction manual, 140, 143
 Genesis (Bible), 231
 Gene therapy, 216–217
 Genetically modified crops
 effects on nontarget organisms, 213–214
 and environment, 213–214
 Genetically modified foods, 211–212
 safety of, 212–213
 in US diet, 211–212
 Genetically modified organism (GMO), 210
 effect on health, 210–213
 Genetically modified plant, 211
 Genetically modified tomatoes, 209
 Genetic code, 198
 Genetic disease
 in humans, 149–150
 Genetic diversity loss
 protection from, 382–386
 Genetic drift, 309–311
 effects of, 310
 losing variability, 384
 in small populations, 311, 385
 Genetic engineering, 192–221
 food modification, 208–215
 pros and cons of, 221
 Genetic engineers, 194
 modifying humans, 215–218

Genetic information
 flow of, **196**
 Genetic material
 transfer of, **214**
 Genetic traits
 calculating likelihood in children, **152**
 Genetic variability, **382**
 Genetic variation
 cause of, **141–142**
 Genotype, **148, 148–149**
 Genus, **235**
 Geological periods, **335**
 Geologic barriers, **289**
 Germ-line gene therapy, **216**
 Germ theory, **7**
 GI Joe, **61**
 Global climate, **392–400**
 Global precipitation, **399**
 Global precipitation patterns, **399–400**
 Global temperature patterns, **393–396**
 Global warming, **72, 365**
 and cellular respiration, **87–88**
 decreasing effects of, **95–97**
 and photosynthesis, **92–93**
 Glucose, **30, 47, 55**
 Glucose monomer, **30**
 Glycerol, **49, 61**
 Glycogen, **47**
 Glycolysis, **80–81, 81**
 GMO. *See* Genetically modified organism
 (GMO)
 GM tomato, **209**
 Golden rice, **210**
 Golgi apparatus, **37, 39**
 Gonads, **123**
Gonyaulax polyedra, **327**
 Gould, Stephen Jay, **270**
 Gradualism, **293**
 Graduation, **293**
 Grana, **89**
 GRAS. *See* Generally recognized as safe (GRAS)
 Grasslands, **405–406**
 Gray wolves
 individuals varying within populations, **263**
 Greenhouse effect, **72, 72–77**
 with organisms and environment, **75–77**
 Greenhouse gas emissions
 decreasing, **97**
 Growing human population, **346–350**
 Growth
 limits to, **351**
 Growth factors, **112**
 Growth rate, **348**
 species recovery, **381**
 Guanine (G), **34**
 Guard cells, **93**

H

Habitat destruction, **363, 364, 365**
 decreasing rate of, **380–381**
 Habitat diversification, **363–364**
 Habitat fragmentation, **365, 366–367**
 Habitat loss, **363, 363–364**
 Habitat protection for critically endangered species,
380
Halobacterium, **324**
 Haploid, **125**
 Haptoglobin 1 allele
 frequency of, **302, 302**
 Hardy, Godfrey, **304**
 Hardy-Weinberg theorem, **304–305**
 Hawthorn flies, **291**
 HDL. *See* High-density lipoprotein (HDL)
 Headwaters, **411**
 Heart attack, **66**
 Heat, **72–73**
 Heath hens, **381, 381–382**
 Hemophilia, **169, 179**
 Hemophilia allele, **181**
 Henslow, John, **229**
 HER2
 in ovarian cancer, **115, 115**
 Herbicide-resistant crops, **214**
 Heritability, **157**
 analyzing inheritance, **156–157**
 calculating in human populations, **157,**
157–158
 environmental effect on, **160, 160–162, 161**
 individual differences, **162**
 and IQ, **159**
 use and misuse of, **160–162**
 Hernstein, Charles, **160, 161**
 Heterozygosity
 benefits of, **383**
 Heterozygous genotype, **148, 148**
 High-density lipoprotein (HDL), **47, 65**
 High-fat, low-fiber diet
 as cancer risk factor, **118**
 High tides, **71**
 Hitting the wall, **82**
 HIV. *See* Human immunodeficiency
 virus (HIV)
 HMS *Beagle*, **229–230, 230**
 Hodgkin's disease, **369**
 Homeostasis, **24**
 Hominins, **245**
 dating, **246**
 Hominin species
 evolutionary relationships among, **248**
 Homologous pair, **124, 140**
 Homologous pairs of chromosomes, **125**

