



Concepts of Biology

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OpenStax Text	Samantha Fowler, Clayton State University; Rebecca Roush, Sandhills Community College; James Wise, Hampton University	Concepts of Biology	OpenStax Text
Interactive Questions	Wiley		
Animations	TBD		Coming Soon

Concepts of Biology is designed for a one-semester non-majors biology course, with topics such as cell structure and function, photosynthesis, cell division and genetics, molecular biology and biotechnology, evolution, animal structure and function, and ecology.

Knewton Alta Concepts of Biology has two instructional (**once the videos are added*) sequences for every learning objective, giving students multiple opportunities to learn new concepts. Knewton Alta Concepts of Biology covers the typical introductory biology course for nonmajors, and also provides the necessary depth to ensure the course is manageable and engaging for instructors and students alike with just-in-time instruction, personalized remediation, and engaging interactive questions.

Concepts of Biology | Table of Contents

Unit 1. The Cellular Foundation of Life

- Chapter 1. Introduction to Biology
 - 1.1. Themes and Concepts of Biology
 - Define biology as a science, and identify and distinguish between the eight characteristics that living things universally share
 - Identify and distinguish between the hierarchical levels of organization of living things
 - Identify and distinguish between the hierarchical levels of biological classification that encompass the diversity of life
 - Appreciate that biology is a vast discipline with many sub-disciplines in which biologists specialize
 - Identify the major unifying principles of modern biology
 - 1.2. The Process of Science
 - Identify the components of the scientific method and understand their functional relationships
 - Differentiate between pure and applied sciences
 - Differentiate natural sciences from other types of sciences
 - Distinguish between deductive reasoning and inductive reasoning by recognizing examples of each
 - Describe the role of a hypothesis and hypothesis testing
 - Chapter 2 Chemistry of Life
 - 2.1. The Building Blocks of Molecules
 - Explore the fundamental nature of matter and atomic structure, and learn how atoms of the various elements differ
 - Recognize that atomic interactions involving electrons can lead to chemical bonding
 - Identify and distinguish between the major ways in which atoms, ions, and molecules interact
 - 2.2. Water
 - Investigate the polar nature of water
 - Explore temperature-dependent properties of water
 - Recognize that hydrogen bonding between water molecules gives water several special properties that are important for biological processes
 - Contrast cohesion and adhesion
 - Compare and contrast acids and bases, understand how the pH scale is organized, and explain how buffers stabilize pH
 - 2.3. Biological Molecules
 - Explore the importance of carbon to living things
 - Explore carbohydrate diversity, and describe basic carbohydrate structure and function
 - Explore polysaccharides
 - Explore lipid diversity, and describe basic lipid structure and function
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- Explore the structure of fats
 - Explore phospholipids and steroids
 - Explore protein diversity
 - Explore protein structure
 - Explore nucleic acid diversity, and describe basic nucleic acid structure and function
 - Chapter 3. Cell Structure and Function
 - 3.1. How Cells Are Studied
 - Survey the basics of microscopy
 - Survey the basics of cell theory
 - 3.2. Comparing Prokaryotic and Eukaryotic Cells
 - Compare and contrast a prokaryotic cell and a eukaryotic cell
 - Explore cell size
 - 3.3. Eukaryotic Cells
 - Explore the structure and function of the plasma membrane
 - Explore the structure and function of the cytoplasm and cytoskeleton
 - Identify the components of the endomembrane system
 - Explore the structure and function of the major components of the endomembrane system
 - Explore the structure and function of ribosomes, mitochondria, and peroxisomes
 - Explore the structure and function of the cell wall, chloroplasts, and the central vacuole
 - Explore the structure and function of the extracellular matrix and intercellular junctions
 - 3.4. The Cell Membrane
 - Explain the major functions of the plasma membrane in terms of the fluid mosaic model
 - Identify classes of macromolecules that make up a plasma membrane, and explore the amphipathic nature of phospholipids
 - 3.5. Passive Transport
 - Explain selective permeability in terms of normal cell function
 - Explore the major passive processes of diffusion, facilitated diffusion, and osmosis
 - Explain tonicity in terms of osmosis
 - 3.6. Active Transport
 - Explore the biological importance of active transport and vesicular transport
 - Chapter 4. How Cells Obtain Energy
 - 4.1. Energy and Metabolism
 - Explore metabolism, recognize and define the two types of metabolic pathways, and explain the role of ATP in metabolic processes
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- Define "thermodynamics", understand the first and second laws of thermodynamics, and explore the concept of energy
 - Define kinetic, potential, free, and activation energy
 - Explain how enzymes function as catalysts, describe mechanisms of enzyme regulation, and explore environmental factors that affect enzyme function
 - 4.2. Glycolysis
 - Explore the importance of ATP
 - Explore the importance of glycolysis in terms of energy metabolism
 - 4.3. Citric Acid Cycle and Oxidative Phosphorylation
 - Explore the conversion of pyruvate and the citric acid cycle as the first two phases of cellular respiration
 - Explore oxidative phosphorylation as the third phase of cellular respiration
 - 4.4. Fermentation
 - Explain the primary function of fermentation and compare fermentation to respiration
 - Explore different methods of fermentation
 - 4.5. Connections to Other Metabolic Pathways
 - Describe the central set of metabolic pathways, and explain how various fuels can enter that set of pathways to be processed for energy
 - Identify compounds that store fuels, and investigate how various compounds are processed as fuels
 - Chapter 5. Photosynthesis
 - 5.1. Overview of Photosynthesis
 - Investigate the importance of photosynthesis
 - Identify the photosynthetic inputs and outputs
 - Identify the leaf and chloroplast structures involved in photosynthesis
 - Investigate photosynthesis in terms of the capture, transfer, and transformation of energy
 - 5.2. The Light-Dependent Reactions of Photosynthesis
 - Explore electromagnetic energy
 - Describe how photosynthetic pigments can harness energy for organisms to build organic compounds
 - Explain the importance of the light-dependent reactions to photosynthesis
 - Describe the roles of ATP and NADPH in photosynthesis
 - 5.3. The Calvin Cycle
 - Describe the three basic stages of the Calvin cycle
 - Recognize the prokaryotic origin of photosynthesis, explore adaptive changes to photosynthesis, and describe the relationship between photosynthesis and carbohydrate catabolism
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Unit 2. Cell Division and Genetics

