Chapter Objectives

Biology and Society: Biology All Around Us
1. Describe three examples of how biology is woven into the fabric of society.

The Scope of Life
2. Describe seven properties or processes we associate with life.

3. List and give an example of each level of biological organization, starting with an ecosystem and ending with atoms.

4. Describe the two main dynamic processes in an ecosystem.

5. Compare the structure of prokaryotic and eukaryotic cells.

6. Distinguish between the three domains and four eukaryotic kingdoms of life.

Evolution: Biology’s Unifying Theme
7. Describe the two main points that Darwin made in his book *The Origin of Species*.

8. Describe the two observations that led Darwin to his inescapable conclusion. State this conclusion.


The Process of Science
10. Compare discovery science and hypothesis-driven science. Provide examples of each regarding the study of trans fats in the human diet.

11. Distinguish between a hypothesis and a theory. Explain why natural selection qualifies as a scientific theory.

12. Distinguish science from other styles of inquiry.
13. Describe examples of the interdependence of technology and science.

**Evolution Connection: Evolution in Our Everyday Lives**

14. Explain how changes in the effectiveness of antibiotics illustrate natural selection.

**Key Terms**

- biology
- case study
- controlled experiment
- discovery science
- ecosystem
- hypothesis
- hypothesis-driven science
- life
- natural selection
- scientific method
- theory

**Chapter 2**

**Chapter Objectives**

**Biology and Society: Fluoride in the Water**

1. Explain how fluoride prevents tooth decay.

**Some Basic Chemistry**

2. Distinguish between matter, chemical elements, and compounds. Give examples of each.

3. Explain the significance of trace elements to human health.

4. Describe the relative size, location, and electrical charge of protons, neutrons, and electrons within an atom. Explain how the atomic number and mass number are determined.

5. Define an isotope and explain how isotopes are used in biological research and medicine.

6. Explain how the location of electrons determines the chemical properties of an atom.

7. Distinguish between ionic, covalent, and hydrogen chemical bonds.

8. Describe the structure of water and explain how its shape makes water a polar molecule.
9. Write the chemical formula for the creation of water from hydrogen and oxygen. Identify the reactants and products of this reaction.

**Water and Life**

10. Describe the four life-supporting properties of water. Describe an example of how each property affects some form of life.

11. Describe the relationship between aerobic exercise and brain size.

12. Distinguish between the chemical properties of acids, bases, and neutral solutions. Explain how buffers stabilize the pH of acidic and basic solutions.

13. Describe the potential impact of rising levels of carbon dioxide on the pH of the ocean.

**Evolution Connection: The Search for Extraterrestrial Life**

14. Explain why the search for extraterrestrial life centers on the search for water.

## Key Terms

<table>
<thead>
<tr>
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<th>compound</th>
<th>isotope</th>
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<tr>
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Chapter 3

**Chapter Objectives**

**Biology and Society: Got Lactose?**

1. Describe the causes and consequences of lactose intolerance.

**Organic Compounds**

2. Describe the special bonding properties of carbon that allow it to form an endless variety of organic molecules.
3. Compare a dehydration reaction to hydrolysis.

**Large Biological Molecules**

4. Compare the structures and roles of monosaccharides, disaccharides, and polysaccharides in living organisms. Give examples of each.

5. Compare the structure and properties of saturated and unsaturated fatty acids.

6. Distinguish between steroids and anabolic steroids, and explain how the use of anabolic steroids can be dangerous to a person’s health.

7. Describe the structure of proteins. Distinguish between the primary structure and the final three-dimensional shape.

8. Describe and compare the structures of DNA and RNA.

**Evolution Connection: Evolution and Lactose Intolerance in Humans**

9. Explain why lactose intolerance has evolved differently in humans spread throughout the world.

**Key Terms**

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**Chapter 4**

**Chapter Objectives**

**Biology and Society: Drugs That Target Bacterial Cells**

1. Explain how antibiotics specifically target bacteria while minimally harming the human host.
The Microscopic World of Cells

2. Compare the following pairs of terms, noting the most significant differences: light microscopes versus electron microscopes, scanning electron microscopes versus transmission electron microscopes, magnification versus resolution, prokaryotic cells versus eukaryotic cells, plant cells versus animal cells.

Membrane Structure

3. Describe the structure of the plasma membrane and other membranes of the cell. Explain why this structure is called a fluid mosaic.

4. Explain how MRSA bacteria disable human immune cells.

5. Compare the structures and functions of a plant cell wall and the extracellular matrix of an animal cell.

The Nucleus and Ribosomes: Genetic Control of the Cell

6. Explain how the genetic information in the nucleus is used to direct the production of proteins in the cytoplasm.

The Endomembrane System: Manufacturing and Distributing Cellular Products

7. Compare the structures and functions of the following components of the endomembrane system: rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi apparatus, lysosomes, and vacuoles.

Chloroplasts and Mitochondria: Energy Conversion

8. Compare the structure and function of chloroplasts and mitochondria. Describe the adaptive advantages of extensive folds in the grana of chloroplasts and the inner membrane of mitochondria.

The Cytoskeleton: Cell Shape and Movement

9. Describe the functions of the cytoskeleton. Compare the structures and functions of cilia and flagella.

Evolution Connection: The Evolution of Antibiotic Resistance

10. Explain how and why antibiotic-resistant bacteria have evolved.

Key Terms

- cell junctions
- cell theory
- central vacuole
- chloroplast
- chromatin
- chromosome
- cilia
- cristae
- cytoplasm
- cytoskeleton
- cytosol
- electron microscope (EM)
- endomembrane system
- endoplasmic reticulum (ER)
- eukaryotic cell
- extracellular matrix
- flagella
- fluid mosaic
- food vacuoles
- gene
- Golgi apparatus
Chapter 5

Chapter Objectives

Biology and Society: Natural Nanotechnology

1. Explain how nanotechnology might be used to power microscopic robots.

Some Basic Energy Concepts

2. Define the terms energy, kinetic energy, potential energy, and the principle of conservation of energy.

3. Explain the relationship between heat and entropy.

4. Compare the processes by which a car and a human use "fuel" to perform work.

5. Compare the amount of energy in a Calorie to that found in a kilocalorie. Which is most commonly used on food labels?

ATP and Cellular Work

6. Explain how ATP powers cellular work.

7. Explain how ATP is recycled.

Enzymes

8. Explain why enzymes are needed in living organisms.

9. Explain how enzymes are able to speed up specific chemical reactions.

10. Explain how inhibitors and poisons can affect enzyme activity.

Membrane Function
11. Define and distinguish between the following pairs of terms: diffusion versus osmosis, passive transport versus active transport, hypertonic versus hypotonic, endocytosis versus exocytosis, and phagocytosis versus pinocytosis.