- Homology, 238
 - in biochemistry, 240–242
 - in development, 239–240
 - evidence of, 237–242
 - Homo neanderthalensis*, 246
 - Homo sapiens*
 - characteristics of, 295
 - Homozygous genotype, 148
 - Homunculus, 147, 147
 - Hooded vulture (*Necrosyrtes monachus*), 338
 - Horses, 287
 - Horseshoe crab (*Limulus polyphemus*), 330
 - Host, 259
 - Human(s)
 - classification of, 236–237
 - gamete production in, 126
 - and race concept, 295–299
 - Human Genome Project, 215–216
 - Human groups
 - differences, 306–313
 - Human habitats, 414–415
 - Human immunodeficiency virus (HIV), 258–262
 - description of, 259
 - drug therapy, 277
 - evolution of, 272, 272–273
 - human evolving HIV resistance, 277–278
 - immune response, 261
 - infection
 - course, 261–262
 - typical course, 262
 - infection prevention, 278
 - living with, 278–279
 - mutation, 273
 - particle
 - in HIV life cycle, 260
 - replications
 - reduction, 275–276
 - reproductive cycle, 260
 - Human life cycle, 138, 138
 - Human muscle cell, 82
 - Human population future, 353–354
 - Human population growth, 348
 - Human races
 - genetic evidence of isolation, 302
 - isolation of, 303–304
 - not biological groups, 300–303
 - Human waste treatment, 416
 - Huntington's disease
 - caused by dominant allele, 149–150
 - Punnett square, 152
 - Hutton, James, 229
 - Hydrocarbons, 29, 49
 - Hydrogen
 - cis configuration, 49, 50
 - transconfiguration, 50, 50
 - Hydrogenation, 49, 50
 - Hydrogen atom, 83
 - Hydrogen bond, 26
 - Hydrogen bonding
 - in water, 73
 - Hydrophilic, 27
 - Hydrophobic, 27
 - Hypertension, 64–65, 66
 - Hyphae, 331
 - Hypotheses, 2
 - using correlation to test, 10–11
 - Hypothesis
 - generation of, 2
 - Hypothesis testing
 - logic of, 3–5
- ## I
- Ice core, 75
 - IDDM. *See* Insulin-dependent diabetes mellitus (IDDM)
 - Ideal weight
 - determining, 62
 - Identical twins, 145, 146
 - Immortal
 - dividing cells, 116
 - Immune response, 258
 - Immune system
 - disease of, 258
 - Inbreeding, 383
 - Inbreeding depression, 383
 - Income
 - growth rate and women's literacy, 355
 - Incomplete dominance, 148, 169, 170
 - Independent assortment, 142–143, 144
 - Indigenous knowledge, 341
 - Individual genetic variability
 - importance of, 382–384
 - Individuals varying within populations, 263
 - Individual variation, 263
 - Induced fit, 54–55
 - Inductive reasoning, 3
 - Infection
 - HIV, 262
 - Inheritance, 138–145
 - Instantaneous speciation, 292
 - Insulin, 64, 64
 - Insulin-dependent diabetes mellitus (IDDM), 64
 - Intelligent quotient (IQ)
 - heritability of, 159, 160
 - tests, 157
 - Intermediate hypotheses, 233

Interphase, 108–109
 and meiosis, 127, 127
Interspecies hybrids, 286
Intertidal zones, 411–412, 412
Introduced species, 365, 367
Invertebrates, 330, 330
In vitro, 220
Ionic bond, 28
IQ. *See* Intelligent quotient (IQ)
Islam, 231
Isolation between races
 genetic evidence of, 299