- Chapter 6. Reproduction at the Cellular Level
 - 6.1. The Genome
 - Explore the concepts of genome and ploidy
 - Explore the chromosomal structure and homology, define "gene" and "locus", and distinguish between a characteristic and a trait
 - 6.2. The Cell Cycle
 - Explore the cell cycle and the primary and secondary subphases into which it is divided
 - Explore mitosis and cytokinesis, and identify the subphases of each
 - Recognize that the cell cycle is highly regulated, describe checkpoints, and explain what it means for a cell to be in G_0
 - 6.3. Cancer and the Cell Cycle
 - Recognize that the various cancers are caused by DNA mutations, and explore the types of genes in which mutation can lead to cancer
 - 6.4. Prokaryotic Cell Division
 - Explore cell division in prokaryotic cells, and compare and contrast cell division in prokaryotes and eukaryotes
 - Chapter 7. The Cellular Basis of Inheritance
 - 7.1. Sexual Reproduction
 - Explore advantages and disadvantage for asexual reproduction and sexual reproduction
 - Explain the Red Queen hypothesis in terms of a tradeoffs between the disadvantages and advantages of sexual reproduction
 - 7.2. Meiosis
 - Explore the concept of ploidy, and explain how it relates to sexual life cycles
 - Explore the major events that occur during meiosis
 - Gain a better understanding of meiosis by recognizing similarities and differences between meiosis and mitosis
 - 7.3. Errors in Meiosis
 - Explore the normal human set of chromosomes to understand how abnormalities can lead to inherited disorders
 - Compare and contrast chromosome structural rearrangements and disorders in chromosome number
 - Chapter 8. Patterns of Inheritance
 - 8.1. Mendel's Experiments
 - Recognize the importance of Mendel's work to the understanding of genetics, and explore his experiments and findings
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- Examine sex-linked traits
- Explore recombination in linked genes
- 8.2. Laws of Inheritance
 - Explore basic concepts underlying the laws of inheritance
 - Explore Mendel's law of dominance, and use Punnett squares to investigate genetic crosses
 - Compare and contrast the law of segregation and the law of independent assortment, and relate these laws to meiotic events
- 8.3. Extensions of the Laws of Inheritance
 - Investigate a chromosomal explanations of sex determination
 - Explore extensions to Mendelian inheritance
 - Examine sex-linked traits
 - Explore recombination in linked genes

