



BIOLOGY Learning Objectives



THE SCIENCE OF BIOLOGY

The learner will

- ☑ identify skills scientists use to learn about the world.
- ☑ explain what scientific inquiry involves.
- ☑ describe how to develop a hypothesis and design an experiment.
- ☑ describe the attitudes, or habits of mind, that are important in science.
- ☑ describe the goal of technology.
- ☑ explain how technology differs from science.
- ☑ explain how technology affects people in both positive and negative ways.
- ☑ explain why preparation is important when carrying out scientific investigations in the lab and in the field.
- ☑ describe what you should do if an accident occurs.

THE CHEMISTRY OF LIFE

The learner will

- ☑ identify three subatomic particles found in atoms.
- ☑ explain how all of the isotopes of an element are similar and how they are different.
- ☑ explain what chemical compounds are.
- ☑ describe the two main types of chemical bonds.
- ☑ explain why water molecules are polar.
- ☑ differentiate between solutions and suspensions.
- ☑ explain what acidic solutions and basic solutions are.
- ☑ describe the functions of each group of organic compounds.
- ☑ explain how chemical reactions affect chemical bonds in compounds.
- ☑ describe how energy changes affect how easily a chemical reaction will occur.
- ☑ explain why enzymes are important to living things.

CELL STRUCTURES AND FUNCTIONS

The learner will

- ☑ describe how most small molecules cross the cell membrane.
- ☑ explain what the cell theory is.
- ☑ name the basic cell structures.
- ☑ describe prokaryotes and eukaryotes.
- ☑ describe the main function of the cell wall.
- ☑ describe the function of the cell nucleus.
- ☑ identify the main roles of the cytoskeleton.
- ☑ describe the functions of the major cell organelles.
- ☑ identify the main functions of the cell membrane.
- ☑ describe what happens during diffusion.
- ☑ explain the processes of osmosis, facilitated diffusion and active transport
- ☑ describe cell specialization.
- ☑ identify the organization levels in multi-cellular organisms.

PHOTOSYNTHESIS

The learner will

- ☑ explain where plants get the energy they need to produce food.
- ☑ describe the role of ATP in cellular activities.
- ☑ explain what the experiments of Van Helmont, Priestley and Ingenhousz reveal about how plants grow.
- ☑ state the overall equation for photosynthesis.
- ☑ describe the role of light and chlorophyll in photosynthesis.
- ☑ describe the structure and function of a chloroplast.
- ☑ describe what happens in the light dependent reactions.
- ☑ explain what the Calvin cycle is.
- ☑ identify factors that affect the rate at which photosynthesis occurs.



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CELLULAR RESPIRATION

The learner will

- explain what forms the genetic code.
- explain what cellular respiration is.
- describe what happens during the process of glycolysis.
- name the two main types of fermentation.
- describe what happens during the Krebs Cycle.
- explain how high-energy electrons are used by the electron transport chain.
- identify three pathways the body uses to release energy during exercise.
- compare photosynthesis and respiration.

CELL GROWTH AND DIVISION

The learner will

- explain the problems that growth causes for cells.
- describe how cell division solves the problems of cell growth.
- name the main events of the cell cycle.
- describe what happens during the four phases of mitosis.

NERVOUS SYSTEM

The learner will

- identify the characteristics all plants share.
- describe how the human body is organized.
- explain homeostasis.
- identify the function of the nervous system.
- describe how a nerve impulse is transmitted.
- identify the functions of the central nervous system.
- describe the divisions of the peripheral nervous system.
- name the five types of sensory receptors.
- identify the five senses.
- name the different classes of drugs that directly affect the nervous system.
- describe the effects of alcohol on the body.

SKELETAL, MUSCULAR AND INTEGUMENTARY SYSTEMS

The learner will

- describe levels of organization in animal bodies.
- state the functions of the skeletal system.
- describe the structure of a typical bone.
- explain how bones develop.
- identify the three kinds of joints.
- describe the three types of muscle tissue.
- explain how muscles contract.
- explain how muscles and bones interact.
- state the functions of the integumentary system.
- describe the structure of hair and nails.

CIRCULATORY AND RESPIRATORY SYSTEMS

The learner will

- identify the functions of the human circulatory system.
- describe the structures of the circulatory system
- name the three types of blood vessels in the circulatory system.



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CIRCULATORY AND RESPIRATORY SYSTEMS

The learner will

- describe blood pressure.
- describe blood plasma.
- explain the functions of red blood cells, white blood cells and platelets.
- describe the role of the lymphatic system.
- describe respiration.
- identify the structures of the respiratory system.
- describe gas exchange and breathing.
- explain how smoking affects the respiratory system.

