Course Title: Biology

Department: Science

Grades: 9-10   **Credits**: 1

Course Overview/Description
As this is a general biology class, we will be learning about a wide range of topics throughout this semester, including: ① From Molecules to Organisms, ② Inheritance, ③ Cells and Body Systems, ④ Natural Selection, ⑤ Energy, and ⑥ Ecology.

Course Materials
Binder

Scope and Sequence

Timeframe	Unit	Instructional Topics
6 weeks	From Molecules to Organisms	• Properties of Water • Biological Molecules • DNA Structure and Function • Protein Structure and Function
8 weeks	Inheritance	• Chromosomes and Karyotyping • Variation in Traits • Mendelian Genetics
6 weeks	Cells and Body Systems	• Cell Organelles • Cell Size and Cell Division • Homeostasis
6 weeks	Natural Selection	• Evidence for Evolution • Adaptation • Natural Selection
4 weeks	Energy	• Photosynthesis • Cellular Respiration • Metabolic Pathways Interactions
6 weeks	Ecology	• Ecological Organization and Trophic Pyramids • Energy Flow Through an Ecosystem • Nutrient Cycling • Ecological Succession • Population Growth • Human Influences on Ecosystems

Detailed Curriculum Map

Unit 1: From Molecules to Organisms (6 weeks)

- General Description: Exploration of the basics of biochemistry and genetics, with a focus on

water properties, biological molecules, and DNA and protein structures.
- Student Learning Objective: Understand the properties of water, structure and function of biological molecules, DNA and proteins.
  - Properties of Water
  - Biological Molecules
  - DNA Structure and Function
  - Protein Structure and Function

Unit 2: Inheritance (8 weeks)

- General Description: Introduction to the principles of inheritance, including chromosomal structure, trait variation, and Mendelian genetics.
- Student Learning Objective: Understand the concepts of chromosomes and karyotyping, trait variations, and principles of Mendelian Genetics.
  - Chromosomes and Karyotyping
  - Variation in Traits
  - Mendelian Genetics

Unit 3: Cells and Body Systems (6 weeks)

- General Description: Examination of cellular biology and various body systems, with a focus on cell organelles, cell division, and the circulatory, nervous, and respiratory systems.
- Student Learning Objective: Understand cell organelles, cell size and cell division, and an overview of circulatory, nervous, and respiratory systems, including homeostasis.
  - Cell Organelles
  - Cell Size and Cell Division
  - Homeostasis

Unit 4: Natural Selection (6 weeks)

- General Description: Comprehensive study of evolution and natural selection, focusing on the evidence for evolution, adaptation, and natural selection.
- Student Learning Objective: Understand evidence for evolution, adaptation, and the process of natural selection.
  - Evidence for Evolution
  - Adaptation
  - Natural Selection

Unit 5: Energy (4 weeks)

- General Description: Exploration of energy concepts, including photosynthesis, cellular respiration, and the interaction of metabolic pathways.
- Student Learning Objective: Understand the processes of photosynthesis, cellular respiration, and interactions in metabolic pathways.
  - Photosynthesis
  - Cellular Respiration
  - Metabolic Pathways Interactions

Unit 6: Ecology (6 weeks)

- General Description: Introduction to ecology, with a focus on ecological organization, energy flow, nutrient cycling, ecological succession, population growth, and human influences.
- Student Learning Objective: Understand ecological organization and trophic pyramids, energy flow in ecosystems, nutrient cycling, ecological succession, population growth, and human influences on ecosystems.
  - Ecological Organization and Trophic Pyramids
  - Energy Flow Through an Ecosystem
  - Nutrient Cycling
  - Ecological Succession
  - Population Growth
  - Human Influences on Ecosystems

Course Essential Standards

Unit 1: Molecules to Organisms

1.1 | Properties of Water: "I can describe the properties of water and model how these unique properties allow for life to exist." [HS-PS1-1]

Scale Score	Description
1	I can describe polarity, and illustrate or identify what a water molecule looks like.
2	Additionally, I can describe several unique properties of water that allow for life to exist on earth.
3	Additionally, I can examine *how* polarity is the defining characteristic that allows water to be such a crucial component to life on earth, and also how this polarity allows for all of the other unique properties of water.

