



Science Shepherd Homeschool Biology Curriculum

Scope & Sequence

Chapter 1 – Introduction

Goals

- Discuss the following properties that all living things have in common:
 - They are made up of one or more cells.
 - They contain DNA.
 - They reproduce.
 - They are complex and organized.
 - They respond to their surroundings.
 - They extract energy from their environment.
 - They maintain homeostasis.
 - They grow.
 - They can be systematically classified.
- Explore the principles and practice of the scientific method.
- Discuss the SI measurement units.
- Discuss properties of light and electron microscopes.

Chapter 2 – The Composition and Chemistry of Life

Goals

- Understand how organisms obtain the energy they need to live and the relationship between photosynthesis and cellular respiration.
- Investigate the properties of the building blocks of all matter—atoms and molecules.
- Define isotopes and their properties.
- Investigate how covalent and ionic chemical bonds form by following the Law of Conservation of Mass.
- Discuss the unique properties of water that make it the best substance to surround and fill cells.
- Introduce basic concepts of solutes, solvents, acids, and bases.

Chapter 3 – Basic Biochemistry of the Molecules of Life

Goals

- Define what organic molecules are and why they are important to life.
- Understand the difference between organic and inorganic molecules.
- Learn about isomers and why they require the use of structural formulae.
- Investigate how the four classes of organic molecules—carbohydrates, proteins, lipids, and nucleic acids—are made and broken down by chemical reactions in the cell.

Chapter 4 – Introduction to the Cell and Cell Membrane

Goals

- Review “cell theory.”
- Discuss the general features and functions of a cell.
- Define the two basic cell types—prokaryote and eukaryote.
- Review basic cell structure.
- Investigate the structure and function of the outer boundary of the cell—the cell membrane.
- Understand why cells are “so small.”

Chapter 5 – The Cell Interior and Function

Goals

- Investigate and understand the organization and function of the cell interior.
- Define the differences between eukaryotic and prokaryotic cell structure.
- Discuss the structure and function of the following eukaryotic organelles and structures:
 - Protoplasm
 - Cytoplasm
 - Nucleoplasm
 - Cytoskeleton
 - Nucleus
 - Ribosome
 - Endoplasmic reticulum
 - Golgi apparatus
 - Lysosomes and peroxisomes
 - Mitochondria
 - Plastids
 - Vacuoles
 - Middle lamella
 - Extracellular matrix

Chapter 6 – Metabolism Overview and Enzymes

Goals

- Define types of metabolism.
- Investigate the properties of potential and kinetic energy and understand that living things convert one form to the other to stay alive.
- Review the First and Second Law of Thermodynamics.
- Investigate the activation energy lowering and energy coupling properties of enzymes.
- Classify types of enzymes based upon the chemical reactions they perform.
- Define cofactors and coenzymes.

Chapter 7 – Photosynthesis

Goals

- Describe the ways in which organisms obtain their energy and make their cell mass.
- Investigate the components and properties of the electromagnetic spectrum, including the visible light spectrum.
- Discuss the absorption spectrum of plant leaves and how that relates to photosynthesis.
- Study the plant structures and molecules that perform photosynthesis.
- Learn that, although photosynthesis occurs in many linked biochemical reactions, it is really a two part process—a light absorbing/energy transforming event and a carbon fixation event.

Chapter 8 – Cellular Respiration

Goals

- Investigate the structure and function of ATP.
- Learn how ATP is utilized by enzymes to fuel endergonic reactions they catalyze.
- Investigate the biological processes of aerobic and anaerobic respiration.
- Study the internal structure of mitochondria and how it relates to aerobic respiration.

Chapter 9 – DNA, RNA, and Proteins

Goals

- Investigate the structure and function of DNA and RNA.
- Discuss the organization of DNA into chromosomes and genes.
- Study the concept that one gene codes for the production of one protein.
- Introduce the concept that genes control all traits of an organism or cell.
- Explore the biological processes of eukaryotic transcription and translation.
- Discuss transcription and translation in prokaryotes.
- Learn what the genetic code is and become comfortable using it.