J

Jellyfish (*Aequorea victoria*), 330
Johnson, Earvin "Magic," 257–258
Judaism, 231
Jurassic Park, 193
Jury-rigged design, 270

K

Kale
 instantaneous speciation, 292
Kansas
 evolution, 225–226
Karyotype, 124, 124
Karyotyping, 173
Keystone species, 375–376, 376, 376
Kingdom, 235
Kingdoms, 320–321, 321
Klamath Basin, 386–387
Klamath Falls, Oregon, 359
Kleinfelter syndrome, 175
Koch, Robert, 7, 259
Koch's postulate, 259
Krebs cycle, 80–81, 81, 83
Kyoto Protocol, 96

L

Lactase, 55
Lactose intolerance, 55
Lagenidium giganteum, 327
Lake
 algal bloom in, 410

 nutrients in, 410
 in spring, 410
 in summer, 410
Lakes, 409–410
Lamarck, Jean Baptiste, 229
Landfills, 416
Laparoscope, 121
Law of independent assortment, 142, 144
Law of segregation, 142
LDL. *See* Low-density lipoprotein (LDL)
Lenin, Vladimir, 167
Leopon, 286, 286, 287
Leptin, 66
Leukemia, 369
 risk factors of, 120
Life
 classification of, 321
 definition of, 24–25
 on earth, 35–41
 oldest form of, 323
 requirements for, 24–35
Life cycle, 138, 138
Life in the universe, 41
Life span
 estimating, 362
Light
 absorption effect on temperature, 397
Light reactions, 89, 90–92, 91
Limulus polyphemus, 330
Linked genes, 130
Linnaean classification, 234–235, 235
Linnaean classification of human
 variety, 295
Linnaeus, Carolus, 234–235
Lipid bilayer, 58
Lipids, 31
 types of, 32
Local precipitation patterns, 400
Locomotion, 245
Logistic growth, 350–351
Logistic growth curve, 350
Low-density lipoprotein (LDL), 47, 65
Low genetic variability
 consequences of, 384–386
LSD, 332
Lucy, 246
Lung cancer
 risk factors of, 119
Lutein, 53
Lycopene, 53
Lyell, Charles, 229, 230
Lymphatic system, 103
Lymph nodes, 103
Lysine, 48
Lysosome, 37
Lysosomes, 39

M

Macromolecules
 metabolism of, 86
 on other planets, 34
 structure and function of, 29–30
Macronutrients, 46–50
Magnesium, 52, 52
Malaria
 resistance to, 150
Malignant, 103
Malignant ovarian tumor, 121
Mammal forelimbs
 homology of, 238
Marine biomes, 411–412
Mark-recapture method, 346–347
Mass extinction, 361, 361–362
Mass number, 27
Mattesia oryzaephili, 327
Mean, 154, 154
Mechanical isolation, 285
Mechanical work, 78
Meiosis, 123–133, 172, 174, 186, 292
 and DNA fingerprinting, 185–186
 interphase, 127
 vs. mitosis, 132
Meiosis I, 127
Meiosis II, 127–128
Mendel, Johann Gregor, 147, 147
Mendelian genetics, 146–153
 extensions of, 168–172, 170
Mesozoic era, 335
Messenger RNA (mRNA), 197
Metabolic rate, 56–57
 and age, 56
 basal, 56
Metabolism, 24, 54–57
Meta female, 175
Metaphase, 109
Metastasis, 103, 104
Microbes, 324
Microbiologists, 324
Micronutrients, 46, 50–52
Microtubules, 109
Migration, 409
 leading to speciation, 289
Milk production in cows
 artificial selection increasing, 156
Millennium man, 247
Minerals, 52, 52
Miss America, 61
Missing link, 248, 248–249
Mitochondria, 39, 81, 81
Mitochondrion, 36
Mitosis, 108–112

