Biology-Integrated Year-at-a-Glance

ARKANSAS STATE SCIENCE STANDARDS

FIRST SEMESTER		FIRST/SECOND	SECOND SEMESTER	
Unit 1 **Biochemistry/Cell Division/ Specialization**	**Unit 2** **Photosynthesis/ Cellular Respiration**	**Unit 3** **Genetics and Evolution**	**Unit 4** **Ecology & Human Impact**	**Unit 5** **Systems**
8 weeks	4 weeks	8 weeks	6 weeks	5 weeks
• **BI-LS1-3** • **BI-LS1-4** • **BI-LS1-6** • **BI-ESS2-5**	• **BI-LS1-5** • **BI-LS1-7** • **BI-LS2-3** • **BI-LS2-4** • **BI-LS2-5** • **BI-ESS2-6** • **BI-ESS3-6**	• **BI-LS1-1** • **BI-LS2-8** • **BI-LS3-1** • **BI-LS3-2** • **BI-LS3-3** • **BI-LS4-1** • **BI-LS4-2** • **BI-LS4-3** • **BI-LS4-4** • **BI-LS4-5** • **BI-ESS2-7** • **BI-ETS1-4**	• **BI-LS1-2** • **BI-LS2-1** • **BI-LS2-2** • **BI-LS2-6** • **BI-LS2-7** • **BI-LS4-6** • **BI-ESS2-2** • **BI-ESS3-1** • **BI-ESS3-2** • **BI-ESS3-3** • **BI-ESS3-4** • **BI-ESS3-5** • **BI-ETS1-1** • **BI-ETS1-2** • **BI-ETS1-3** • **BI-ETS1-4**	• **BI-LS1-1** • **BI-LS1-2** • **BI-LS1-4**

Recurring

- **RST.9-10.2** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- **RST.9-10.5** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
- **RST.9-10.9** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
- **WHST.9-10.1** Write arguments focused on discipline-specific content.

Unit 1	Biochemistry/Cell Division/ Specialization	**Grade Level**	10	**Approx length**	8 weeks

CPSD Power Standards with Student Learning Objectives

BI-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Student-Friendly Objectives:

- I can develop a model showing the steps of mitosis.
- I can describe how a single cell can lead to many cells via mitosis.
- I can explain how specialized cells develop from the same beginning cell.

BI-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

Student-Friendly Objectives:

- I can relate the different types of chemical bonds to various macromolecules.
- I can identify a molecule as being a protein, lipid, carbohydrate, or nucleic acid based on its structure.
- I can contrast the functions of proteins, lipids, carbohydrates, and nucleic acids.
- I can illustrate the importance of digestion and the role it plays in the creation of large carbon-based molecules.
- I can describe the role of water in breaking down and building macromolecules.

Learning Indicators of Power Standards

Students will know…	And be able to…
• Individual cells grow and divide via a process called mitosis • A multicellular organism begins as a single cell (fertilized egg) that undergoes division • Daughter cells produced as a result of mitosis are genetically identical • Cellular reproduction is the means by which organisms grow and repair damage • The steps involved in cell differentiation • Types of macromolecules (including monomers/polymers) • Types of chemical bonds: ionic, covalent, H-bonds • Types of reactions: dehydration, synthesis, and hydrolysis • Digestion of food provides basic elements (carbon, hydrogen, and oxygen) for making proteins, lipids, and nucleic acids	• Develop a model showing the steps of mitosis/cell division. • Explain how a single cell can divide to make two exact duplicate cells. • Outline the steps of cell differentiation. • Distinguish between the structures of proteins, lipids, carbohydrates, and nucleic acids. • Distinguish between the functions of proteins, lipids, carbohydrates, and nucleic acids. • Explain how proteins, lipids, carbohydrates, and nucleic acids work together to form living organisms. • Describe the role of water in the building and breaking down of macromolecules.

Additional Arkansas State Standards	
● **BI-LS1-3** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. ● **BI-ESS2-5** Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	

Unit 2	Photosynthesis and Cellular Respiration	Grade Level	10	Approx Length	4 weeks

CPSD Power Standards with Student Learning Objectives

BI-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Student-Friendly Objectives:

- I can identify the products and reactants of a chemical reaction.
- I can create a model to explain photosynthesis.
- I can interpret graphs and diagrams of photosynthesis.

BI-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Student-Friendly Objectives:

- I can identify the products and reactants of a cellular respiration.
- I can develop a model to explain cellular respiration.
- I can interpret graphs and diagrams of cellular respiration.