12. Explain how signal transduction pathways permit environmental stimuli to impact the activities inside of a cell.

Evolution Connection: The Origin of Membranes

13. Explain why phospholipids were probably some of the first organic compounds to form as life emerged on Earth.

Key Terms

activation energy  entropy  metabolism  
active site  enzyme  osmoregulation  
active transport  enzyme inhibitor  osmosis  
ADP  exocytosis  passive transport  
ATP  facilitated diffusion  phagocytosis  
calorie  feedback regulation  pinocytosis  
chemical energy  heat  plasmolysis  
concentration gradient  hypertonic  potential energy  
conservation of energy  hypotonic  receptor-mediated endocytosis  
diffusion  induced fit  signal-transduction pathway  
endocytosis  isotonic  substrate  
energy  kinetic energy  transport proteins

Chapter 6

Chapter Objectives

Biology and Society: Marathoners versus Sprinters

1. Explain how differences in muscle fibers relate to athletic performance.

Energy Flow and Chemical Cycling in the Biosphere

2. Explain why photosynthesis is important to most ecosystems.

3. Define and compare autotrophs and heterotrophs, producers and consumers.

4. Explain how the processes of photosynthesis and cellular respiration are complementary to each other.

Cellular Respiration: Aerobic Harvest of Food Energy

5. Compare the processes of cellular respiration and breathing.
6. Write and explain the overall equation for cellular respiration.

7. Explain how the processes of oxidation and reduction are used to transfer electrons from food molecules to NADH, the electron transport chain, and oxygen.

8. Compare the reactants, products, location in the cell, and energy yield of the three stages of cellular respiration (glycolysis, citric acid cycle, and electron transport chain).

**Fermentation: Anaerobic Harvest of Food Energy**

9. Compare the reactants, products, and energy yield of aerobic metabolism versus fermentation in human cells. Indicate where this process occurs in each type of cell.

**Evolution Connection: Life before and after Oxygen**

10. Describe the lines of evidence that suggest that glycolysis is a primitive form of metabolism.

### Key Terms

- aerobic
- anaerobic
- ATP synthase
- autotroph
- cellular respiration
- citric acid cycle
- consumer
- electron transport
- electron transport chain
- fermentation
- glycolysis
- heterotroph
- NADH
- oxidation
- photosynthesis
- producer
- redox reaction
- reduction

### Chapter 7

**Chapter Objectives**

**Biology and Society: Green Energy**

1. Describe the advantages of biofuels over fossil fuels.

**The Basics of Photosynthesis**

2. Describe the structure of chloroplasts and indicate where the chlorophyll molecules are located. Explain how carbon dioxide and oxygen move in and out of leaves.

3. Explain how the process of photosynthesis is similar to the reverse of cellular respiration.

4. Compare the reactants and products of the light reactions and the Calvin cycle.
The Light Reactions: Converting Solar Energy to Chemical Energy

5. Define wavelength and the electromagnetic spectrum. Identify the wavelengths that are absorbed by and reflected from an object that appears green.

6. Explain how Theodor Engelmann was able to determine that only certain wavelengths of light are used in photosynthesis.

7. Compare the functions of chlorophyll $a$, chlorophyll $b$, and carotenoids.

8. Explain how the energy of photons is transferred within a photosystem.


10. Compare the process of ATP production in the inner mitochondrial membrane to the thylakoid membrane of chloroplasts.

The Calvin Cycle: Making Sugar from Carbon Dioxide

11. Describe the reactants and products of the Calvin cycle. Explain why this cycle is dependent on the light reactions.

Evolution Connection: Solar-Driven Evolution

12. Compare the mechanisms that C$_3$, C$_4$, and CAM plants use to obtain carbon dioxide.

Key Terms

- $C_3$ plants
- $C_4$ plants
- Calvin cycle
- CAM plants
- chlorophyll
- chlorophyll $a$
- chloroplast
- electromagnetic spectrum
- grana
- light reactions
- NADPH
- photon
- photosynthesis
- photosystem
- primary electron acceptor
- reaction center
- stomata
- stroma
- thylakoids
- wavelength

Chapter Objectives

Biology and Society: Rain Forest Rescue

1. Explain why cell division is an essential part of life.
What Cell Reproduction Accomplishes

2. Describe the roles of cell division in living organisms.

3. Compare the cellular processes and cellular products of asexual and sexual reproduction.

The Cell Cycle and Mitosis

4. Describe the basic structure of a chromosome. Explain how DNA is packaged into an elaborate, multilevel system of coiling and folding.

5. Explain how and when chromosomes are duplicated.

6. Describe the key events of each phase of the cell cycle.

7. Describe the key events of each phase of mitosis.

8. Compare the processes of cytokinesis in animal and plant cells.

9. Describe how the cell cycle control system normally functions and explain the consequences of errors in this system.

10. Explain how cancer cells are different from healthy cells of the body.

11. Distinguish between benign and malignant tumors. Explain what is meant by the “slash, burn, and poison” approach to treating cancer.

12. Explain how you can reduce your risks of developing cancer.

Meiosis, the Basis of Sexual Reproduction

13. Distinguish between the following pairs of terms: sex chromosomes versus autosomes, somatic cells versus gametes, and diploid versus haploid cells.

14. Explain why the generation of haploid gametes is necessary in sexually reproducing organisms.

15. Compare the processes and products of meiosis I and meiosis II.

16. Compare the overall processes and products of meiosis and mitosis.
17. Explain how independent assortment of chromosomes during meiosis, random fertilization, and crossing over contribute to genetic diversity in offspring.

18. Describe the consequences of nondisjunction in autosomes and sex chromosomes.

**Evolution Connection: The Advantages of Sex**

19. Explain why asexual and sexual reproduction are adaptive.

**Key Terms**

- anaphase
- asexual reproduction
- autosome
- benign tumor
- cancer
- cell cycle
- cell cycle control system
- cell division
- cell plate
- centromere
- centrosome
- chemotherapy
- chiasma
- chromatin
- chromosome
- cleavage furrow
- crossing over
- cytokinesis
- diploid
- Down syndrome
- fertilization
- gamete
- genetic recombination
- haploid
- histone
- homologous chromosome
- interphase
- karyotype
- life cycle
- malignant tumor
- meiosis
- metaphase
- metastasis
- mitosis
- mitotic phase
- mitotic spindle
- nucleosome
- nondisjunction
- prophase
- radiation therapy
- sex chromosome
- sexual reproduction
- sister chromatid
- somatic cell
- telophase
- trisomy 21
- tumor
- zygote

**Chapter 9**

**Chapter Objectives**

**Biology and Society: A Matter of Breeding**

1. Explain why purebred dogs are important in genetic research.

**Heritable Variation and Patterns of Inheritance**

2. Define and distinguish between self-fertilization, cross-fertilization, true-breeding organisms, hybrids, the P generation, the F₁ generation, and the F₂ generation.

3. Define and distinguish between the following pairs of terms: *heterozygous* versus *homozygous*, *dominant allele* versus *recessive allele*, *genotype* versus *phenotype*, and *phenotypic ratio* versus *genotypic ratio*. 
4. Define the law of segregation and explain how it applies to reproduction.

5. Define Mendel’s law of independent assortment and explain how it applies to a dihybrid cross.

6. Explain how a testcross can be performed to determine an organism’s genotype.

7. Explain how and when the rule of multiplication should be used to determine the probability of an event.

8. Explain how a pedigree is used to determine how a particular human trait is inherited. Define a carrier and explain how carriers are revealed in human pedigrees.

9. Compare the frequency and method of inheritance of recessive and dominant disorders. Explain how a dominant lethal allele can be inherited.

**Variations on Mendel’s Laws**

10. Define and distinguish between complete dominance, incomplete dominance, and codominance.

11. Describe the selective advantage of people who are heterozygous for sickle-cell disease.

12. Define and distinguish between pleiotropy and polygenic inheritance. Describe examples of each.

13. Explain how the environment influences the expression of traits.

**The Chromosomal Basis of Inheritance**

14. Define the chromosome theory of inheritance and explain how linked genes are inherited differently from nonlinked genes.