Model organisms, 10, 10, 215
Modern humans
 history, 297–298
 origins of, 297
Modern organisms
 origin hypotheses, 233, 250
Mold, 332
Molecular clock, 242
Molecule, 25
Mollusca, 329
Monera, 321
Monomers, 47, 57
Monosaccharides, 61
Monosomy, 174
Monozygotic twins, 145, 146
Montagnier, Luc, 259
Morphological species
 comparison of, 296, 296–297
mRNA. *See* Messenger RNA (mRNA)
Mules, 287, 287
Multiple allelism, 169, 170
Multiple drug resistance, 275
Multiple drug resistant HIV, 275–276
Multiple hit model, 117
Multiplicity, 193
Murray, Richard, 160, 161
Muscular dystrophy, 177
Mutant allele, 141
Mutated Her2 receptor, 115
Mutation, 113, 141, 141, 141–142, 269
Mutualism, 371–372, 372
Mycologists, 331
Mycteria americana, 338

N

NAD. *See* Nicotinamide adenine dinucleotide (NAD)
National Cancer Institute (NCI), 337
Natural experiments, 158
Natural resources, 414–415, 415
Natural selection, 227, 256–279, 262–272, 269, 306–308
 acting on inherited traits, 268–269
 does not imply progression, 270
 fruit flies, 267, 267
 HIV, 272–273
 in lab, 266–267
 modern understanding of, 267–268
 not resulting in perfection, 269–270
 resulting from current environmental conditions, 270–271
 subtleties of, 268–269

testing, 266–267
in wild populations, 267
Nature
innate appreciation of, 378
psychological effects of, 378
NCI. *See* National Cancer Institute (NCI)
Neanderthal man, 246
Necrosyrtes monachus, 338
Net primary production (NPP), 352
Neutral mutation, 201, 201
Neutral pH, 27
Neutrons, 25
New England maple syrup industry
global warming, 77
Niacin, 51
Nicholas II, 167, 168
Nicotinamide adenine dinucleotide (NAD), 83, 84,
84
NIDDM. *See* Non-insulin-dependent diabetes melli-
tus (NIDDM)
Nitrogenous bases, 34
Nondisjunction, 174, 174
Nonhomologous pairs of chromosomes, 125
Nonidentical twins, 145, 146
Non-insulin-dependent diabetes mellitus (NIDDM),
64
Nonpolar, 25
Nonrenewable resources, 352
Non-sex chromosomes, 124
Normal distribution, 154
Normal ovarian tumor, 121
Normal rate of ripening
tomatoes, 209
Normal tomato, 209
Nose
shape affected by natural selection, 307
NPP. *See* Net primary production (NPP)
Nuclear envelope, 109
Nuclear transfer, 218
Nucleases, 204
Nucleic acids, 32–33
Nucleus, 36, 39
Nutrient cycling, 377, 377–378
Nutrients, 46–53
metabolism of, 86–87
moving from bloodstream to cells, 57
Nutrition, 46

O

Obesity, 45, 62–66, 63, 66
as cancer risk factor, 118
Objective, 9

Observations, 2
Occupationally-acquired HIV infections, 259
Oceanic islands, 289
Oceans, 411–412
abyssal plain, 412
effect on local climates, 397
Offspring, 141, 143
diversity, 142–143
Oil and water, 27
Oncogenes, 113
Orangutan, 234
Order, 235
Organelles, 35, 39
Organic chemistry, 27
Organisms
relationships among, 323
Origin of life, 252–253
Origin of Species, 231, 245, 262
Orrorin tugenensis, 247
Osmosis, 58–59
Osteoporosis, 66, 66
Out-of-Africa hypothesis, 298
Ovarian cancer
risk factors of, 119
Ovarian cyst, 102
Overexploitation, 367–368
Overshooting, 353
Ovulation, 104

P

Paclitaxel, 337
Paleontologists, 334
Paleozoic era, 335
Panda
thumb, 270, 270
Pantothenic acid, 51
Parasites, 372
Parents, 141, 143
correlations with children, 157–158
Passive transport, 58–59, 59
Pasteur, Louis, 7
Patau syndrome, 175
Pauling, Linus, 4
PCB, 417
PCR. *See* Polymerase chain reaction (PCR)
Peahens
sexual selection, 312
Pea plants, 147, 147
Pectinase, 208
Pedigrees, 178–180, 179
analysis of, 179
inheritance modes, 180