Chapter 10 – Cellular Reproduction: Mitosis

Goals

- Discuss the biological process of asexual cell division, called mitosis.
- Review the theory of spontaneous generation and how it was disproved.
- Review the Theory of Biogenesis.
- Investigate the process of DNA replication.
- Learn how DNA is packaged in the cell at various stages.
- Discuss the events of the cell cycle.

Chapter 11 – Organism Reproduction: Binary Fission, Budding, and Meiosis

Goals

- Investigate the asexual cell/organism reproductive processes of binary fission and budding.
- Review more information regarding chromosomes and how they align during the sexual reproductive cell division process of meiosis.
- Completely define the meaning of diploid and haploid as it relates to meiosis.
- Investigate the two stages of meiosis—meiosis I and II.
- Define the differences between male and female meiosis in humans.
- Discuss ways in which genetic variation occurs.

Chapter 12 – Genes and Heredity

Goals

- Discuss how genes are related to traits.
- Define what alleles are.
- Learn the basic processes—such as gene segregation and independent assortment—that govern how genes are passed from generation to generation.
- Become comfortable using the technical jargon of geneticists.

Chapter 13 – Inheritance Patterns

Goals

- Discuss the importance that probability plays in the study of genetics.
- Investigate the inheritance patterns of:
 - incomplete dominance
 - multiple alleles
 - co-dominance
 - continuous variation
 - epistasis
- Evaluate the impact the environment can have on the phenotype.

Chapter 14 – Genetic Variation

Goals

- Discuss normal genetic variation and how it is generated.
- Investigate point mutation and chromosomal mutation types.
- Learn the difference between somatic and germ cell mutations.

Chapter 15 – Human Genetics

Goals

- Define congenital genetic diseases.
- Learn why most genetic diseases are inherited as an autosomal recessive pattern.
- Discuss the meanings of carriers, affected and unaffected individuals as it relates to genetic disorders.
- Learn how to use a pedigree analysis.
- Investigate:
 - the autosomal recessive genetic diseases of phenylketonuria, cystic fibrosis and sickle cell anemia.
 - the autosomal dominant genetic disease of Huntington's chorea.
 - the X-linked diseases of hemophilia and color blindness.
 - the polyploid condition of Down's syndrome.

Chapter 16 – DNA Technology

Goals

- Define the terms associated with DNA technology.
- Discuss the process of transformation.
- Investigate the common methods for making recombinant DNA and inserting it into appropriate hosts.
- Review several ways in which recombinant DNA technology is being applied on a daily basis.

Chapter 17 – Introduction to the Creation and Evolution Origins Models

Goals

- Introduce the creation and evolution origins models.
- Discuss biblical “kinds,” “types” and “varieties” as clearer descriptions than “species” when referring to organism “speciation.”
- Dive into the creation origins model, which is driven by the understanding that God’s unerring Word accurately describes predicted and documented scientific observations.
- Learn that the objective scientific data are perfectly compatible with the creation origins model and frequently contradict the evolution model.
- Describe the difference between intelligent design and the intelligent design movement.
- Review the properties of “creation design” and its polar opposite, “evolution randomness,” to clearly see that living systems display design properties and at the same time do not display random ones, implying that life is the result of specific design, not random events.
- Identify God as the perfect Intelligent Designer of life.

Chapter 18 – Evolution: History and Present State

Goals

- Explore further how Charles Darwin’s evolutionary ideas specifically explain the existence of life without God.
- Review the history of naturalistic explanations of life origins and diversity in order to identify that evolution is a completely materialistic origins model.
- Learn about Charles Darwin’s reluctance to publish his theory and how he overcame that with the political assistance of his scientific allies.
- Dissect natural selection and surprisingly learn that it is fully compatible with the creation model and is incapable of “doing” what evolution needs it to do.
- Learn that abiogenesis, a necessary event, is completely unable to be explained through naturalistic mechanisms.
- Properly define evolution not simply as “change” (as evolutionists do) but as the very specific type of change that it is.
- Point out that what evolutionists typically refer to as “evolution” is actually the result of the observable effects of natural selection, which is not “evolution” at all.
- Introduce “microevolution” and “macroevolution” and learn that “microevolution” is a terrible descriptor and “macroevolution” is not supported by scientific data.