1.2 | Biological Molecules: "I can compare and contrast the four main types of biomolecules that comprise the body: carbohydrates, lipids, nucleic acids and proteins." [HS-PS1-1]

Scale Score	Description
1	I can identify different biological molecules (polymers) and their respective building blocks (monomers).
2	Additionally, I can describe the chemical formation and separation of biological molecules, and use this to explain the relative amounts of energy stored in different biomolecules.
3	Additionally, I can describe the functions of the different biological molecules.

1.3 | DNA Structure and Function: "I can explain how DNA serves as the genetic blueprints for all life." [HS-LS1-1]

Scale Score	Description
1	I can identify the structure of DNA and base pairs.
2	Additionally, I can describe the process of DNA replication.
3	Additionally, I can explain the function of DNA, as it relates to heritable traits.

1.4 | Protein Structure and Function: "I can model how DNA structure determines the structure and function of proteins which carry out essential functions for all cells." [HS-LS1-1]

Scale Score	Description
1	I can define transcription and translation.
2	Additionally, I can model or interpret the processes of transcription and translation.
3	Additionally, I can explain protein folding, and model different protein structures and shapes to explain the role of a resulting protein in a living organism.

Unit 2: Inheritance

2.1 | Chromosomes and Karyotyping: "I can explain how DNA and chromosomes carry the instructions for heritable traits." [HS-LS3-1]

Scale Score	Description
1	I can differentiate between chromatin and a chromosome.
2	Additionally, I can define a karyotype and explain how one is used to identify genetic traits.
3	Additionally, I can create or interpret a karyotype to identify a genetic trait that may result.

2.2 | Variation in Traits: "I can show how genetic variations may result from: (1) meiosis events, (2) replication errors, and/or (3) environmental factors." [HS-LS3-2]

Scale Score	Description

Scale Score	Description
1	I can define "trait," "variation," and "mutation".
2	Additionally, I can describe how the process of meiosis can produce new genetic combinations.
3	Additionally, I can analyze evidence to determine the source of genetic variation in an example.

2.3 | Mendelian Genetics: "I can apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population." [HS-LS3-3]

Scale Score	Description
1	I can define key inheritance terms, such as "heterozygous," "homozygous," "dominant," "recessive," etc.
2	Additionally, I can create a Punnett squares to calculate genotypic and phenotypic probabilities for various crosses (e.g., simple dominance, codominance, x-linked, etc.)
3	Additionally, I can interpret pedigrees by identifying inheritance patterns from one generation to the next.

Unit 3: Cells and Body Systems

*3.1 | Cell Structure and Function: "I can describe the structure and function of cellular organelles, and explain how they contribute to the overall physiology of the cell." [HS-LS1-2.a]

Scale Score	Description
1	I can identify cell structures in a cell model or histology slide.
2	Additionally, I can describe the function of cellular organelles.
3	Additionally, I can explain how variations in organelle abundance and diversity contribute to the overall function of the cell.

3.2 | Cell Size and Cell Division: "I can explain why and how cells undergo division, emphasizing the importance of small cell size." [HS-LS1-2.b]

Scale Score	Description
1	I can describe mitosis as a form of cellular division and list its functions for the organism/cell.

Scale Score	Description
2	Additionally, I can explain why cells have a small size relative to the organism.
3	Additionally, I can use data to analyze cellular efficiency based on surface area and volume.

3.3 | Homeostasis: "I can plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis." [HS-LS1-3]

Scale Score	Description
1	I can define positive and negative feedback, and describe how they each affect homeostasis in the body.
2	Additionally, I can plan and conduct a scientific investigation to demonstrate the effects of a body system's feedback mechanisms on a measurable physiological trait.
3	Additionally, I can analyze experimental evidence to answer scientific questions about homeostasis.

Unit 4: Natural Selection

Standard 4.1 | Adaptation and Natural Selection: "I can explain the concept of adaptation, and demonstrate how a species changes over time due to natural selection forces." [HS-LS4-4, HS-LS4-5]

Scale Score	Description
1	I can define key evolutionary terms such as "adaptation," "population" and "selection."
2	Additionally, I can compare and contrast the different types (sexual, disruptive, directional and stabilizing) and patterns (convergent, divergent and parallel) of natural selection, as well as compare them to artificial selection and genetic drift.
3	Additionally, I can use an example to connect a certain environmental change to a predicted adaptation in a population of organisms.