Peer review, 15
Penicillium, 332
 Peptide bond, 31
 Perennial chaparral plants, 404
 Permafrost, 408
 PFLP. *See* Restriction fragment length polymorphism (RFLP) analysis
 Phenotype, 148, 148–149
 environment effect on, 155
 Phenylthiocarbamide (PTC)
 allele frequency inhibiting ability to taste, 302, 302
 Phospholipid bilayer, 38
 Phospholipids, 32, 32
 Phosphorus, 52
 Phosphorylation, 78, 78
 Photorespiration, 93
 Photosynthesis, 74, 88–95
 Photosynthetic organisms, 412
 PH scale, 27, 27
 Phyla, 325
 Phylogeny, 339
 Phylum, 235
 Physical separation
 leading to speciation, 290
Phytophthora infestans, 386, 386
 Pigeons
 individual variation, 263–264
 Pima Indians, 63
 Pituitary dwarfism, 195
 Placebos, 8
 Plantae, 321, 332–334
 Plant cells, 39
 Plant diversity, 333
 Plant seedlings
 similarity among, 241
 Plasma membrane, 35, 36, 57, 57
 Plasmid, 206
 Platyhelminthes, 329
 Pleiotropy, 169, 170
Pneumocystis carinii, 258
 Poison dart frog, 328
 Polar, 25
 Polar ice, 25
 Polarity
 in water molecules, 25
 Poles, 109, 394
 Pollution, 365, 368
 Polygenic inheritance, 170
 Polygenic traits, 154, 169
 Polymerase chain reaction (PCR), 182, 182–183
 Polyploidy, 291
 Polysaccharides, 29
 Polyunsaturated fat, 49
 Ponds, 409–410
 Population, 346
 structure of, 346–347
 Population bottleneck, 310, 311
 Population crash, 353, 353, 354
 Population cycle, 353
 Population dispersion, 347
 Population growth, 345, 347–349
 limits to, 350–353
 Population isolation, 288
 Population pyramid, 354
 Populations, 288
 blood types mixing between, 303
 Populations in same race
 do not have similar allele frequencies, 301–302
 Porifera, 329
 Potassium, 52
 Potato blight, 386, 386
 Potatoes
 genetic variability, 385
 Prairies, 406
 in bloom, 407
 Pre-Cambrian era, 335
 Precipitation, 393, 398–400
 distribution on earth's surface, 398–399
 Predation, 372–373, 373
 Predator, 372
 Prediction, 4
 Primary consumers, 366
 Primary sources, 15, 15
 Primates, 234
 Prince Philip, 189
Principles of Geology, 230
 Probe, 184
 Processed foods
 vs. whole foods, 52–53
 Producers, 366
 Products, 25
 Projected human population, 351
 Prokaryotes, 42, 323–324
 diversity of, 324
 Prokaryotic cells, 35
 protein synthesis in, 202
 Promoter, 197
 Prophase, 109
 Prostate cancer
 risk factors of, 120
 Protecting habitat, 379–380
 Proteins, 30–31
 breakdown, 61
 complete, 47–48
 instructions for making, 139–140
 as nutrients, 47–48
 Protein synthesis, 195
 and gene expression, 194–195

Protista, 321, 325–328, **327**
diversity of, 326
Protons, 25
Proto-oncogenes, 113
mutations to, **114**
Pseudomyrmex triplarinus, 330, **330**
PTC. *See* Phenylthiocarbamide (PTC)
Pteridophyta, **333**
Publishing scientific results, **15**
Punctualism, **293**
Punctuated equilibrium, 293, **293**
Punnett, Reginald, 151, 304
Punnett squares, **152**, 304
Cystic fibrosis, **152**
Huntington's disease, **152**
with multiple genes, 152–153
predicting offspring genotypes, 150–153
Sickle-cell anemia, **152**
with single gene, 151
Pyridoxine, **51**
Pyrimidines, 34
Pyruvic acid, 80

