

GLOBAL
EDITION



Campbell Biology

Concepts & Connections

TENTH EDITION

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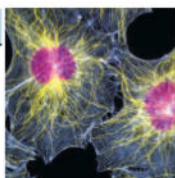
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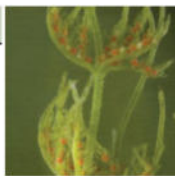
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1.11 Theme: Life depends on the flow of information

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- 22.1 Gas exchange in humans involves breathing, transport of gases, and exchange with body cells
- 22.2 Animals exchange O₂ and CO₂ across moist body surfaces
- 22.3 Visualizing The Concept Gills are adapted for gas exchange in aquatic environments
- 22.4 The tracheal system of insects provides direct exchange between the air and body cells
- 22.5 Evolution Connection The evolution of lungs facilitated the movement of tetrapods onto land

The Human Respiratory System

- 22.6 In mammals, branching tubes convey air to lungs located in the chest cavity
- 22.7 Scientific Thinking Warning: Cigarette smoking is hazardous to your health
- 22.8 Negative pressure breathing ventilates your lungs
- 22.9 Breathing is automatically controlled

Transport of Gases in the Human Body

- 22.10 Blood transports respiratory gases
- 22.11 Hemoglobin carries O₂, helps transport CO₂, and buffers the blood
- 22.12 Connection The human fetus exchanges gases with the mothers blood

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Chapter 23: Circulation

Circulatory Systems

- 23.1 Circulatory systems facilitate exchange with all body tissues
- 23.2 Evolution Connection Vertebrate cardiovascular systems reflect evolution

The Human Cardiovascular System and Heart

- 23.3 Visualizing The Concept The human cardiovascular system illustrates the double circulation of mammals
- 23.4 The heart contracts and relaxes rhythmically
- 23.5 The SA node sets the tempo of the heartbeat
- 23.6 Scientific Thinking How should heart disease be treated?

Structure and Function of Blood Vessels

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- 23.7 The structure of blood vessels fits their functions
- 23.8 Blood pressure and velocity reflect the structure and arrangement of blood vessels
- 23.9 Connection Measuring blood pressure can reveal cardiovascular problems
- 23.10 Arteriole diameter and precapillary sphincters control the distribution of blood
- 23.11 Capillaries allow the transfer of substances through their walls

Structure and Function of Blood

- 23.12 Blood consists of red and white blood cells suspended in plasma
- 23.13 Connection Too few or too many red blood cells can be unhealthy
- 23.14 Blood clots plug leaks when blood vessels are injured
- 23.15 Connection Stem cells offer a potential cure for blood cell diseases

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Chapter 24: The Immune System

Innate Immunity

- 24.1 All animals have innate immunity
- 24.2 The inflammatory response disinfects damaged tissue

Adaptive Immunity

- 24.3 The adaptive immune response counters specific invaders
- 24.4 The lymphatic system becomes a crucial battleground during infection
- 24.5 Lymphocytes mount a dual defense
- 24.6 Antigen receptors and antibodies bind to specific regions on an antigen
- 24.7 Visualizing The Concept Clonal selection mobilizes defenses against specific antigens
- 24.8 The primary and secondary responses differ in speed, strength, and duration
- 24.9 The structure of an antibody matches its function
- 24.10 Connection Herd immunity prevents the outbreak of infectious disease
- 24.11 Scientific Thinking Why is herd immunity so difficult with the flu?
- 24.12 Helper T cells stimulate the humoral and cell-mediated immune responses
- 24.13 Cytotoxic T cells destroy infected body cells
- 24.14 Connection HIV destroys helper T cells, compromising the body's defenses
- 24.15 Evolution Connection The rapid evolution of HIV complicates AIDS treatment
- 24.16 The immune system depends on our molecular fingerprints

Disorders of the Immune System

- 24.17 Connection Immune system disorders result from self-directed or underactive responses
- 24.18 Connection Allergies are overreactions to certain environmental antigens

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Chapter 25: Control of Body Temperature and Water Balance