Standard 4.2 | Evidence for Evolution: "I can provide different types of evidence that supports the theory of evolution." [HS-LS4-1]

Scale Score	Description
1	I can explain the origin of similar traits in families as the passing on of genes/DNA of ancestors.
2	Additionally, I can compare and contrast the different pieces of evidence that support the theory of evolution, including: fossil, anatomical structures, molecular, embryonic development, biogeographical and direct observation.

Scale Score	Description
3	I can provide specific examples in each of the 5 main categories of evidence for evolution:

Standard 4.3 | Cladistics and Phylogeny: "I can interpret or model evolutionary relationships based on shared DNA or derived characteristics." [HS-LS4-5]

Scale Score	Description
1	I can define terms such as "clade," "phylogeny" and/or "homology."
2	Additionally, I can explain the importance of phylogeny and cladistics and in studying the evolutionary history of life.
3	Additionally, I model or interpret phylogenetic trees and cladograms based on shared derived characteristics and molecular data.

Unit 5: Energy

Standard 5.1 | Photosynthesis: "I can model how photosynthesis transforms light energy into chemical energy." [HS-LS1-5]

Scale Score	Description
1	I can identify the reactants, products, and steps of the photosynthetic process.
2	Additionally, I can describe the importance of the photosynthetic process.
3	Additionally, I can identify the source of reactants and product destinations of the photosynthetic process. I can describe pressures that can influence the direction of the photosynthetic process.

Standard 5.2 | Cellular Respiration: "I can model how cellular respiration converts chemicals (food and oxygen molecules) into new compounds." [HS-LS1-7]

Scale Score	Description
1	I can identify the reactants, products, and steps of the cellular respiration process.
2	Additionally, I can describe the importance of the cellular respiration process.
3	Additionally, I can identify the source of reactants and product destinations of the cellular respiration process. I can describe pressures that can influence the direction of the cellular respiration process.

Standard 6.1 | Ecological Organization and Trophic Pyramids: "I can illustrate and analyze the ecological organization of life on earth." [HS-LS1-4]

Scale Score	Description
1	I can identify the different levels of ecological organization, from an individual to the biosphere.
2	Additionally, I can explain the interdependent relationship between abiotic and biotic factors in an ecosystem.
3	Additionally, I can predict the impact of predator-prey, top-down (trophic cascades), or bottom-up impacts on an ecosystem when the populations of different players of a trophic pyramid are affected.

Standard 6.2 | Energy Flow Through an Ecosystem: "I can use mathematical or other visual representations to show how matter and energy flow through ecosystems." [HS-LS2-4]

Scale Score	Description
1	I can identify the trophic level or ecological position of an organism based on where and/or how it gets its energy.
2	Additionally, I can demonstrate how energy is passed from one trophic level to the next, as well as calculate an organism's energy efficiency.
3	Additionally, I can use energy efficiency data to extrapolate the impact of that efficiency on the rest of the ecosystem.

Standard 6.3 | Nutrient Cycling: "I can illustrate how compounds are cycled around the planet through the hydrologic, carbon, nitrogen and phosphorus cycles to sustain life." [HS-LS2-4]

Scale Score	Description
1	I can identify the type of nutrient cycle given either a diagram or description.
2	Additionally, I can explain the importance of each nutrient cycle as a source of life-sustaining renewable resources.
3	Additionally, I can predict and explain the interconnectedness of nutrient cycles and their connection to metabolism in living organisms.

Standard 6.4 | Ecological Succession: "I can evaluate the conditions that allow for ecosystems to maintain stability or change over time." [HS-LS2-6]

Scale Score	Description
1	I can describe how ecosystems develop over time.
2	Additionally, I can describe the processes of primary and secondary succession, as well as explain how succession is altered over time.
3	Additionally, I can summarize the impact that humans have on ecological succession and develop strategies for ecosystem development.

Standard 6.5 | Population Growth: "I can evaluate factors that affect the carrying capacity of ecosystems at different scales." [HS-LS2-1]

Scale Score	Description
1	I can determine the change in population size given quantitative information.
2	Additionally, I can compare logistic growth with exponential growth in a population, including carrying capacity.
3	Additionally, I can consider the type of survivor to predict how density-dependent and density-independent variables affect population size.