Unit 3. Molecular Biology and Biotechnology

- Chapter 9. Molecular Biology
 - 9.1. The Structure of DNA
 - Investigate the evidence for the Watson-Crick model of DNA
 - Explore nucleic acid structure
 - Explain the double helix in DNA structure
 - Investigate the structure of RNA and compare to DNA
 - Investigate the arrangement of DNA in a cell
 - 9.2. DNA Replication
 - Investigate the processes of DNA replication and repair, and identify important enzymes involved in these processes
 - 9.3. Transcription
 - Identify the roles of DNA and RNA in the central dogma, and explore differences in transcription as it occurs in eukaryotes and prokaryotes
 - Explore the details of transcription of a protein-coding gene
 - Explore the details of post-transcriptional processing in eukaryotic cells
 - 9.4. Translation
 - Describe translation in the context of the central dogma, and identify different types of RNA involved in translation
 - Explore the genetic code, and explain how tRNA operates as an adapter molecule in the process of translating a nucleotide sequence in mRNA to an amino acid sequence in a polypeptide
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- Describe the events that occur in translation, and identify the molecular components involved in the various steps of the process
- 9.5. How Genes Are Regulated
 - Explore the control of gene expression, and compare and contrast such control in prokaryotes and eukaryotes
- Chapter 10. Biotechnology
 - 10.1. Cloning and Genetic Engineering
 - Define "biotechnology", and explore techniques used to work with DNA
 - Explore techniques for cloning and for molecular manipulation of DNA
 - 10.2. Biotechnology in Medicine and Agriculture
 - Explore ways in which biotechnology is used in medicine
 - Explore ways in which biotechnology is used in agriculture
 - 10.3 Genomics and Proteomics
 - Explore fundamental principles of genomics and of genome mapping
 - Explore various scientific fields that sprang from and use genomics
 - Explore proteomics, and describe the relationship between genomics and proteomics