Q

Quantitative genetics, 153–159
Quantitative traits, 153–154, **154**
reasons for, 154–156

R

Race
in human society, 313–314
Race concept, 293–295
Race-specific allele, 299–300
Race-specific alleles, 300–301
Racial categories
socially meaningful, 313
Racism, 313
Radiation therapy, 122–123
Radiometric dating, 246, **247**
Rainfall patterns, 399
Rain forest destruction, 364
Random alignment, 130, 131, **131**, **187**
Random assignment, 8
Random distribution, 347
Random fertilization, 144–145
rBGH. *See* Recombinant bovine growth hormone (rBGH)
Reactants, 25

Reading frame, 201
Receptor, 114
Recessive alleles, 148
Recombinant bovine growth hormone (rBGH),
194–195
Recombinant plasmid, 206
Recombinant proteins
production of, 204–207
Rectal cancer
risk factors of, **120**
Recycling, 416–417
Red algae, 327, **327**
Red blood cell genotypes, **171**
Red blood cell phenotypes, **171**
Red-green color blindness, **177**
Redundancy, 198
Reef bioprospectors, 330
Regional climate, 392–400
Release
in HIV life cycle, **260**
Remission, 123
Replicated chromosomes, **108**, **125**
Repressors, 203
Reproduction
not random, 265, **265**
Reproduction timing
leading to speciation, **291**
Reproductive isolation, 285
evolution of, 292–293
between horses and donkeys, **287**
nature of, 285
Resistant pests
evolution of, 214
Resource loss, 368–370
Restriction enzymes, 183, 204
Restriction fragment length polymorphism (RFLP)
analysis, 183
Reverse transcription
in HIV life cycle, **260**
Rh factor, 171–172
Rhodopsin, 140
Riboflavin, 51
Ribonucleic acid (RNA), 195, **196**
and HIV, 261
polymerase, 197
Ribosomal RNA (rRNA), 198
Ribosomes, 37, 39, 198, **198**, **323**
Ribulose biphosphate carboxylase oxygenase, 91
Risk factors, 117
River habitats, **411**
River mouth, **411**
RNA. *See* Ribonucleic acid (RNA)
Romanov, Alexandra, 167, 168
Romanov, Alexis, 167, 168, 169, 186
Romanov, Anastasia, 168
Romanov, Maria, 168

Romanov, Olga, 168
Romanov, Tatiana, 168
Romanovs
 ancestors of, 179
 church burial for, 189, 189
 family pedigree, 188
 grave, 167
Rosy periwinkle (*Catharanthus roseus*), 369, 369
Roughage. *See* Dietary fiber
Roundup Ready soybeans, 214, 215
rRNA. *See* Ribosomal RNA (rRNA)
Rubisco, 91
Russian Revolution, 167

S

Saccharomyces cerevisiae, 207
Salmonella enteritidis, 373
Salt water, 26
Saltwater, 411–412
Sample, 12
Sampling error, 13
SARS. *See* Severe acute respiratory syndrome (SARS)
Saturated fat, 49, 49
Savannas, 406, 406
 maintenance, 406
Saving species, 379–386
SCID. *See* Severe combined immunodeficiency (SCID)
Science
 in news, 16–17
 evaluation guide for, 18
 process of, 2–3
Scientific information
 evaluating, 15–16
Scientific method, 1–19, 4, 189
Scientific theory, 6–7, 228
Sea levels, 71, 76
Secondary consumers, 366
Secondary sources, 16, 17–19
Seeds, 333, 336
Selection, 265
Selenium, 53
Semipermeable, 38
Sense RNA, 208
Separate types, 233
Severe acute respiratory syndrome (SARS), 327
Severe combined immunodeficiency (SCID),
 216–217
 gene therapy in, 217
Sex chromosomes, 124, 124, 172, 174
Sex determination, 172, 172–173, 173