15. Explain why researchers used fruit flies and how they created linkage maps.

**Sex Chromosomes and Sex-Linked Genes**

16. Explain how chromosomes determine the sex of a human.

17. Explain why sex-linked diseases are more common in male humans.

18. Describe the general characters of the following sex-linked disorders in humans: red-green colorblindness and hemophilia.
Evolution Connection: Barking Up the Evolutionary Tree

19. Describe the relationships between the many breeds of dogs.

Key Terms
ABO blood groups  heredity  P generation
achondroplasia  heterozygous  phenotype
alleles  homozygous  pleiotropy
carrier  Huntington’s disease  polygenic inheritance
character  hybrid  Punnett square
chromosome theory of inheritance  hypercholesterolemia  recessive allele
codominance  inbreeding  recombination frequency
cross  incomplete dominance  red-green colorblindness
dihybrid cross  law of independent assortment  rule of multiplication
dominant allele  law of segregation  sex-linked gene
F1 generation  linkage map  sickle-cell disease
testcross  linked genes  trait
generics  loci  true cross
Genotype  monohybrid cross  true-breeding
hemophilia  pedigree  wild-type traits

Chapter 10

Chapter Objectives
Biology and Society: Tracking a Killer
1. Explain how flu vaccines are produced and why flu vaccines are important.

DNA: Structure and Replication
2. Explain what was and was not known about DNA by the early 1950s.
3. Describe and compare the chemical compositions of DNA and RNA.
4. Describe the key features of the overall shape of a DNA molecule. Explain how Watson and Crick determined the structure of DNA.
5. Describe the process of DNA replication.

The Flow of Genetic Information from DNA to RNA to Protein
6. Define transcription and translation. Explain why the hypothesis “one gene-one enzyme” is not correct.
7. Explain how the language of DNA directs the production of polypeptides.

8. Explain how codons are used to construct polypeptides. Explain what the authors mean when they state “there is redundancy in the code but no ambiguity.”

9. Describe the steps of transcription and the processing of RNA before it leaves the nucleus.

10. Compare the structures and functions of mRNA, tRNA, and rRNA.

11. Describe in detail the process of translation.

12. Distinguish between insertion, deletion, and substitution mutations. Explain how mutations can be harmful or beneficial to organisms.

**Viruses and Other Noncellular Infectious Agents**

13. Compare the lytic and lysogenic cycles of bacteriophages.

14. Compare the life cycles of RNA and DNA viruses. Describe the spread, symptoms, and prevention of viral diseases in plants and animals.

15. Describe the reproductive cycle of retroviruses such as HIV and the mechanisms by which AZT and protease inhibitors limit AIDS.

16. Explain how viroids and prions cause disease.

**Evolution Connection: Emerging Viruses**

17. Describe the three processes that contribute to the emergence of viral disease.

**Key Terms**

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Chapter 11

Chapter Objectives

Biology and Society: Tobacco’s Smoking Gun

1. Describe the evidence that suggests that cigarette smoking causes lung cancer.

How and Why Genes Are Regulated

2. Explain how the many types of adult human cells are formed.

3. Explain how the lac operon works.

4. Explain how DNA packing influences gene expression.

5. Explain how transcription is regulated in eukaryotes. Compare transcriptional regulation in eukaryotes and prokaryotes.

6. Explain how RNA is processed in eukaryotes before it leaves the nucleus. Explain how this processing can result in different proteins from the same gene.

7. Describe the mechanisms used to regulate gene expression after eukaryotic mRNA is transported to the cytoplasm.

8. Describe the significance of cell signaling in multicellular organisms.

9. Explain how homeoboxes help us understand animal evolution and development.

10. Explain how DNA microarrays help scientists visualize gene expression.

Cloning Plants and Animals

11. Explain how every cell has the potential to act like every other cell. Illustrate with examples.
12. Explain how plants are cloned, what this reveals about cell differentiation, and why growers clone plants.

13. Explain how nuclear transplantation can be used to clone animals. Describe advantages of reproductive cloning of animals.

14. Compare the properties of embryonic and adult stem cells. Explain why embryonic stem cells may be better to produce replacement tissues in adults.

The Genetic Basis of Cancer

15. Explain how mutations in proto-oncogenes and tumor suppressor genes can lead to cancer.

16. Explain how personal habits and individual choices can affect a person's risk of developing cancers.

Evolution Connection: The Evolution of Cancer in the Body

17. Explain how populations of cancer cells can evolve.

Key Terms

activators, adult stem cells, alternative RNA splicing, carcinogens, cellular differentiation, complementary DNA (cDNA), DNA microarray, embryonic stem cells (ES cells), enhancers, gene expression, gene regulation, growth factors, homeotic genes, nuclear transplantation, oncogene, operator, operon, promoter, proto-oncogene, regeneration, repressor, reproductive cloning, silencers, therapeutic cloning, transcription factors, tumor-suppressor genes, X chromosome inactivation

Chapter Objectives

Biology and Society: DNA, Guilt, and Innocence

1. Explain how DNA profiling is used in criminal trials.

Recombinant DNA Technology

2. Explain how recombinant DNA technology can be used to produce useful products.
3. Explain how recombinant DNA techniques are used to mass-produce a protein from an isolated gene.

4. Explain how genetic engineering is used to produce Humulin, human growth hormone, erythropoietin, vaccines, crops, and "pharm" animals.

5. Describe the process of cloning genes using plasmids.

6. Explain how the "shotgun" approach produces a genomic library.

7. Explain how restriction enzymes and DNA ligase are used to create recombinant DNA.

**DNA Profiling and Forensic Science**

8. Describe the many ways that DNA profiling can be used in our society.

9. Explain how the polymerase chain reaction (PCR), short tandem repeat (STR) analysis, restriction fragment length polymorphism (RFLP), and gel electrophoresis are used in the process of DNA profiling.

**Genomics and Proteomics**

10. Describe the types of organisms that have been the subject of recent sequencing efforts. Explain why these particular organisms have been examined.

11. Describe the goals of the Human Genome Project. Explain why our genome presents a major challenge.

12. Explain how comparative genomics has been used to investigate acts of bioterrorism, track the spread of disease, and study evolutionary relationships.

13. Explain why scientists study DNA and proteins to better understand the functioning of cells and organisms.

**Human Gene Therapy**

14. Describe the steps used to treat severe combined immunodeficiency disease using human gene therapy.

**Safety and Ethical Issues**

15. Describe the potential benefits, risks, and concerns of producing genetically modified foods.

16. Describe the concerns for the abuse of genetic information and technology as it relates to human society.

**Evolution Connection: Profiling the Y Chromosome**
17. Describe the surprising results of DNA profiling of the human Y chromosome.

**Key Terms**

biotechnology  
clone  
DNA ligase  
DNA profiling  
DNA technology  
forensics  
gel electrophoresis  
gene cloning  
genetic engineering  
genetic marker  
  genetically modified (GM) organism  
genomic library  
genomics  
human gene therapy  
human genome project  
nucleic acid probe  
plasmid  
polymerase chain reaction (PCR)  
proteomics  
recombinant DNA  
repetitive DNA  
restriction enzyme  
restriction fragments  
short tandem repeat (STR)  
STR analysis  
transgenic organism  
vaccine  
vector
Chapter 13

Chapter Objectives
Biology and Society: Persistent Pests
1. Explain how pesticide-resistant insect populations evolve.