Unit 4. Evolution and the Diversity of Life

- Chapter 11. Evolution and Its Processes
 - 11.1. Discovering How Populations Change
 - Explore the history of evolutionary thought, and appreciate important contributions by scientists who influenced Darwin
 - Explore the principles of natural selection as the mechanism by which populations undergo adaptive evolution
 - Define the "modern synthesis", and explain important concepts of evolution at the population level
 - 11.2. Mechanisms of Evolution
 - Explore adaptive and non-adaptive forces that cause evolution of populations
 - Explore genetic drift and gene flow
 - 11.3. Evidence of Evolution
 - Explore fossils, anatomy, and embryology as evidence for evolution
 - Explore biogeography and molecular biology
 - 11.4. Speciation
 - Define the biological species concept and speciation, and explore and identify ways in which speciation can occur in nature
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- 11.5. Common Misconceptions about Evolution
 - Explore various misconceptions about evolution, and explain why they are misconceptions
 - Chapter 12. Diversity of Life
 - 12.1. Organizing Life on Earth
 - Explore concepts of classification, use binomial nomenclature, and interpret the evolutionary relationships represented in phylogenetic trees
 - 12.2. Determining Evolutionary Relationships
 - Explore concepts of cladistics, recognize monophyletic taxa on phylogenetic trees, and explain how phylogenetic trees are constructed based on data
 - Chapter 13. Diversity of Microbes, Fungi, and Protists
 - 13.1. Prokaryotic Diversity
 - Describe conditions on early earth, and explore the earliest life forms
 - Describe features common to all cells, and explore important differences between prokaryotic groups
 - Explore asexual reproduction and biochemical diversity in prokaryotes, and identify ways in which prokaryotes increase genetic variation without sex
 - Explore important ways in which humans are positively and negatively affected by bacteria
 - 13.2. Eukaryotic Origins
 - Describe conditions on early Earth, and explore the origins of life and the evolution of eukaryotes
 - 13.3. Protists
 - Explore protist diversity, and recognize that protists make up a polyphyletic group
 - Describe various ways in which protists reproduce, and explore the ecological importance of protists
 - 13.4. Fungi
 - Compare and contrast Fungi with Animals and Plants, and explore fungal lifestyles and anatomy
 - Explore fungal diversity and fungal ecology
 - Chapter 14. Diversity of Plants
 - 14.1. The Plant Kingdom
 - Explore the plant kingdom, describe shared characteristics of plants, and explain how the sexual life cycle of plants differs from the sexual life cycles of other sexual organisms
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- Describe the anatomy, growth, and reproduction of plants, and explore the phylogenetic classification of taxa within the plant kingdom
 - 14.2. Seedless Plants
 - Explore diversity of bryophytes and seedless vascular plants, and compare and contrast these two major groups within the plant kingdom
 - 14.3. Seed Plants: Gymnosperms
 - Describe distinctive characteristics of gymnosperms, and explore gymnosperm diversity
 - 14.4. Seed Plants: Angiosperms
 - Describe distinctive characteristics of angiosperms, and explore angiosperm diversity
 - Chapter 15. Diversity of Animals
 - 15.1. Features of the Animal Kingdom
 - Explore major characteristic shared by all animals, and classify animals based on characteristics shared by only some animals
 - 15.2. Sponges and Cnidarians
 - Compare and contrast parazoans and cnidarians, and explore distinguishing characteristics for both of these animal groups
 - 15.3. Flatworms, Nematodes, and Arthropods
 - Compare and contrast flatworms and roundworms, and explore diversity within each of the animal groups
 - Describe distinguishing characteristics of arthropods, and explore arthropod diversity
 - 15.4. Mollusks and Annelids
 - Describe distinguishing characteristics of mollusks, and explore mollusk diversity
 - Describe distinguishing characteristics of annelids, and explore annelid diversity
 - 15.5. Echinoderms and Chordates
 - Describe distinguishing characteristics of echinoderms, and explore echinoderm diversity
 - Describe distinguishing characteristics of chordates, and explore invertebrate chordate diversity
 - 15.6. Vertebrates
 - Explore early vertebrate life, and describe major groups of fishes
 - Describe the phylogeny of tetrapods, and compare and contrast Amphibia and Amniota
 - Explore mammalian phylogeny and diversity
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Unit 5. Animal Structure and Function