Sex linkage, 176
Sex-linked genes, 176
Sexual reproduction, 105
Sexual selection, 312
 effects of, 312
Shamans, 340–341, 341
Shared characteristics
 among humans and apes, 237
Shortnose suckers, 360, 386
Shrublands, 400–401
Sickle-cell allele, 150, 150, 301
 in malarial environments, 307
Sickle-cell anemia
 Punnett square, 152
Simon, Julian, 345
Sister chromatids, 105
Sixth extinction, 360–368
Skin cancer
 risk factors of, 119
Skin color
 genetic and environmental influence, 155, 155
 UV exposure, 308
Slowed rate of ripening
 tomatoes, 209
Sludge, 416
Small intestines, 57
Small populations
 chance events in, 310
Small population size, 381
Smog, 417
Sodium, 52
Solar irradiance, 393
 on earth's surface, 393
Solid waste, 416
Solstice, 395
Solute, 25
Solvent, 25
Somatic cell gene therapy, 216
Somatic cells, 123
Soybeans
 genetically modified, 211
Spatial isolation, 285
Special creation, 225, 231
Speciation, 288–289
Species, 40, 226, 235, 335–341
 definition of, 284, 294
 differences between, 293
Species and race, 282–314
Species-area curve, 363
Species concepts
 comparison of, 296
Species interactions, 375
Species overexploitation, 365, 367–368
Specificity, 54
Sperm, 136, 138, 139, 143, 143, 146
Spores, 331

Spruce bark beetle, 87
 SRY gene, 177
 St. Anthony's Fire, 332
 Stabilizing selection, 270, 271
Staphylococcus aureus, 332
 Starch, 47
 StarLink, 214
 Static model, 233
 Static model hypothesis, 250
 Statins, 332
 Statistically significant, 13
 Statistical significance, 12
 factors influencing, 14
 Statistical tests, 12
 cannot tell us, 14–15
 Statistics
 understanding, 12–15
 Stem cells, 220, 221
 Steppes, 406
 Sterile hybrids, 287
 Steroids, 32
 Stomata, 89, 89
 Stop codons, 198
 Stored carbohydrates, 47
 Stored energy, 78
 Streams, 410–411
Streptomyces venezuelae, 324
 Stress
 correlated with illness, 11
 Stroke, 65, 66
 Stroma, 89
 Strong inference, 8
 Subspecies, 284
 Substrate, 54, 55
 Sucrase, 55
 Sucrose, 30, 55
 Sugar-phosphate backbone, 34
 Sulfur, 52
 Sun
 traveling across sky, 395
 Survival
 not random, 265, 265–266
 Sympatric, 290
Systema Naturae, 295
 Systematists, 320
 Systolic blood pressure, 64–65

T

T. *See* Thymine (T)
 Taq polymerase, 318
Taq polymerase, 182
 Taxol, 123, 337

T4 cells, 258
 Telomerase, 116
 Telophase, 110
 Temperate forest, 401
 springtime in, 403
 Temperate forests, 402–403
 Temperature, 72–73, 393–398
 local factors affecting, 396–398
 Temperature patterns
 earth's tilt, 394
 Temporal isolation, 286
 Temporal pre-fertilization barrier to reproduction,
 286
 Terrestrial biomes, 400–404
 Testable, 3
 Testicle cancer
 risk factors of, 120
 Theory of evolution, 7, 40
 Therapeutic cloning, 221
 Thermal momentum, 396
Thermus aquaticus, 182
 Thiamin, 51
 Thylakoids, 89
 Thymine (T), 34
 Tigers, 365
 Ti plasmid, 210
 genetically modifying plants, 210
 Tobacco use
 as cancer risk factor, 118
 Tomatoes
 genetically modified, 209
 normal rate of ripening, 209
 slowed rate of ripening, 209
 Totipotent, 220
 Transcription, 196, 197, 197
 in HIV life cycle, 260
 regulation of, 202–203
 Transfer RNA (tRNA), 198, 198
 Transformation, 233
 Transformation hypothesis, 250
 Transgenic organism, 210
 Translation, 197
 in HIV life cycle, 260
 Transpiration, 93
 Transport
 across membranes, 58–60
 Transport work, 78
 Tree of life, 40, 40–41, 322
 Triceratops
 species of, 296
 Trisomy, 174
 Trisomy 13 (Patau syndrome), 175
 Trisomy 18 (Edward syndrome), 175
 Trisomy 21 (Down syndrome), 175
 Trisomy X (meta female), 175
 tRNA. *See* Transfer RNA (tRNA)