2. Explain why an understanding of evolution is important.

Charles Darwin and The Origin of Species
3. Compare the ideas of Aristotle, Buffon, Lamarck, Wallace, and Darwin on the ability of species to change.

4. Explain how Darwin’s voyages on the Beagle influenced the development of his thoughts on evolution.

5. Explain how Lyell’s ideas impacted Darwin’s thinking.

6. Describe the circumstances that led to the presentation of Darwin’s and Wallace’s ideas in 1858 and the publication of Darwin’s work, The Origin of Species.

7. Describe Darwin’s two main points in The Origin of Species.

Evidence of Evolution
8. Explain how each of the following provides evidence that evolution occurs: the fossil record, biogeography, comparative anatomy, comparative embryology, and molecular biology.

Natural Selection
9. Describe Darwin’s two main observations that led to the concept of natural selection.

10. Explain how natural selection is more a process of editing than a creative mechanism.

Evolutionary Trees
11. Explain how evolutionary trees are constructed and what they represent.

The Modern Synthesis: Darwinism Meets Genetics
12. Explain what is meant by the phrases “modern synthesis” and “population genetics.” Further, define a population, describe its properties, and explain why a population is the smallest unit of evolution.

13. Explain the relative importance of mutation and sexual recombination in the evolution of life.
14. Explain how the Hardy-Weinberg formula can be used to determine the frequency of genotypes in a gene pool. Explain why this formula is a model for genetic equilibrium.

**Mechanisms of Evolution**

15. Distinguish between the following concepts: genetic drift versus gene flow; the founder effect versus bottleneck effect; directional selection, disruptive selection, and stabilizing selection; and sexual selection and natural selection.

**Evolution Connection: The Genetics of the Sickle-Cell Allele**

16. Explain why sickle-cell disease is much more common in African Americans than in the general U.S. population.

**Key Terms**

- biogeography
- bottleneck effect
- comparative anatomy
- directional selection
- disruptive selection
- evolution
- evolutionary adaptation
- evolutionary tree
- fitness
- fossil record
- fossils
- founder effect
- gene flow
- gene pool
- genetic drift
- Hardy-Weinberg equilibrium
- homology
- microevolution
- modern synthesis
- natural selection
- population
- sexual selection
- sexual dimorphism
- stabilizing selection
- vestigial structures

**Chapter 14**

**Chapter Objectives**

**Biology and Society: The Sixth Mass Extinction**

1. Explain why scientists think we may be in the middle of the sixth mass extinction in the last 600 million years.

**Macroevolution and the Diversity of Life**

2. Describe the processes included in the study of macroevolution. Distinguish between speciation and nonbranching evolution.

**The Origin of Species**

3. Define the biological species concept. Explain its limitations when applied to all types of living organisms.

4. Describe the different types of prezygotic and postzygotic reproductive barriers, noting examples of each.
5. Distinguish between allopatric and sympatric speciation, noting examples of each.

6. Compare the punctuated equilibria model to the graduated model of evolution. Relate a sudden geological appearance to our human sense of time.

The Evolution of Biological Novelty
7. Explain the concept of exaptation and describe several examples.

8. Explain how paedomorphosis can create new species. Describe some of the paedomorphic traits of humans.

9. Explain how duplications and mutations of homeotic genes can result in major evolutionary change.

Earth History and Macroevolution
10. List, in order, the four distinct ages in the history of life on Earth. Explain how the boundaries of each division are defined.

11. Explain how analyzing sedimentary rock layers and radiometric dating help us understand the fossil history of life on Earth.

12. Explain how the formation and breakup of the supercontinent Pangaea affected the evolution of life on Earth.

13. Explain how an extraterrestrial object could have caused the mass extinction 65 million years ago. Explain how mass extinctions can be seen as times of great opportunity.

Classifying the Diversity of Life
14. Define and distinguish between taxonomy and systematics. Explain how the binomial system is used to identify species. Finally, list the levels of taxonomic groups in order, beginning with species and ending at domain.

15. Explain how homologies are used to create classification systems. Distinguish between homologous and analogous structures. Explain how convergent evolution can make interpreting homologies difficult.

16. Define cladistics and describe how it is used to create classification systems.

17. Distinguish between the two-kingdom, five-kingdom, and three-domain systems of classification. Explain why classification systems are revised.

Evolution Connection: Rise of the Mammals
18. Explain how the extinction of most of the dinosaurs affected mammalian evolution.

**Key Terms**

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**Chapter 15**

**Chapter Objectives**

**Biology and Society: Can Life Be Created in the Lab?**

1. Explain how and why scientists are trying to create artificial life.

**Major Episodes in the History of Life**

2. Identify the sequence and timing of the major events in the evolution of early life, ending with the movement of the first life onto land.

**The Origin of Life**

3. Distinguish between spontaneous generation and biogenesis.

4. Describe the four stages of the hypothesis for the origin of life on Earth. Explain how natural selection would have affected these first pre-cells.

**Prokaryotes**

5. Describe the relative abundance of prokaryotes on Earth and the many ways they affect humans and ecosystems.

6. Describe the structure, function, and reproduction of prokaryotes.

7. Compare the types of nutritional diversity used by prokaryotes.

8. Compare the two groups of prokaryotic cells—bacteria and archaea. Describe three specific extreme environments in which members of archaea are found.
9. Describe the many ways that bacteria harm and benefit humans and ecosystems.

10. Explain how bacteria have been used in bioterrorism and bioremediation.

**Protists**

11. Describe the two main processes that explain how eukaryotic cells evolved.

12. Describe and compare the four main protist groups. Explain how these different groups impact our lives.

**Evolution Connection: The Origin of Multicellular Life**

13. Compare unicellular life to multicellular life, and explain the advantages of each system.

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**Key Terms**

- algae
- amoebas
- apicomplexans
- archaea
- bacilli
- bacteria
- binary fission
- biogenesis
- bioremediation
- cellular slime molds
- ciliates
- cocc
ci
- diatoms
- dinoflagellates
- endospor
es
- endosymbiosis
- endotoxins
- eukaryote
- exotoxins
- flagellates
- green algae
- pathogens
- plankton
- plasmodial slime mold
- prokaryote
- protists
- protozoans
- pseudopodia
- ribozymes
- seaweeds
- spontaneous generation
- symbiosis

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**Chapter 16**

**Chapter Objectives**

**Biology and Society: Will the Blight End the Chestnut?**

1. Explain why the American chestnut tree is seriously threatened.

**Colonizing Land**

2. Distinguish between algae and plants. Describe the functions of the following terrestrial adaptations: stomata, cuticle, lignin, vascular tissue, and gametangia.

3. Describe the process by which algae likely evolved onto land.

**Plant Diversity**
4. Describe the four major periods of plant evolution and the major adaptations associated with each stage.

5. Describe the life cycle and two key terrestrial adaptations of mosses.

6. Explain how ferns differ from and are similar to mosses. Explain how ancient life became today’s fossil fuels.

7. Describe the environmental conditions that favored the evolution of gymnosperms. Describe the three additional adaptations to life on land that first appeared in gymnosperms.