Thermoregulation

- 25.1 An animal's regulation of body temperature helps maintain homeostasis
- 25.2 Thermoregulation involves adaptations that balance heat gain and loss
- 25.3 Scientific Thinking Drop-keeping helps mosquitoes control body temperature

Osmoregulation and Excretion

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- 25.4 Visualizing The Concept Animals balance their levels of water and solutes through osmoregulation
- 25.5 Evolution Connection Several ways to dispose of nitrogenous wastes have evolved in animals
- 25.6 The urinary system plays several major roles in homeostasis
- 25.7 The kidney is a water-conserving organ
- 25.8 Hormones regulate the urinary system
- 25.9 Connection Kidney dialysis can save lives

Chapter Review

Chapter 26: Hormones and the Endocrine System

The Nature of Chemical Regulation

- 26.1 Chemical and electrical signals coordinate body functions
- 26.2 Hormones affect target cells using two main signaling mechanisms
- 26.3 Scientific Thinking A widely used weed killer demasculinizes male frogs

The Vertebrate Endocrine System

- 26.4 The vertebrate endocrine system consists of more than a dozen major glands
- 26.5 The hypothalamus, which is closely tied to the pituitary, connects the nervous and endocrine systems

Hormones and Homeostasis

- 26.6 The thyroid regulates development and metabolism
- 26.7 The gonads secrete sex hormones
- 26.8 Visualizing The Concept Pancreatic hormones regulate blood glucose level
- 26.9 Connection Diabetes is a common endocrine disorder
- 26.10 The adrenal glands mobilize responses to stress
- 26.11 Evolution Connection A single hormone can perform a variety of functions in different animals
- 26.12 Connection Hormones can promote social behaviors

Chapter Review

Chapter 27: Reproduction and Embryonic Development

Asexual and Sexual Reproduction

- 27.1 Asexual reproduction results in the generation of genetically identical offspring
- 27.2 Sexual reproduction results in the generation of genetically unique offspring

Human Reproduction

- 27.3 The human female reproductive system includes the ovaries and structures that deliver gametes
- 27.4 The human male reproductive system includes the testes and structures that deliver gametes
- 27.5 The formation of sperm and egg cells requires meiosis
- 27.6 Hormones synchronize cyclic changes in the ovary and uterus
- 27.7 Scientific Thinking Sexual activity can transmit disease
- 27.8 Connection Contraception can prevent unwanted pregnancy

Principles of Embryonic Development

- 27.9 Fertilization results in a zygote and triggers embryonic development
- 27.10 Cleavage produces a blastula from the zygote
- 27.11 Gastrulation produces a three-layered embryo
- 27.12 Organs start to form after gastrulation

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27.13 Multiple processes give form to the developing animal