DIGESTIVE AND EXCRETORY SYSTEMS

The learner will

- explain how food provides energy.
- describe the nutrients your body needs.
- state why water is such an important nutrient.
- explain how to use the Food Guide Pyramid.
- identify the organs of the digestive system.
- describe the function of the digestive system.
- name the organs of the excretory system.
- explain how the kidneys maintain homeostasis.
- describe how homeostasis is maintained by machine.

ENDOCRINE AND REPRODUCTIVE SYSTEMS

The learner will

- state the function of the endocrine system.
- describe hormones and glands.
- explain how the endocrine systems maintains homeostasis.
- identify the functions of the major endocrine glands.
- describe sexual development.
- explain the role of the male and female reproductive systems.
- identify the four phases of the menstrual cycle.
- describe fertilization.
- describe the function of the placenta.
- outline the life cycle after birth.

THE IMMUNE SYSTEM AND DISEASE

The learner will

- identify the causes of disease.
- explain how infectious diseases are transmitted.
- describe how antibiotics fight infection.
- identify the body's nonspecific defenses against invading pathogens.
- describe immunity.
- state what happens when the immune system overreacts.
- explain what an autoimmune disease is.
- describe how HIV affects the immune system.
- identify the basic mechanism of cancer.
- describe how cancer is treated.



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INTRODUCTION TO GENETICS

The learner will

- ☑ describe how Mendel studied inheritance in peas.
- ☑ summarize Mendel's conclusion about inheritance.
- ☑ explain the principle of dominance.
- ☑ describe what happens during segregation.
- ☑ explain how geneticists use the principles of probability.
- ☑ describe how geneticists use Punnett squares.
- ☑ explain the principle of independent assortment.
- ☑ describe the other inheritance patterns that exist aside from simple dominance.
- ☑ explain how Mendel's principles apply to organisms.
- ☑ contrast the chromosome number of body cells and gametes.
- ☑ summarize the events of meiosis.
- ☑ contrast meiosis and mitosis.
- ☑ identify the structures that actually assort independently.
- ☑ explain how gene maps are produced.

DNA AND RNA

The learner will

- ☑ summarize the relationship between genes and DNA.
- ☑ describe the overall structure of the DNA molecule.
- ☑ summarize the events of DNA replication.
- ☑ relate the DNA molecule to chromosome structure.
- ☑ tell how RNA differs from DNA.
- ☑ name the three main types of RNA.
- ☑ describe transcription and the editing of RNA.
- ☑ identify the genetic code.
- ☑ summarize translation.
- ☑ explain the relationship between genes and proteins.
- ☑ contrast gene mutations and chromosomal mutations.
- ☑ describe a typical gene.
- ☑ describe how lac genes are turned off and on.
- ☑ explain how most eukaryotic genes are controlled.
- ☑ relate gene regulation to development.

GENETIC ENGINEERING

The learner will

- ☑ explain the purpose of selective breeding.
- ☑ describe two techniques used in selective breeding.
- ☑ tell why breeders try to induce mutations.
- ☑ explain how scientists manipulate DNA.
- ☑ summarize what happens during transformation.
- ☑ explain how you can tell if a transformation experiment has been successful.
- ☑ describe the usefulness of some transgenic organisms to humans.
- ☑ summarize the main steps in cloning.

THE HUMAN GENOME

The learner will

- ☑ identify the types of human chromosomes in a karyotype.
- ☑ explain how sex is determined.
- ☑ explain how pedigrees are used to study human traits.
- ☑ describe examples of the inheritance of human traits.
- ☑ explain how small changes in DNA cause genetic disorders.



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THE HUMAN GENOME

The learner will

- ☑ identify characteristics of human chromosomes.
- ☑ describe some sex-linked disorders and explain why they are more common in males than in females.
- ☑ explain the process of X-chromosome inactivation.
- ☑ summarize nondisjunction and the problems it causes.
- ☑ summarize methods of human DNA analysis.
- ☑ state the goal of the Human Genome project.
- ☑ describe how researchers are attempting to cure genetic disorders.

DARWIN'S THEORY OF EVOLUTION

The learner will

- ☑ describe the pattern Darwin observed among organisms of the Galapagos Islands.
- ☑ state how Hutton and Lyell described geological change.
- ☑ identify how Lamarck thought species evolve.
- ☑ describe Malthus's theory of population growth.
- ☑ list events leading to Darwin's publication of *On the Origin of Species*.
- ☑ describe how natural variation is used in artificial selection.
- ☑ explain how natural selection is related to species' fitness.
- ☑ identify evidence Darwin used to present his case for evolution.
- ☑ state Darwin's theory of evolution by natural selection.