8. Describe the parts and functions of a flower. Explain how flowers attract pollinators and why this is adaptive.

9. Describe the reasons for the ongoing loss of plant diversity and its likely cost to humans.

**Fungi**

10. Describe the structure, feeding, reproduction, and ecological roles of fungi.

**Evolution Connection: Mutually Beneficial Symbiosis**

11. Distinguish between parasitic and mutually beneficial symbiotic relationships. Describe the relationships between fungi and plant roots to form mycorrhizae and algae and fungi to form lichens.

**Key Terms**

- absorption
- alternation of generations
- angiosperms
- anther
- bryophytes
- carpel
- charophytes
- conifers
- cuticle
- double fertilization
- endosperm
- ferns
- filament
- flower
- fossil fuels
- fruit
- fungi
- gametangia
- gametophyte
- germinate
- gymnosperms
- hyphae
- lichens
- lignin
- mosses
- mycelium
- mycorrhizae
- ovary
- ovules
- petals
- phloem
- pollen grain
- roots
- seed
- sepals
- shoots
- spores
- sporophyte
- stamen
- stigma
- stomata
- style
- symbiosis
- vascular tissue
- xylem
Chapter 17

Chapter Objectives
Biology and Society: Rise of the Hobbit People

1. Describe the fossil discoveries on the Indonesian island of Flores and relate the findings to modern humans.

The Origins of Animal Diversity

2. Define what it means to be an animal and describe common aspects of animal development.

3. Describe the significance of the Cambrian explosion. Describe two hypotheses that attempt to explain this major event in evolution.

4. Distinguish between the nine major animal phyla according to the presence of tissues, type of body symmetry, and presence of a body cavity.

Major Invertebrate Phyla

5. Describe the body structure and feeding strategies of sponges, cnidarians, molluscs, and flatworms.

6. Describe the general structure of annelids and nematodes. Compare the lifestyles and feeding habits of earthworms, polychaetes, leeches, and nematodes.

7. Describe the general structure of arthropods, and discuss the advantages and disadvantages of an exoskeleton. Distinguish between arachnids, crustaceans, millipedes, centipedes, and insects.

8. Describe the general structure of echinoderms and explain the significance of the water vascular system.

Vertebrate Evolution and Diversity

9. Describe the four defining characteristics of the phylum Chordata.

10. Distinguish between the following aquatic groups: jawless vertebrates, cartilaginous fishes, ray-finned fishes, and lobe-finned fishes. Describe the significance of jaws and a swim bladder.

11. Describe several aquatic and terrestrial adaptations of amphibians.

12. Describe the adaptations of reptiles to life on land.

13. Describe three adaptations for flight found in birds.
14. Describe the characteristics common to all mammals. Distinguish between monotremes, marsupials, and eutherian mammals, and provide examples of each.

**The Human Ancestry**

15. Describe the primate adaptations for living in trees. Compare the three main groups of primates, noting examples of each.

16. Compare Old World monkeys, New World monkeys, and hominoids.

17. Explain why it is incorrect (a) to consider chimpanzees as our ancestors, (b) to think of human evolution as a ladder, and (c) to think that human traits evolved together.

18. Describe the traits of each of the following species and the relationships between them: *Australopithecus afarensis*, *Homo habilis*, *Homo erectus*, *Homo neanderthalensis*, and *Homo sapiens*.

19. Explain why we think that Neanderthals had red hair and pale skin.

20. Describe the evolution of our species as we spread across the world.

21. Describe the three main stages of cultural evolution in modern humans.

**Evolution Connection: Recent Human Evolution**

22. Explain the significance of the *FOXP2* gene in humans.

**Key Terms**

- amniotes
- amniotic egg
- amphibians
- animals
- annelids
- anthropoids
- arachnids
- arthropods
- bilateral symmetry
- birds
- bivalves
- blastula
- body cavity
- body segmentation
- bony fishes
- cartilaginous fishes
- cephalopods
- chordates
- cnidarians
- coelom
- complete digestive tract
- crustaceans
- culture
- dorsal, hollow nerve cord
- earthworms
- echinoderms
- ectotherms
- endoskeleton
- endotherms
- eutherians
- evo-devo
- exoskeleton
- flatworms
- gastropods
- gastrovascular cavity
- gastrula
- hominids
- hominoids
- insects
- invertebrates
- larva
- lateral line system
- leeches
- lobe-finned fishes
Chapter 18

Chapter Objectives

Biology and Society: Penguins and Polar Bears in Peril

1. Describe the global climate changes already documented over the past century.

An Overview of Ecology

2. Define ecology and explain how ecologists learn about the structure and processes of our natural world.

3. Define the biosphere and the four levels of ecology.

Living in Earth’s Diverse Environments

4. Explain why the biosphere is patchy. List and describe the major abiotic factors affecting the distribution of life in the biosphere.

5. Define and describe examples of the three main types of responses that enable plants or animals to adjust to changes in their environments.

Biomes

6. Define the term biome, and describe the two traits that usually determine what type of biome will exist in a particular region. Also, explain how biomes get their names.

7. Compare the photic, aphotic, and benthic zones of a lake or large pond.

8. Compare the properties of a stream or river at its source and at the place where it empties into a lake or the sea. Explain how human activities impact the properties of rivers and streams.

9. Compare the characteristics of estuaries, intertidal zones, marine pelagic zones, and coral reefs. Explain what is special about hydrothermal vent communities.
10. Describe the threats to marine ecosystems.

11. Explain how climate affects terrestrial biome distribution.

12. Explain how the biosphere is linked by the global water cycle.

13. Explain how humans have impacted the world's biomes and describe the goals of sustainability.

**Global Climate Change**


15. Explain why CO\(_2\) levels may be increasing in the global atmosphere.

16. Explain how global climate change impacts the distribution and interactions of species.

17. Explain how you can decrease your carbon footprint.

**Evolution Connection: Climate Change as an Agent of Natural Selection**

18. Explain why organisms with low genetic diversity and long life spans might suffer the most in a rapidly changing climate.

**Key Terms**

- abiotic factors
- acclimation
- aphotic zone
- benthic realm
- biome
- biosphere
- biotic factors
- carbon footprint
- chaparral
- community
- community ecology
- coniferous forests
- coral reef
- deserts
- ecology
- ecosystem
- ecosystem ecology
- estuary
- greenhouse effect
- greenhouse gases
- habitat
- intertidal zone
- organismal ecology
- pelagic realm
- permafrost
- photic zone
- phytoplankton
- polar ice
- population
- population ecology
- savannas
- sustainability
- taiga
- temperate broadleaf forests
- temperate grasslands
- temperate rain forests
- temperate zones
- tropical forests
- tropics
- tundra
- wetland
- zooplankton
Chapter 19

Chapter Objectives
Biology and Society: Multiplying Like Rabbits

1. Describe the impact of the introduction of European rabbits and European red foxes into Australia.

An Overview of Population Ecology

2. Define the terms population, population ecology, and population density.

3. Explain how life tables are used to track mortality and survivorship in populations.

4. Compare Type I, Type II, and Type III survivorship curves.

5. Compare the characteristics of species that show opportunistic or equilibrilal life histories. Describe examples of each.

Population Growth Models

6. Compare the exponential growth model to the logistic growth model. Describe examples of each.

7. Distinguish between density-dependent and density-independent factors.

8. Explain why the hare and lynx populations cycle in a boom-and-bust fashion.

Applications of Population Ecology

9. Explain how population ecology can help guide efforts to save populations close to extinction. Distinguish between endangered species and threatened species.

10. Explain how population ecology can be used to provide the highest sustainable yields from harvests of natural populations.