27.14 Evolution Connection Pattern formation during embryonic development is controlled by ancient genes

Human Development

27.15 The embryo and placenta take shape during the first month of pregnancy

27.16 Visualizing The Concept Human pregnancy is divided into trimesters

27.17 Childbirth is induced by hormones and other chemical signals

27.18 Connection Reproductive technologies increase our reproductive options

Chapter Review

Chapter 28: Nervous Systems

Nervous System Structure and Function

28.1 Nervous systems receive sensory input, interpret it, and send out commands

28.2 Neurons are the functional units of nervous systems

Nerve Signals and Their Transmission

28.3 Nerve function depends on charge differences across neuron membranes

28.4 A nerve signal begins as a change in the membrane potential

28.5 The action potential propagates itself along the axon

28.6 Visualizing The Concept Neurons communicate at synapses

28.7 Chemical synapses enable complex information to be processed

28.8 A variety of small molecules function as neurotransmitters

28.9 Connection Many drugs act at chemical synapses

28.10 Scientific Thinking Published data are biased toward positive findings

An Overview of Animal Nervous Systems

28.11 Evolution Connection The evolution of animal nervous systems reflects changes in body symmetry

28.12 Vertebrate nervous systems are highly centralized

28.13 The peripheral nervous system of vertebrates can be divided into functional components

28.14 The vertebrate brain develops from three anterior bulges of the neural tube

The Human Brain

28.15 The structure of a living supercomputer: The human brain

28.16 The cerebral cortex controls voluntary movement and cognitive functions

28.17 Connection Injuries and brain surgery provide insight into brain function

28.18 The nervous system can reorganize its neural connections

28.19 Sleep is an active state for the brain

28.20 The limbic system is involved in emotions and memory

28.21 Connection Changes in brain physiology can produce neurological disorders

Chapter Review

Chapter 29: The Senses

Sensory Reception

29.1 Sensory receptors convert stimuli to action potentials

29.2 Scientific Thinking The model for magnetic sensory reception is incomplete

29.3 Specialized sensory receptors detect five categories of stimuli

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Hearing and Balance

- 29.4 The ear converts air pressure waves to action potentials that are perceived as sound
- 29.5 The inner ear houses our organs of balance
- 29.6 Connection What causes motion sickness?

Vision

- 29.7 Evolution Connection Several types of eyes have evolved among animals
- 29.8 The human eye focuses by changing the shape of the lens
- 29.9 Connection Many vision problems can be corrected with artificial lenses or surgery
- 29.10 The human retina contains two types of photoreceptors: rods and cones

Taste and Smell

- 29.11 Taste and odor receptors detect chemicals present in solution or air
- 29.12 Connection Does cilantro taste like soap to you?
- 29.13 Summary: The central nervous system couples stimulus with response

Chapter Review

Chapter 30: How Animals Move

Movement and Locomotion

- 30.1 Locomotion requires energy to overcome friction and gravity
- 30.2 Skeletons function in support, movement, and protection

The Vertebrate Skeleton

- 30.3 Evolution Connection Vertebrate skeletons are variations on an ancient theme
- 30.4 Bones are complex living organs
- 30.5 Connection Healthy bones resist stress and heal from injuries
- 30.6 Joints permit different types of movement

Muscle Contraction and Movement

- 30.7 The skeleton and muscles interact in movement
- 30.8 Each muscle cell has its own contractile apparatus
- 30.9 A muscle contracts when thin filaments slide along thick filaments
- 30.10 Motor neurons stimulate muscle contraction
- 30.11 Connection Aerobic respiration supplies most of the energy for exercise
- 30.12 Scientific Thinking Characteristics of muscle fibers affect athletic performance

Chapter Review

Unit VI: Plants: Form and Function

Chapter 31: Plant Structure, Growth, and Reproduction

Plant Structure and Function

- 31.1 Scientific Thinking The domestication of crops changed the course of human history
- 31.2 The two major groups of angiosperms are the monocots and the eudicots
- 31.3 A typical plant body contains three basic organs: roots, stems, and leaves
- 31.4 Connection Many plants have modified roots, stems, and leaves
- 31.5 Three tissue systems make up the plant body
- 31.6 Plant cells are diverse in structure and function

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Plant Growth

- 31.7 Primary growth lengthens roots and shoots
- 31.8 Secondary growth increases the diameter of woody plants

Reproduction of Flowering Plants

- 31.9 The flower is the organ of sexual reproduction in angiosperms
- 31.10 The development of pollen and ovules culminates in fertilization
- 31.11 The ovule develops into a seed
- 31.12 The ovary develops into a fruit
- 31.13 Seed germination continues the life cycle
- 31.14 Asexual reproduction produces plant clones
- 31.15 Connection Plant cloning is an important agricultural tool
- 31.16 Evolution Connection Evolutionary adaptations help some plants to live very long lives

Chapter Review

Chapter 32: Plant Nutrition and Transport

The Uptake and Transport of Plant Nutrients

- 32.1 Plants acquire nutrients from air, water, and soil
- 32.2 The plasma membranes of root cells control solute uptake
- 32.3 Visualizing The Concept Transpiration pulls water up xylem vessels
- 32.4 Guard cells control transpiration
- 32.5 Phloem transports sugars
- 32.6 Connection Humans tap into plant transport structures