Trophic level, 366
Trophic pyramid, 366, 366
Tropical forest, 365
Tropical forests, 401–402
Tropical rain forest, 401
Tumor, 103
Tumor suppressor genes
 mutations to, 114, 115
Tumor suppressors, 114
Tundra, 408, 408
Turkey Vulture (*Cathartes aura*), 338
Turner syndrome, 175
Turnip
 instantaneous speciation, 292
Tuvalu, 71, 77
Twins
 correlations between, 158–159
 dizygotic, 145, 146
 formation of, 146
 monozygotic, 145, 146

U

Undifferentiated, 220
Unicellular, 324
Uniform distribution, 347
Uniformitarianism, 230
Unity, 251
Universal, 198
Unreplicated chromosomes, 108
Unsaturated fat, 49, 49
Urban heat island, 398
Urban sprawl, 417
Ursus americanus, 235
Ursus arctos, 235
USDA Food Guide Pyramid, 67
UV light
 convergent evolution, 308–309
 relationship to folate, vitamin D and skin color,
 309

V

Vacuole, 39
Valence shell, 28
Valine, 48
Variable number tandem repeats (VNTR), 183, 183,
 188
Variance, 154, 154
Variation
 origins of, 267–268
Vascular tissue, 333

Vertebrates, 328
Vestigial traits, 238, 239
Vinblastine, 369, 369
Vincristine, 369, 369
Vitamin(s), 50
 fat-soluble, 51
 water-soluble, 51
Vitamin A, 51, 53
Vitamin B₁ (thiamin), 51
Vitamin B₂ (riboflavin), 51
Vitamin B₃ (niacin), 51
Vitamin B₆ (pyridoxine), 51
Vitamin B₁₂ (cobalamin), 51
Vitamin C, 1, 1, 51, 53
Vitamin C and the Common Cold, 4
Vitamin D (calcitrol), 50, 51
Vitamin E, 51, 53
Vitamin K, 51
VNTR. *See* Variable number tandem repeats (VNTR)
Von Linné, Carl, 234–235

W

Wallace, Alfred Russel, 231
Wasp (*Catolaccus grandis*),
 369, 370
Waste gas emissions
 effect of, 417
Waste production, 415–416
Wastewater, 416
Water, 46, 72–73
 moderating influence of, 397
 properties of, 25–26
Water as solvent, 26
Water loss, 93
Water molecule
 hydrogen bonding, 26
Water-soluble vitamins, 51
Watson, James, 34
Weather, 393
Web of life, 370
Wetlands, 411, 411
Wildfire, 405–408
Wild man
 characteristics of, 295
Wilson, Edward O., 378
Wind patterns, 399
Wolves
 feeding beavers, 375–376
Wood Stork (*Mycteria americana*), 338
World Trade Organization (WTO) meeting
 protesters at, 211
WTO. *See* World Trade Organization (WTO)
 meeting

X

- X chromosome, **176**
 - traits controlled by genes on, **177**
- X inactivation, **177, 178, 178**
 - in female cats, **179**
- X-linked genes, **176**
- X-linked hemophilia trait, **176**
- XO (Turner syndrome), **175**
- XXY (Klinefelter syndrome), **175**

- Y chromosome, **176**
- Yeast, **331**
- Yeast cell, **82**
- Y-linked genes, **177**
- Yule, George Udny, **304**

Z

- Zea diploperennis*, **369, 369**
- Zinc lozenges
 - colds, **13**
- Zoologists, **328**
- Zygomycota, **331**
- Zygote, **126, 138, 139, 141, 146**