11. Define invasive species and explain why they are a major ecological and financial problem.

12. Explain how biological controls are used to manage introduced species and the risks of adopting this strategy.

13. Describe the goals of integrated pest management and its advantages over the widespread use of pesticides.

Human Population Growth
14. Describe the growth of the human population over the last 2,000 years.

15. Explain how age structure diagrams can help to predict changes in a population and in social conditions.

16. Explain how the ecological footprint of a nation indicates the country’s impact on the world’s resources.

Evolution Connection: Humans as an Invasive Species

17. Explain how and why the North American population of mammals has changed in the last 15,000 years.

Key Terms

age structure  equilibrial life history  opportunistic life history
biological control  exponential population growth  population
carrying capacity  intraspecific competition  population density
coevolution  invasive species  population ecology
density-dependent factor  life history  population momentum
density-independent factor  life table  survivorship curve
ecological footprint  limiting factors  threatened species
endangered species  logistic population growth

Chapter 20

Chapter Objectives

Biology and Society: Does Biodiversity Matter?

1. Explain why biodiversity matters.

The Loss of Biodiversity

2. Describe the three levels of biological diversity.

3. Describe the main causes of declining biodiversity.

Community Ecology

4. Define a community, an ecological niche, and the competitive exclusion principle, noting examples of each.

5. Distinguish between parasitic and mutualistic relationships and describe examples of each.
6. Describe examples of predator adaptations, plant defenses against herbivores, and animal defenses against predators.

7. Define cryptic coloration and warning coloration and describe examples of each.

8. Define and list examples of producers, primary consumers, secondary consumers, detritivores, and decomposers in an ecosystem.

9. Distinguish between a food chain and a food web.

10. Explain how biological magnification concentrates toxins in the highest trophic levels.

11. Explain how species richness and relative abundance contribute to species diversity.

12. Describe the function of a keystone species in a community.

13. Explain how predation can help maintain species diversity.

14. Describe the types and effects of disturbances in communities.

15. Distinguish between primary and secondary succession.

**Ecosystem Ecology**

16. Compare the processes of energy flow and chemical cycling as they relate to ecosystem dynamics.

17. Explain why a continuous input of energy is required for ecosystems to function.

18. Describe the composition of the levels of an energy pyramid. Explain why energy pyramids usually do not have more than five levels.

19. Explain why it takes about the same amount of photosynthetic productivity to produce ten kilograms of corn as one kilogram of bacon.

20. Describe the biogeochemical cycles of carbon, nitrogen, water, and phosphorus.

21. Explain how human activities have disrupted the carbon, nitrogen, phosphorus, and water cycles.
Conservation and Restoration Biology

22. Explain the importance of biodiversity hot spots to the conservation of biological diversity.

23. Describe the nature of the issues confronting modern conservation biology.

24. Explain how edges and movement corridors impact species.

25. Explain how habitat fragmentation affects biodiversity.

26. Describe the goals and some of the methods of restoration ecology.

27. Describe the goals of sustainable development.

Evolution Connection: Biophilia and an Environmental Ethic

28. Describe the concept and significance of biophilia.

Key Terms

- abiotic reservoir
- biodiversity
- biodiversity hot spot
- biogeochemical cycles
- biological magnification
- biomass
- biophilia
- bioremediation
- carnivores
- chemical cycling
- community
- competitive exclusion principle
- conservation biology
- consumers
- cryptic coloration
- decomposers
- detritivores
- detritus
- disturbances
- ecological niche
- ecological succession
- ecosystem
- ecosystem services
- endemic species
- energy flow
- food chain
- food webs
- herbivores
- herbivory
- host
- interspecific competition
- interspecific interactions
- keystone species
- landscape
- landscape ecology
- movement corridor
- mutualism
- nitrogen fixation
- omnivores
- parasite
- predation
- primary consumers
- primary production
- primary succession
- producers
- pyramid of production
- quaternary consumers
- relative abundance
- restoration ecology
- secondary consumers
- secondary succession
- species diversity
- species richness
- sustainable development
- tertiary consumers
- trophic structure
- warning coloration

Chapter 21
Chapter Objectives

Biology and Society: Keeping Cool

1. Explain how a person keeps from overheating when exercising strenuously. Explain how these functions fail when heat exhaustion or heat stroke occur.

The Structural Organization of Animals

2. Define and compare anatomy and physiology. Explain why the two are usually studied together.

3. Define a tissue and describe the four main categories of animal tissues, noting examples of each.

4. Describe the relationships among tissues, organs, and organ systems.

Exchanges with the External Environment

5. Explain why every organism is an open system.

6. Explain how an animal’s size and shape affect how it exchanges energy and materials with its surrounding environment.

Regulating the Internal Environment

7. Define homeostasis and illustrate with an example.

8. Define and compare negative and positive feedback. Give examples of each within the human body.

9. Define thermoregulation and describe adaptations, in humans and other animals, that aid in thermoregulation.

10. Define and compare endotherms and ectotherms.

11. Describe the causes and functions of fever.

12. Define the process of osmoregulation. Distinguish between osmoconformers and osmoregulators.

13. Describe the functions of the kidneys. Explain how the structure of the human kidney contributes to the process of osmoregulation.

14. Relate the anatomy of the human urinary system to its functions.

15. Describe the causes, consequences, and treatment of kidney failure.
Evolution Connection: Adaptations for Thermoregulation

16. Explain how animals conserve heat or cool themselves in the process of thermoregulation.

Key Terms

- adipose tissue
- anatomy
- blood
- bone
- cardiac muscle
- cartilage
- connective tissue
- dialysis
- ectotherms
- endotherms
- epithelial tissue
- epithelium
- excretion
- fever
- fibrous connective tissue

- filtrate
- filtration
- homeostasis
- interstitial fluid
- loose connective tissue
- muscle tissue
- negative feedback
- nephron
- nervous tissue
- neuron
- open system
- organ
- organ systems
- osmoconformers
- osmoregulation

- osmoregulators
- physiology
- positive feedback
- reabsorption
- secretion
- skeletal muscle
- smooth muscle
- thermoregulation
- tissue
- tubules
- ureter
- urethra
- urinary bladder
- urine

Chapter 22

Chapter Objectives

Biology and Society: Stomach Surgeries

1. Explain how gastric bypass surgery promotes weight loss.

Overview of Animal Nutrition

2. Define and distinguish between herbivores, carnivores, and omnivores.

3. Define and distinguish between ingestion, digestion, absorption, and elimination.

4. Explain why the digestive dismantling of large food molecules is necessary.

5. Explain how animals digest their food without digesting their own cells and tissues.

6. Compare the different types of digestive compartments in animals.
A Tour of the Human Digestive System

7. Describe the main components of the human digestive tract and the associated digestive glands.

8. Describe the functions of the molecules in saliva and the roles of the tongue and teeth in digestion.

9. Explain how swallowing occurs and how food is directed away from the trachea.

10. Relate the structure of the stomach to its functions. Describe the functions of the components of gastric juice.

   Finally, explain the causes of heartburn and why the stomach does not digest itself.

11. Describe the most common cause of stomach ulcers and the primary forms of treatment.

12. Describe the different types of chemical digestion that occur in the small intestine. Explain how the structure of the small intestine promotes nutrient absorption.

13. Describe the structure and functions of the large intestine and rectum. Note the causes of constipation and diarrhea.