Standard 6.6 | Human Influences on Ecosystems: "I can describe the impact of human activities on the planet, and come up with a solution for how to remedy it." [HS-LS2-7]

Scale Score	Description
1	I can identify ways that humans are altering the natural environment.
2	Additionally, I can explain the consequences of human influences on the environment, focusing on risks to ecosystems, economies, and human health.
3	Additionally, I can develop and propose a solution to an environmental problem or sustainability issue.

STEM.Skill.1 | Research: "I can identify sources of information that are credible, using a variety of criteria to determine the legitimacy of the information I am consuming."

Scale Score	Description
1	I can identify credible and reliable sources of information.
2	Additionally, I can summarize the specific criteria that legitimize the sources I have chosen to rely on for information, focusing on accuracy, authority, objectivity, currency and coverage.
3	Additionally, I can properly cite the sources I've relied on for my research in APA format, both in-text and within a bibliography, if necessary.

STEM.Skill.2 | CERCA: "I can think critically about a scientific topic or phenomenon, by identifying claims, summarizing evidence, proposing counter arguments, and providing sound reasoning to support a conclusion."

Scale Score	Description
1	I can provide or identify claims about a particular phenomenon.
2	Additionally, I can identify or provide multiple pieces of evidence that support the claim being made.
3	Additionally, I can think critically about the evidence at hand, identifying potential counter-arguments, and ultimately coming to a reasoned conclusion as to whether or not the claim is sufficiently substantiated.

STEM.Skill.3 | Writing: "I can express my mastery of science content or skills in written form, while being detailed yet concise, using appropriate grammar."

Scale Score	Description
1	I can write coherently about a scientific topic.
2	Additionally, my writing is well organized, structured in a logical manner. Sentences flow nicely and ideas are concise but not redundant.
3	Additionally, I can write with proper conventions, demonstrating very minor grammatical errors, such as spelling mishaps or incorrect punctuation.

STEM.Skill.4 | Presentation: "I can create a presentation on a specific scientific topic or phenomenon and communicate the information to my peers."

Scale Score	Description
1	I can create a presentation that is rich with visuals or other multimedia, which help convey a particular scientific topic or phenomenon.
2	Additionally, I can share my presentation with the class in a way where it is evident that I am knowledgeable about the topic and that I've prepared.
3	Additionally, I can communicate with pride, poise and professionalism, since I am the expert on this topic. This includes answering any questions that my peers or instructor may have on the given topic.

STEM.Skill.5 | Dissection: "I can demonstrate understanding of anatomical structures and functions through hands-on dissections."

Scale Score	Description
1	I can follow safety procedures while in the laboratory setting, limiting risk to myself and/or my dissection partners.
2	Additionally, I can rely on my dissection specimen to correctly identify anatomical structures.
3	Additionally, I can demonstrate physiological understanding of anatomical structures in a dissection setting.

STEM.Skill.6 | Practicum: "I can apply content learned in a laboratory setting."

Scale Score	Description
1	I can show beginning levels of understanding of the content being learned in a laboratory setting.
2	Additionally, I can show emerging levels of understanding of the content being learned in a laboratory setting.
3	Additionally, I can show proficient or advanced levels of understanding of the content being learned in a laboratory setting.

ACT.1 | Data Representation: "I can manipulate and analyze scientific data presented in tables, graphs, and diagrams."

Scale Score	Description

Scale Score	Description
1	I can identify a passage that illustrates data representation.
2	Additionally, manipulate and analyze scientific data presented in tables, graphs, and diagrams.
3	Additionally, I can achieve the level 2 scale at 80% proficiency or greater.

ACT.2 | Research Summaries: "I can understand experimental tools, procedures, and design."

Scale Score	Description
1	I can identify a passage that illustrates research summaries.
2	Additionally, I can understand experimental tools, procedures, and design.
3	Additionally, I can achieve the level 2 scale at 80% proficiency or greater.

ACT.3 | Conflicting Viewpoints: "I can judge the validity of scientific information and formulate conclusions and predictions based on that information."

Scale Score	Description
1	I can identify a passage that demonstrates conflicting viewpoints.
2	Additionally, I can judge the validity of scientific information and formulate conclusions and predictions based on that information.
3	Additionally, I can achieve the level 2 scale at 80% proficiency or greater.