EVOLUTION OF POPULATIONS

The learner will

- ☑ explain what a gene pool is.
- ☑ identify the main sources of inheritable variation in a population.
- ☑ state what determines how a phenotype is expressed.
- ☑ explain how natural selection affects single-gene and polygenic traits.
- ☑ describe genetic drift.
- ☑ list the five conditions needed to maintain genetic equilibrium.
- ☑ identify the condition necessary for a new species to evolve.
- ☑ describe the process of speciation in the Galapagos finches.

BACTERIA AND VIRUSES

The learner will

- ☑ explain how the two groups of prokaryotes differ.
- ☑ describe the factors that are used to identify prokaryotes.
- ☑ describe the ecological roles that bacteria play in the environment.
- ☑ explain how bacteria cause disease.
- ☑ identify ways humans use bacteria.
- ☑ describe how bacteria are controlled.
- ☑ describe the structure of a virus.
- ☑ explain how viruses cause infection.

PROTISTS

The learner will

- ☑ explain what a Protist is.
- ☑ describe the major phyla of animal-like protists.
- ☑ explain how animal-like protists harm other living things.
- ☑ describe the function of chlorophyll and accessory pigments in algae.



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PROTISTS

The learner will

- ☑ describe the major phyla of unicellular algae.
- ☑ summarize the ecological roles of unicellular algae.
- ☑ describe the major phyla of multi-cellular algae.
- ☑ explain how multi-cellular algae reproduce.
- ☑ identify some human uses of algae.
- ☑ compare and contrast fungus-like protists and fungi.
- ☑ describe slime molds and water molds.
- ☑ summarize the ecological roles of fungus-like protists.

PLANT DIVERSITY

The learner will

- ☑ explain what a plant is.
- ☑ describe what plants need to survive.
- ☑ describe how the first plants evolved.
- ☑ describe the adaptations of bryophytes.
- ☑ identify three groups of bryophytes.
- ☑ explain how bryophytes reproduce.
- ☑ explain how vascular tissue is important to ferns and their relatives.
- ☑ describe the three phyla of spore-bearing plants.
- ☑ identify the stages in the life cycle of ferns.
- ☑ describe the reproductive adaptations of seed plants.
- ☑ describe the evolution of seed plants.
- ☑ identify the four groups of gymnosperms.
- ☑ identify the characteristics of angiosperms.
- ☑ explain what monocots and dicots are.

ROOTS, STEMS AND LEAVES

The learner will

- ☑ describe the organs and tissues of vascular plants.
- ☑ contrast meristematic tissue with other plant tissues.
- ☑ identify the specialized cells of vascular tissue.
- ☑ describe the two main types of roots.
- ☑ identify the tissues and structures in a mature root.
- ☑ describe the different functions of roots.
- ☑ describe the two main functions of stems.
- ☑ contrast monocot and dicot stems.
- ☑ explain how primary growth and secondary growth occur in stems.
- ☑ describe how the structure of a leaf enables it to carry out photosynthesis.
- ☑ describe how gas exchange takes place in a leaf.
- ☑ explain how water is transported throughout a plant.
- ☑ describe how the products of photosynthesis are transported throughout a plant.

REPRODUCTION OF SEED PLANTS

The learner will

- ☑ identify the reproductive structures of gymnosperms and angiosperms.
- ☑ explain how pollination and fertilization differ between gymnosperms and angiosperms.
- ☑ describe the development of seeds and fruits.
- ☑ explain how seeds are dispersed.
- ☑ list the factors that influence the dormancy and germination of seeds.
- ☑ identify the forms of plant vegetative reproduction.
- ☑ describe plant propagation.



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REPRODUCTION OF SEED PLANTS

The learner will

- identify the major food-supply crops for humans.
- define percent by volume and percent by mass solutions.

PLANT RESPONSES AND ADAPTATIONS

The learner will

- describe patterns of plant growth.
- explain what hormones are.
- describe how auxins, cytokinins, gibberellins and ethylene affect plant growth.
- explain what plant tropisms are.
- explain what photoperiodism is.
- describe how temperate plants prepare for winter.
- summarize how plants are adapted to different environments.
- describe how plants obtain nutrients.
- explain how plants use chemical defenses.

RESOURCES

Prentice-Hall Biology, Miller and Levine, 2002.

Internet research, applications and supplementary materials.