Human Nutritional Requirements

14. Distinguish between calories and kilocalories.

15. Define basal metabolic rate and explain how to best lose extra body fat.

16. Define essential amino acids and explain the complexities associated with a vegetarian diet.

17. Define vitamins and minerals and explain why they are important in the diet.

18. Describe the types of information found on food labels.

Nutritional Disorders

19. Define and distinguish between malnutrition and obesity.

20. Describe the causes, symptoms, and treatments of bulimia and anorexia nervosa.

Evolution Connection: Fat and Sugar Cravings

21. Explain how fat cravings in humans might have evolved.
Chapter 23
Biology and Society: The ABCs of Saving Lives

1. Explain what is meant by the ABCs of lifesaving.

Unifying Concepts of Animal Circulation

2. Explain why most animals require a circulatory system.

3. Describe the three main components of circulatory systems. Compare the structures of open and closed circulatory systems.

The Human Cardiovascular System

4. Compare the structures and functions of the human pulmonary and systemic circuits.

5. Describe the path of blood as it makes one full circuit through the body, including the heart.

6. Explain how heart rate is regulated.

7. Relate the structure of blood vessels to their functions. Define blood pressure, pulse, and hypertension.

8. Describe the components of blood and their functions.
9. Define stem cells and leukemia. Explain how stem cells can be used to fight leukemia.

10. Explain how the cardiovascular system contributes to homeostasis.

11. Describe the causes and frequency of cardiovascular disease.

**Unifying Concepts of Animal Respiration**

12. Explain how the circulatory and respiratory systems cooperate to facilitate gas exchange.

13. Describe four types of respiratory surfaces and the types of animals that use them.

**The Human Respiratory System**

14. Describe the three phases of gas exchange in humans.

15. Trace the path of a breath of air as it travels to and from the deepest portions of the lungs.

16. Describe the process of breathing and explain how it is controlled.

17. Describe the functions of hemoglobin. Explain how a shortage of iron, the presence of carbon monoxide, and smoking interfere with oxygen transport.

18. Explain how cigarette smoking affects public health.

**Evolution Connection: Choked Up**

19. Explain why our respiratory and digestive systems share a common entrance through our pharynx.

**Key Terms**

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<td>arterioles</td>
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<td>atherosclerosis</td>
<td>cardiovascular disease</td>
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<td>atrium</td>
<td>cardiovascular system</td>
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Chapter Objectives
Biology and Society: An AIDS Vaccine Failure

1. Explain why vaccines are important in the fight against harmful viruses.

Innate Defenses

2. Describe and compare the external and internal innate defenses that protect us from microbes and other substances that could invade and harm the body.

3. Describe the inflammatory response, the role of histamine, and the effects of drugs such as aspirin and ibuprofen.

4. Explain how lymph is formed.

5. Describe the general structure and functions of the lymphatic system.

Adaptive Defenses

6. Distinguish between an antigen and an antibody.

7. Explain how T and B cells are formed and how each functions.

8. Relate the shape of an antibody to its functions.

9. Describe the process of clonal selection. Explain how effector cells and monoclonal antibodies are produced.

10. Compare the primary immune response and the secondary immune response.
11. Explain how vaccination can prevent disease.

12. Explain how helper T cells and cytotoxic T cells participate in cell-mediated immune responses.

**Immune Disorders**

13. Define an allergen, an allergy, and anaphylactic shock. Describe the two steps of an allergic reaction.

14. Explain how an individual’s immune system distinguishes self from nonself.

15. Explain why autoimmune diseases occur and describe four examples.

16. Explain why immunodeficiency diseases occur and describe three examples.

17. Describe the widespread nature of HIV and AIDS. Explain the meaning of the name acquired immunodeficiency syndrome. Explain why most people with AIDS die from another infectious agent or from cancer.

**Evolution Connection: HIV Evolution**

18. Explain why the treatment of HIV remains very difficult.

**Key Terms**

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**Chapter Objectives**

**Biology and Society: A Hormonal Fountain of Youth?**

1. Describe the risks and benefits of hormone replacement therapy.
Hormones: An Overview

2. Define an endocrine system, a hormone, endocrine glands, and target cells.

3. Compare the two mechanisms by which hormones trigger changes in target cells.

The Human Endocrine System

4. Describe the different types and functions of vertebrate endocrine glands and the hormones they produce.

5. Describe the functions of and interrelationships between the hypothalamus and the anterior and posterior pituitary glands. Compare the two types of hormones that the hypothalamus uses to control the anterior pituitary.

6. Describe the functions of follicle-stimulating hormone, luteinizing hormone, growth hormone, and endorphins.

7. Describe the functions of the thyroid gland. Describe the symptoms of hypothyroidism, hyperthyroidism, and a goiter.

8. Explain how the thyroid and parathyroid glands maintain calcium homeostasis.

9. Explain how insulin and glucagon manage blood glucose levels. Describe the frequency, causes, symptoms, and treatments of type I and type II diabetes.

10. Compare the functions of the hormones released by the adrenal medulla and the adrenal cortex.

11. Describe the benefits and risks of using glucocorticoid drugs.

12. Describe the three major categories of sex hormones and explain their general functions.

13. Explain how endocrine disruptors disrupt natural ecosystems.

Evolution Connection: Androgens, Anatomy, and Aggression

14. Explain why prolactin is considered an ancient hormone.

Key Terms

| adrenal cortex | adrenal glands | adrenal medulla |
| androgens | epinephrine | norepinephrine |
| antagonistic hormones | estrogens | pancreas |
| anterior pituitary | glucagon | parathyroid glands |
| calcitonin | glucocorticoids | parathyroid hormone (PTH) |
| corticosteroids | gonads | pituitary gland |
| diabetes mellitus | growth hormone (GH) | posterior pituitary |
| endocrine glands | hormone | progestins |
| endocrine system | hypothalamus | target cell |
| endorphins | insulin | thyroid gland |

**Chapter 26**

**Chapter Objectives**

**Biology and Society: High-Tech Babies**

1. Explain why reproductive technologies often result in multiple births.

**Unifying Concepts of Animal Reproduction**

2. Describe the different forms of asexual reproduction. Explain the advantages and disadvantages of asexual reproduction.

3. Explain how hermaphrodites reproduce.

4. Distinguish between external and internal fertilization.

5. Describe the circumstances in which sexual reproduction is generally more adaptive than asexual reproduction.

**Human Reproduction**

6. Compare the structures and functions of the female and male human reproductive systems.

7. Describe and compare the processes and products of oogenesis and spermatogenesis.

8. Describe the events of the female reproductive cycle.

**Reproductive Health**

9. Compare the most common methods of contraception. Note the effectiveness of each.
10. Describe the major types of sexually transmitted diseases and the organisms that cause them. Explain why all sexually active people should be tested regularly for sexually transmitted diseases.

**Human Development**

11. Describe the events of fertilization. Explain how the structure of sperm matches its functions.

12. Describe the stages of development from the zygote to the gastrula. Explain the significance of the three layers produced in gastrulation.

13. Explain why induction and programmed cell death are significant parts of development.

14. Describe the structure of the embryo and its relationship to the uterus during and soon after implantation. Include the functions of the amnion, yolk sac, allantois, and chorion.