- Chapter 16. The Body's Systems
 - 16.1. Homeostasis and Osmoregulation
 - Describe the importance of homeostasis, thermoregulation, and osmoregulation, and explain how organ systems are involved in these processes
 - 16.2. Digestive System
 - Explore basics of nutrition, and explain why animals like humans require a digestive system
 - Describe the major structures and functions of the human digestive system
 - 16.3. Circulatory and Respiratory Systems
 - Explore the basic anatomy and physiology of the human respiratory system, and describe how it functions in conjunction with the circulatory system
 - Explore the basic anatomy and physiology of the human circulatory, and compare and contrast circulatory systems in different animals
 - 16.4. Endocrine System
 - Explore the basic anatomy and physiology of the human endocrine system, explain how chemical signals operate, and compare and contrast endocrine and exocrine glands
 - 16.5. Musculoskeletal System
 - Explore the basic anatomy and physiology of the human skeletal system and muscular system, and explain the interdependency of these two organ systems for the purposes of movement and locomotion
 - 16.6. Nervous System
 - Compare and contrast neurons and glial cells, and describe the basic anatomy and physiology underlying nervous signals
 - Explore the basic anatomy and physiology of the human nervous system, and describe the hierarchical classification of the nervous system into subdivisions
 - Chapter 17. The Immune System and Disease
 - 17.1. Viruses
 - Explore the structure of viri and the interaction of viri with organisms, including humans
 - 17.2. Innate Immunity
 - Explore the fundamentals of vertebrate immunity, and compare and contrast the structural components and functions of innate immunity and adaptive immunity
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- 17.3. Adaptive Immunity
 - Explore the basic structures and functions of adaptive immunity, and compare and contrast cell-mediated immunity and humoral immunity
 - Explore the structures of the lymphatic system that function for immunity, compare and contrast primary and secondary immune responses, and compare and contrast the mucosal and systemic immune systems
- 17.4. Disruptions in the Immune System
 - Explore various pathologies that result from disruptions to the normal functioning of the immune system
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 - 18.1. How Animals Reproduce
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 - Explore methods of sexual reproduction and sex determination
 - 18.2. Development and Organogenesis
 - Describe how animals develop from a single cell to a multicellular body with differentiated structures
 - 18.3. Human Reproduction
 - Explore the male development of the unisex embryo, and describe the anatomy and physiology of the male reproductive system
 - Explore the female development of the unisex embryo, and describe the anatomy and physiology of the female reproductive system
 - Describe the major events that occur during human gestation

Unit 6. Ecology

- 19. Population and Community Ecology
 - 19.1. Population Demographics and Dynamics
 - Explore basic concepts, measurements, and statistics used to study populations
 - 19.2. Population Growth and Regulation
 - Explore basics of population growth and dynamics, and describe the mathematical model for exponential growth
 - Describe the mathematical model for logistic population growth, and describe various factors that regulate growth in real populations
 - 19.3. The Human Population
 - Describe human population growth, and identify global effects caused by human activity and exacerbated by human population growth
 - 19.4. Community Ecology
 - Investigate various interspecific interactions and explain how these interactions have led to adaptations via natural selection
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- Explore community structure and dynamics, and identify categories of species with particular ecological importance to the community
 - 20. Ecosystems and the Biosphere
 - 20.1. Waterford's Energy Flow through Ecosystems
 - Compare and contrast the concepts of "ecosystem" and "biome", classify ecosystems, and explore ecosystem dynamics
 - Explore and distinguish various trophic levels, and describe food chains and food webs in terms of trophic levels
 - Compare and contrast autotrophs and heterotrophs, classify the types of autotrophs, and investigate biomagnification
 - 20.2. Biogeochemical Cycles
 - Explore basics of biogeochemical cycling, and describe the biological importance of organisms' most abundant chemical elements
 - Explore basics of the water cycle and the carbon cycle, and describe the importance of these cycles to biology
 - Explore basics of the nitrogen cycle, and describe its importance to biology,
 - Explore basics of the phosphorus cycle and the sulfur cycle, and describe the importance of these cycles to biology
 - 20.3. Terrestrial Biomes
 - Classify biomes according into two major categories, and identify examples from each category
 - Explore major features of the terrestrial biomes
 - 20.4. Aquatic and Marine Biomes
 - Explore ecological and physical basics of aquatic biomes
 - Compare and contrast the major aquatic biomes
 - 21. Conservation and Biodiversity
 - 21.1. Importance of Biodiversity
 - Explore biodiversity at different levels of organization, and understand the ecological importance of biodiversity
 - 21.2. Threats to Biodiversity
 - Identify and describe the three primary causes of extinction, and describe their effects on biodiversity
 - Describe how human activity is causing global climate change
 - 21.3. Preserving Biodiversity
 - Compare and contrast background extinction and mass extinction, and describe ways of estimating extinction rates
 - Explore ways in which humans attempt to preserve biodiversity
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