Plant Nutrients and the Soil

- 32.7 Plant health depends on obtaining all of the essential inorganic nutrients
- 32.8 Connection Fertilizers can help prevent nutrient deficiencies
- 32.9 Fertile soil supports plant growth
- 32.10 Connection Soil conservation is essential to human life
- 32.11 Scientific Thinking Organic farmers follow principles meant to promote health
- 32.12 Connection Genetic engineering is improving the yields and nutritional values of crops

Plant Nutrition and Symbiosis

- 32.13 Most plants depend on bacteria to supply nitrogen
- 32.14 Evolution Connection Mutually beneficial relationships have evolved between plants and other kinds of organisms
- 32.15 The plant kingdom includes epiphytes, parasites, and carnivores

Chapter Review

Chapter 33: Control Systems in Plants

Plant Hormones

- 33.1 Scientific Thinking A series of experiments by several scientists led to the discovery of a plant hormone
- 33.2 Botanists have identified several major types of hormones
- 33.3 Auxin stimulates the elongation of cells in young shoots
- 33.4 Cytokinins stimulate cell division

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33.5 Gibberellins affect stem elongation and have numerous other effects

33.6 Absciscic acid inhibits many plant processes

33.7 Ethylene triggers fruit ripening and other aging processes

33.8 Connection Plant hormones have many agricultural uses

Responses to Stimuli

33.9 Tropisms orient plant growth toward or away from environmental stimuli

33.10 Plants have internal clocks

33.11 Plants mark the seasons by measuring photoperiod

33.12 Phytochromes are light detectors that help set the biological clock

33.13 Evolution Connection Defenses against herbivores and infectious microbes have evolved in plants

Chapter Review

Unit VII: Ecology

Chapter 34: The Biosphere: An Introduction to Earth's Diverse Environments

The Biosphere

34.1 Ecologists study how organisms interact with their environment at several levels

34.2 Scientific Thinking The science of ecology provides insight into environmental problems

34.3 Physical and chemical factors influence life in the biosphere

34.4 Evolution Connection Organisms are adapted to abiotic and biotic factors through natural selection

34.5 Regional climate influences the distribution of terrestrial communities

Aquatic Biomes

34.6 Sunlight and substrate are key factors in the distribution of marine organisms

34.7 Current, sunlight, and nutrients are important abiotic factors in freshwater biomes

Terrestrial Biomes

34.8 Terrestrial biomes reflect regional variations in climate

34.9 Tropical forests cluster near the equator

34.10 Savannas are grasslands with scattered trees

34.11 Deserts are defined by their dryness

34.12 Spiny shrubs dominate the chaparral

34.13 Temperate grasslands include the North American prairie

34.14 Broadleaf trees dominate temperate forests

34.15 Coniferous forests are often dominated by a few species of trees

34.16 Long, bitter-cold winters characterize the tundra

34.17 Polar ice covers the land at high latitudes

34.18 Visualizing The Concept The global water cycle connects aquatic and terrestrial biomes

Chapter Review

Chapter 35: Behavioral Adaptations to the Environment

Types and Causes of Behavior

35.1 Proximate and ultimate factors cause behavior

35.2 Fixed action patterns are innate behaviors

35.3 Both genetics and environment influence behavior

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Learning

- 35.4 Habituation is a simple type of learning
- 35.5 Imprinting requires both innate behavior and experience
- 35.6 Connection Imprinting poses problems and opportunities for conservation programs
- 35.7 Visualizing The Concept Animal movement may be a response to stimuli or require spatial learning
- 35.8 A variety of cues guide migratory movements
- 35.9 Animals may learn to associate a stimulus or behavior with a response
- 35.10 Animals can learn from each other
- 35.11 Problem-solving behavior relies on cognition

Survival and Reproductive Success

- 35.12 Optimal foraging depends on cost-benefit tradeoffs
- 35.13 Communication is an essential element of interactions between animals
- 35.14 Mating behavior often includes elaborate courtship rituals
- 35.15 Mating systems and parental care enhance reproductive success
- 35.16 Connection Chemical pollutants can cause abnormal behavior