BI-LS2-5 Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Student-Friendly Objectives:

- I can explain how carbon cycles between photosynthesis and cellular respiration.
- I can describe the importance of photosynthesis in the carbon cycle.
- I can describe the importance of cellular respiration in the carbon cycle.

Learning Indicators of Power Standards

Students will know…	And be able to…
• Photosynthesis converts light energy to stored chemical energy • The reactants of photosynthesis are carbon dioxide and water • The products of photosynthesis are sugars and oxygen • The role of pigments and solar energy in photosynthesis • The energy molecules (ATP and NADPH) for photosynthesis	• Create a model that explains photosynthesis. • Interpret graphs of rates of photosynthesis based on different environmental factors. • Develop a model that explains cellular respiration. • Explain the cyclical relationship between photosynthesis and cellular

● Structure of the leaf and chloroplast ● Locations of the reactions of photosynthesis ● The role of transpiration in photosynthesis ● The role of cell transport (diffusion of O_2 and CO_2) ● Food can be converted to energy when it combines with oxygen in a cell ● The reactants of cellular respiration are food molecules (sugars) and oxygen ● The products of cellular respiration are energy (ATP), CO_2, and water ● The energy molecules (ATP, $FADH_2$, NADH) for cellular respiration ● The structure of the cell and mitochondria ● The location of the reactions of cellular respiration ● Cell transport: facilitated diffusion of glucose diffusion of O_2 and CO_2 ● Photosynthesis and cellular respiration provide the majority of the energy for life processes ● The basic biochemical pathways of photosynthesis and cellular respiration ● The carbon in the atmosphere's CO_2 is the same carbon that is in the food we eat ● The CO_2 that we exhale as a product of cellular respiration is the same carbon that plants take up for photosynthesis ● The O_2 that we inhale is the same oxygen that plants release as a product of photosynthesis	respiration. ● Create a diagram illustrating the role of photosynthesis and cellular respiration in the cycling of carbon.
Additional Arkansas State Standards	
● **BI-LS2-3** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● **BI-LS2-4** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● **BI-ESS2-6** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. ● **BI-ESS3-6** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	

Unit 3	Genetics and Evolution	Grade Level	10	Approx Length	8 weeks

CPSD Power Standards with Student Learning Objectives

BI-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Student-Friendly Objectives:

- I can develop a model of DNA.
- I can use base-pair rules to model DNA replication.
- I can connect a specific type of RNA to its role in protein synthesis.
- I can interpret a codon chart to determine the accurate sequence of amino acids.
- I can describe the structure of proteins and how their structure determines their function.
- I can explain how a mutation in DNA or proteins alters the function of the protein.

BI-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Student-Friendly Objectives:

- I can compare and contrast sexual and asexual reproduction.
- I can identify the general stages of meiosis.
- I can explain how meiosis leads to genetic variation.
- I can describe how errors during DNA replication contribute to genetic variation.
- I can write and support a claim that inheritable genetic variation may result from meiosis, DNA replication errors, and/or environmental factors.

BI-LS4-2 Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Student-Friendly Objectives:

- I can predict an individual's ability to compete for resources based on genetic variation.
- I can discuss how a population will change as a result of natural selection.
- I can describe how genetic mutations leads to genetic variation and contributes to the process of evolution.
- I can explain the role of natural selection in the process of evolution.
- I can contrast acclimation, adaptation, and evolution.
- I can interpret a graph relating to changes in population size.

- I can identify adaptations and evidence for evolution.

Learning Indicators of Power Standards

Students will know…

- Structure of DNA
- Structure of RNA
- DNA contains regions called genes
- Genes can code for proteins
- Not all DNA codes for a protein
- Types of RNA and their roles in protein synthesis
- The process of transcription and its role in protein synthesis
- The process of translation and its role in protein synthesis
- Structure of proteins (types of chemical bonds)
- Functions of proteins as enzymes, signal molecules, and transport molecules
- Types of DNA mutations
- Cell differentiation
- The steps of meiosis
- Alleles sort independently of one another during meiosis
- Sexual reproduction gives rise to new genetic combinations and variation between parent and offspring
- During sexual reproduction, chromosomes may swap sections (crossing over) during meiosis, resulting in genetic variation
- Errors that occur during DNA replication lead to mutations, which are another source of genetic variation
- Environmental factors can cause genetic mutations; viable mutations are inherited
- Evolution is genetic change within a population over long periods of time; individual organisms do not evolve
- DNA mutations and sexual reproduction lead to genetic variation
- Natural selection only happens when there is genetic variation between organisms in a population and variation in the expression of that genetic variation
- Variation among expressed traits allows some individuals to reproduce more successfully than others
- Organisms best suited for their environment are more likely to survive and reproduce, making their traits more common in the population