15. Describe the developmental changes that occur in each of the three trimesters of pregnancy.

16. Describe the functions of oxytocin in pregnancy.

17. Describe the main events of the three stages of labor.

**Reproductive Technologies**

18. Describe the common causes and treatments of infertility. Distinguish between infertility and impotency.

19. Describe the process of in vitro fertilization.

20. Describe some of the problems created by modern reproductive technologies.

**Evolution Connection: The “Grandmother Hypothesis”**

21. Explain how natural selection may have favored females who undergo menopause.

**Key Terms**

- allantois
- asexual reproduction
- blastocyst
- amnion
- birth control pills
- budding
Chapter 27

Chapter Objectives

Biology and Society: Beyond Human Experience

1. Explain how echolocation, electroreception, and magnetoreception are used by animals that have these systems.

An Overview of Animal Nervous Systems

2. Describe the structural and functional subdivisions of the nervous system.

3. Describe the structure and functions of neurons.

4. Define a resting potential and explain how it is generated.

5. Describe the changes that are associated with an action potential.
6. Explain how an action potential propagates itself along a neuron.

7. Compare the structures and locations of electrical and chemical synapses.

8. Describe the types of inputs a single neuron can receive and note the nature of the neuron’s response.

9. Describe the types and functions of human neurotransmitters.

10. Explain how drugs can alter chemical synapses.

**The Human Nervous System: A Closer Look**

11. Describe the general structure and functions of the brain and spinal cord.

12. Describe the functions of meninges and cerebrospinal fluid.

13. Compare the functions of the somatic and autonomic divisions of the peripheral nervous system.

14. Compare the functions of the parasympathetic and sympathetic divisions of the peripheral nervous system.

15. Describe the three main regions of the human brain and note their parts and functions.

16. Note the detailed structures and functions of the cerebral cortex.

17. Describe the characteristics of major depression, bipolar disorder, and Alzheimer’s disease.

**The Senses**

18. Define sensory transduction, a receptor potential, and sensory adaptation. Illustrate each with examples.

19. Describe the five general categories of sensory receptors found in animals. Note examples of each.

20. Describe the parts of the human eye and their functions.

21. Compare the structures, functions, distributions, and densities of rods and cones.

22. Explain the causes and symptoms of glaucoma, myopia, hyperopia, and astigmatism.
23. List in order the structures of the ear involved in hearing. Describe the possible causes of hearing loss.

**Motor Systems**

24. Distinguish between the axial and appendicular skeletons. Describe three types of joints and provide examples of each.

25. Describe the complex structure of a bone, noting the major tissues that contribute to bones and their functions.

26. Describe the most common skeletal disorders. Explain why bones break and how we can help them heal.

27. Describe the structure and arrangement of the filaments found in a muscle cell.

28. Explain, in detail, how a muscle cell contracts.

29. Describe the structure and function of motor units.

30. Explain how a motor neuron signals a muscle fiber to contract.

31. Describe an example of a person using his or her sensory receptors, central nervous system, skeleton, and muscles to perform an activity.

**Evolution Connection: Seeing UV**

32. Explain how UV detection appears to have evolved in birds.

**Key Terms**

- action potential
- Alzheimer’s disease
- appendicular skeleton
- aqueous humor
- arthritis
- association areas
- astigmatism
- auditory canal
- autonomic nervous system
- axial skeleton
- axon
- ball-and-socket joints
- bipolar disorder
- brain
- brainstem
- cell body
- central nervous system (CNS)
- cerebellum
- cerebral cortex
- cerebrospinal fluid
- cerebrum
- chemoreceptors
- cochlea
- cones
- cornea
- corpus callosum
dendrites
- eardrum
- effectors
- electromagnetic receptors
- endoskeleton
- Eustachian tube
- farsightedness
- hinge joint
- hypothalamus
- inner ear
- integration
- interneurons
- iris
Chapter 28

Chapter Objectives

Biology and Society: Plants and Human Civilization

1. Describe the significance of the cultivation of wheat to human civilization.

2. Describe the significance of the green revolution.

The Structure and Function of a Flowering Plant

3. Compare the structures of monocots and dicots.

4. Compare the structures and functions of root and shoot systems. Explain how \textit{pinching back} a plant helps make the plant more bushy.

5. Describe and compare the structures and functions of a taproot, runner, rhizome, tuber, and tendril.

6. Describe the structures, functions, and arrangements of the dermal tissue system, vascular tissue system, and ground tissue system in roots and shoots.

7. Compare the structure and function of parenchyma cells, collenchyma cells, sclerenchyma cells, tracheids, vessel elements, and food-conducting cells. Also, compare the structure and function of xylem and phloem.
Plant Growth


The Life Cycle of a Flowering Plant
10. Describe the parts of a flower and their functions. Relate this structure to the life cycle of an angiosperm.

11. Describe the processes and events that lead to double fertilization.

12. Explain how a seed forms and describe the advantages of seed dormancy.

13. Describe the structure, formation, and functions of fruit.

14. Describe the general process of germination in a pea plant.

Evolution Connection: The Problem of the Disappearing Bees
15. Explain how flowering plants and land animals each gain from their mutually beneficial relationship.

Key Terms
angiosperms  
advertisements  
dermal tissue system  
determinate growth  
dicot  
double fertilization  
dhroxy sac  
dendoderma  
derosperm  
educots  
fertilization  
flower  
fruit  
gametophyte  
germinates  
ground tissue system  
guard cells  
determine growth  
ternodes  
leaves  
lignin  
meristem  
mesophyll  
monocot  
nodes  
organ  
ovary  
ovule  
parenchyma cells  
perennials  
petals  
petiole  
phloem  
pistil  
pith  
pollen grain  
pollination  
primary growth  
root  
root cap  
root hairs  
root system
Chapter 29

Chapter Objectives
Biology and Society: Planting Hope in the Wake of Katrina

1. Explain why planting sunflowers is a low-cost solution to the accumulation of toxic materials in New Orleans' soil.

How Plants Acquire and Transport Nutrients

2. Explain where and how a plant obtains all the materials necessary to construct all the other organic materials it needs.

3. Distinguish between micronutrients and macronutrients, noting examples of each.

4. Describe the advantages of organic farming to the environment.

5. Describe the structure and function of root hairs.

6. Explain how mycorrhizae help plants absorb nutrients from the soil.

7. Explain how and why most plants depend on bacteria to supply nitrogen.

8. Describe the special relationship between legumes and nitrogen-fixing bacteria.

9. Explain the transpiration-cohesion-tension mechanism responsible for the ascent of sap in xylem.

10. Explain how and when guard cells control transpiration.

11. Explain how, when, and where phloem conducts sap.

Plant Hormones
12. Describe the general roles and properties of plant hormones.

13. Describe the roles of the five major types of plant hormones.

14. Explain how plant hormones are used to manipulate agricultural crops.

**Response to Stimuli**

15. Define phototropism, gravitropism, and thigmotropism and explain their significance in plants.

16. Distinguish between short-night plants and long-night plants.

**Evolution Connection: The Interdependence of Organisms**

17. Explain how life is interrelated.

**Key Terms**

- abscisic acid
- adherence
- auxin
- cohesion
- compost
- cytokinins
- essential element
- ethylene
- fertilizer
- gibberellins
- gravitropism
- hormones
- macronutrients
- micronutrients
- minerals
- mycorrhiza
- nitrogen fixation
- organic farming
- phloem sap
- photoperiod
- phototropism
- pressure-flow mechanism
- sugar sink
- sugar source
- thigmotropism
- transpiration
- transpiration-cohesion-tension mechanism
- tropisms
- xylem sap