Social Behavior

- 35.17 Social behavior can increase individual fitness
- 35.18 Territorial behavior is a type of resource defense
- 35.19 Agonistic behavior can decrease the costs of aggression
- 35.20 Dominance hierarchies are maintained by agonistic behavior
- 35.21 Evolution Connection Altruistic acts can often be explained by the concept of inclusive fitness
- 35.22 Scientific Thinking Jane Goodall revolutionized our understanding of chimpanzee behavior
- 35.23 Human behavior is the result of both genetic and environmental factors

Chapter Review

Chapter 36: Population Ecology

Population Structure and Dynamics

- 36.1 Population ecology is the study of how and why populations change
- 36.2 Density and dispersion patterns are important population variables
- 36.3 Life tables track survivorship in populations
- 36.4 Idealized models predict patterns of population growth
- 36.5 Multiple factors may limit population growth
- 36.6 Scientific Thinking Some populations have boom-and-bust cycles
- 36.7 Evolution Connection Evolution shapes life histories
- 36.8 Connection Principles of population ecology have practical applications

The Human Population

- 36.9 The human population continues to increase, but the growth rate is slowing
- 36.10 Connection Age structures reveal social and economic trends
- 36.11 Connection An ecological footprint is a measure of resource consumption

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Chapter 37: Communities and Ecosystems

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Community Structure and Dynamics

- 37.1 A community includes all the organisms inhabiting a particular area
- 37.2 Interspecific interactions are fundamental to community structure
- 37.3 Competition may occur when a shared resource is limited
- 37.4 Mutualism benefits both partners
- 37.5 Evolution Connection Predation leads to diverse adaptations in prey species
- 37.6 Evolution Connection Herbivory leads to diverse adaptations in plants
- 37.7 Parasites and pathogens can affect community composition
- 37.8 Trophic structure is a key factor in community dynamics
- 37.9 Visualizing The Concept Food chains interconnect, forming food webs
- 37.10 Species diversity includes species richness and relative abundance
- 37.11 Scientific Thinking Some species have a disproportionate impact on diversity
- 37.12 Disturbance is a prominent feature of most communities
- 37.13 Connection Invasive species can devastate communities

Ecosystem Structure and Dynamics

- 37.14 Ecosystem ecology emphasizes energy flow and chemical cycling
- 37.15 Primary production sets the energy budget for ecosystems
- 37.16 Energy supply limits the length of food chains
- 37.17 Connection An energy pyramid explains the ecological cost of meat
- 37.18 Chemicals are cycled between organic matter and abiotic reservoirs
- 37.19 The carbon cycle depends on photosynthesis and respiration
- 37.20 The phosphorus cycle depends on the weathering of rock
- 37.21 The nitrogen cycle depends on bacteria
- 37.22 Connection A rapid inflow of nutrients degrades aquatic ecosystems
- 37.23 Connection Ecosystem services are essential to human well-being

Chapter Review

Chapter 38: Conservation Biology

The Loss of Biodiversity

- 38.1 Loss of biodiversity includes the loss of ecosystems, species, and genes
- 38.2 Connection Habitat loss, invasive species, overharvesting, pollution, and climate change are major threats to biodiversity
- 38.3 Connection Rapid warming is changing the global climate
- 38.4 Connection Human activities are responsible for rising concentrations of greenhouse gases
- 38.5 Climate change affects biomes, ecosystems, communities, and populations
- 38.6 Evolution Connection Climate change is an agent of natural selection

Conservation Biology and Restoration Ecology

- 38.7 Protecting endangered populations is one goal of conservation biology
- 38.8 Sustaining ecosystems and landscapes is a conservation priority
- 38.9 Establishing protected areas slows the loss of biodiversity
- 38.10 Zoned reserves are an attempt to reverse ecosystem disruption
- 38.11 Scientific Thinking The Yellowstone to Yukon Conservation Initiative seeks to preserve biodiversity by connecting protected areas

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38.12 Connection The study of how to restore degraded habitats is a developing science

38.13 Sustainable development is an ultimate goal

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Appendix 1: Metric Conversion Table

Appendix 2: The Periodic Table

Appendix 3: The Amino Acids of Proteins

Appendix 4: Chapter Review Answers

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