And be able to…

- Develop a model of DNA.
- Illustrate DNA replication.
- Transcribe a segment of DNA into mRNA.
- Translate a segment of mRNA into an amino acid sequence using a codon chart.
- Describe protein synthesis.
- Research and communicate an explanation of a human disorder(s) due to mutations in DNA and/or protein.
- Compare and contrast sexual and asexual reproduction.
- Model the steps of meiosis.
- Evaluate genetic diagrams to determine chromosome changes (good or bad).
- Construct a scientific argument, using supporting evidence, that genetic variation is a result of genetic recombination, replication errors, and environmental factors.
- Evaluate survival strategies based on limited resources.
- Describe how variation in traits help or inhibit individuals' ability to compete for resources.
- Predict effects of natural selection on a population when its environment changes.
- Relate an increase in species, genetic variation, competition among organisms, and natural selection to the process of evolution.
- Distinguish between acclimation, adaptation, and evolution.
- Identify supported evidences for evolution.
- Use graphical data to account for changes within a population.

● Populations change over time due to competition for resources ● Natural selection leads to adaptation and is on-going ● Adaptation is when the majority of a population is anatomically, behaviorally, and physiologically is best suited for its environment ● Examples of biotic and abiotic factors that contribute to a change in gene frequency over time, leading to adaptation of populations: seasonal temperature ranges, acidity, light, geographic barriers, evolution of other organisms, long-term climate change ● Changes in environment may result in expansion, decline, or extinction of a species or the emergence of a new species	

Additional Arkansas State Standards

- **BI-LS2-8** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- **BI-LS3-1** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **BI-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- **BI-LS4-1** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- **BI-LS4-3** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- **BI-LS4-4** Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- **BI-LS4-5** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- **BI-ESS2-7** Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
- **BI-ETS1-4** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Unit 4	Ecology and Human Impact	**Grade Level**	10	**Approx Length**	6 weeks

CPSD Power Standards with Student Learning Objectives

BI-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

- I can calculate averages.
- I can calculate percentages.
- I can interpret population growth graphs.
- I can determine the general mathematical trend for a population.
- I can describe changes in an ecosystem and its populations using multiple graphs for data.
- I can identify potential limiting factors of an ecosystem.
- I can predict the effects limiting factors will have on an ecosystem.

BI-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

- I can differentiate between renewable and non-renewable resources.
- I can use scientific data to present an explanation of an example of human activity change due to climate change.
- I can support a statement/conclusion using evidence relating to human activity and the effect that environmental factors have on the activity.
- I can use evidence to explain how natural hazards have impacted human activity.

Learning Indicators of Power Standards

Students will know…

- The carrying capacity of an ecosystem is the number of organisms and populations the ecosystem can support
- Limiting factors towards carrying capacity may include: availability of living/nonliving resources, predation, disease, and competition
- How populations and diversity are dependent on biotic and abiotic factors
- How mechanisms of evolution (genetic drift, mutations, gene flow, natural selection) contribute to population size and diversity
- Natural resource use and availability (energy/material use)
- Types of pollution (chemical, heat, etc.)

And be able to…

- Identify limiting factors of an ecosystem and how each factor affects carrying capacity of the ecosystem.
- Relate limiting factors to population size.
- Calculate averages.
- Calculate percentages.
- Create and interpret population growth graphs.
- Use evidence to explain examples of human activities that have been altered due to climate changes.
- Use evidence to explain examples of human activities that have been altered due to the occurrence of natural hazards.

● The difference between climate and weather ● Evidence of climate impacting human activity ● Energy production and resource extraction have economic, social, environmental, and political impacts ● Natural hazards and geologic events have changed the human population size	● Identify reusable and nonrenewable resources. ● Use evidence to explain examples of human activities that have been altered due to the availability of natural resources.

Additional Arkansas State Standards

- **BI-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **BI-LS2-1** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- **BI-LS2-6** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- **BI-LS2-7** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- **BI-LS4-6** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
- **BI-ESS2-2** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- **BI-ESS3-2** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- **BI-ESS3-3** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- **BI-ESS3-4** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- **BI-ESS3-5** Analyze geoscience data and the results from global climate models to make an evidence based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
- **BI-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **BI-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **BI-ETS1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- **BI-ETS1-4** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Unit 5	Systems	**Grade Level**	10	**Approx Length**	5 weeks

Arkansas State Standards

- **BI-LS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- **BI-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **BI-LS1-4** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.