Chapter 19 – From Fossils to neo-Darwinism

Goals

- Explore neo-Darwinism, a.k.a. the modern evolutionary synthesis, and the problems it has explaining the origination of new, never-before-in-existence, trait-producing genetic information.
- Learn that beneficial mutations do exist, but they are not capable of “doing” what the evolution model needs them to “do.”
- Differentiate the ways in which antibiotic resistance in bacteria develops to learn that they are not mechanisms that generate new and meaningful new DNA.
- Further explore nephesh chayyah and how it relates to creation, Noah’s Flood and biological diversity.
- Through reviewing various scientific data in light of the Flood, learn that there is scientific support for such a catastrophic worldwide flood event and that the creation model states it was responsible for the majority of existent fossils.
- Apply concepts of comparative genomics to the creation and evolution models to learn that there is excellent scientific data that supports the creation model.
- Perform a review of the fossil record and find that the data provides support for the creation model, while there are several aspects of the fossil record that specifically argue against the evolution model.
- Explore radiometric dating in some depth to learn that there is convincing, relevant data rendering it a dubious scientific endeavor that at least requires further research.

Chapter 20 – Biological Classification and Viruses

Goals

- Review a brief history of classification schemes.
- Discuss the classification devised by Linnaeus, which is still in use today, called the binomial system.
- Introduce the six classification kingdoms of Archaea, Bacteria, Protista, Fungi, Plantae, and Animalia.
- Investigate the structure and function of the non-living particles called viruses.

Chapter 21 – Kingdoms Bacteria and Archaea

Goals

- Understand the main differences between the organisms of the Kingdoms Bacteria and Archaea.
- Discuss common Bacteria cell shapes and structures.
- Investigate Bacteria cell wall structure and how it relates to the Gram staining process.
- Learn about the mechanism of action of antibiotics.
- Explore Bacteria and Archaea modes of obtaining energy and manufacturing organic molecules.

Chapter 22 – Kingdom Protista

Goals

- Discuss how the organisms in Protista acquire their energy source.
- Describe the common body structures of algae.
- Discuss the reproductive cycle of algae, protozoa and slime molds/water molds.
- Introduce the concept of the reproductive cycle of alternation of generations, which will also be a common mode of reproduction for many Fungi and Plantae species.
- Discuss the attributes of organisms in Protista.

Chapter 23 – Kingdom Fungi

Goals

- Discuss the common characteristics Fungi share.
- Define the general structure plan of Fungi.
- Investigate the modes of sexual and asexual reproduction of the fungal divisions of Basidiomycota, Ascomycota, Zygomycota and Deuteromycota.
- Define the specific structural plans for the four Fungi divisions.
- Investigate the structure and function of lichens.
- Learn the beneficial and harmful features of Fungi.

Chapter 24 – Plants: Introduction, Structure and Function

Goals

- Review plant cell structure.
- Discuss the structure of plant cell walls.
- Define the difference between vascular and nonvascular plants.
- Introduce the basic concepts of plant reproduction with special attention to monocots and dicots.
- Investigate the specialized structure and function of the tissues that form the roots, stems, and leaves of plants.
- Discuss the important place that water has in maintaining the structure and function of plants.

Chapter 25 – Plants: Physiology, Reproduction, and Classification

Goals

- Discuss plant hormones and their effects on plant tissues.
- Discuss asexual means of plant reproduction.
- Study the sexual reproductive cycle of mosses, ferns, conifers, and angiosperms.
- Investigate the structure and function of the flower.
- Discuss the process of pollination and germination.
- Discuss general features of organisms in the Plantae divisions as a wrap up of our study of plants.

Chapter 26 – Kingdom Animalia I

Goals

- Introduce the phyla of animals we will be discussing.
- Differentiate vertebrates from invertebrates.
- Define body structure and symmetry terms.
- Discuss the following properties of animals:
 - germ layer/tissue development
 - embryonic tissue differentiation
 - segmentation
 - embryonic development
 - development patterns
 - tissue and organ systems
- Investigate the organisms of the Placozoa and Porifera phyla.

Chapter 27 – Kingdom Animalia II

Goals

- Resume our discussion of the Animalia phyla of:
 - Cnidaria
 - Platyhelminthes
 - Nemertea
 - Nematoda
 - Mollusca
 - Annelida
 - Arthropoda
 - Echinodermata
 - Chordata
- Discuss the differences between the vertebrate and invertebrate organisms of Chordata.

Chapter 28 – Kingdom Animalia III

Goals

- Discuss the features of vertebrates.
- Discuss vertebrate organ systems.
- Review the features of the organisms classified into:
 - Agnatha
 - Chondrichthyes
 - Osteichthyes
 - Amphibia
 - Reptilia
- Introduce the concept of the one-loop and two-loop circulatory systems.
- Discuss the function of capillaries.
- Investigate the structure and function of the amniotic egg.
- Discuss endothermia and ectothermia.

Chapter 29 – Kingdom Animalia IV

Goals

- Discuss the classification of birds into the phylum Aves
- Investigate the bird structures of beaks, feathers and air sacs.
- Discuss the classification of mammals into three classes – Monotremata, Marsupalia and Placentalia.
- Learn about common mammalian traits.
- Investigate mammalian specializations of:
 - flight
 - aquatic life
 - echolocation
 - brain enlargement
- Introduce human organ systems.

Chapter 30 – Human Anatomy and Physiology I, Nervous System & Special Senses

Goals

- Describe the anatomy and physiology of the nervous system, with attention to:
 - the individual nerve cell (neuron)
 - the neuron's ability to generate and conduct an electrical impulse
 - neurotransmitters
 - the central nervous system
 - the peripheral nervous system
 - the autonomic nervous system
- Describe the anatomy and physiology of vision, hearing, taste and smell.

Chapter 31 – Human Anatomy and Physiology II, Immunologic, Endocrine, and Excretory Systems

Goals

- Describe the components and function of the immune system.
- Discuss the specific and non-specific phases of the immune response.
- Define active and passive immunity.
- Discuss the condition of an autoimmune disease.
- Describe the anatomy of the endocrine system.
- Discuss the effects and control of the endocrine system.
- Investigate the anatomy and physiology of the excretory system.

Chapter 32 – Human Anatomy and Physiology III, Circulatory and Respiratory Systems

Goals

- Discuss the components of the circulatory system.
- Review the two-loop circulatory system.
- Examine the internal and external heart anatomy.
- Investigate the electrical activity of the heart and how it relates to EKG activity and the generation of blood pressure.
- Study the structure and function of blood.
- Discuss the anatomy of the respiratory system.
- Investigate how inhalation and exhalation occur.

Chapter 33 – Human Anatomy and Physiology IV, Digestive, Musculoskeletal/Connective Tissue, and Integumentary Systems

Goals

- Discuss the anatomy of the digestive system.
- Investigate the physiology of the digestive system with special attention to:
 - salivary glands and amylase
 - peristalsis
 - the mechanical actions of the stomach and the enzyme pepsinogen
 - the function of the duodenum, jejunum, ileum, gall bladder, liver, pancreas and colon
 - the absorptive capacity of villi and microvilli
- Discuss the structure and function of the three types of muscles—skeletal, cardiac, and smooth.
- Learn the structure and function of bone.
- Review the function of ligaments and tendons.
- Investigate joint types.
- Study the structure and function of the integumentary system (skin).

Chapter 34 - Ecology

Goals

- Introduce basic concepts and terms of ecology.
- Investigate the dynamics of population studies.
- Discuss food chains, food webs, food pyramids and trophic levels.
- Define the differences between mimicry and camouflage and study examples of both.
- Investigate the hydrologic, carbon and oxygen cycles.
- Delve into the controversial topic of global warming.
- Discuss the seven land biomes as well as marine and fresh water biomes.