

Subject Area - 3: Science and Technology and Engineering Education

Standard Area - 3.1: Biological Sciences

Organizing Category - 3.1.A: Organisms and Cells

Course - 3.1.B.A: BIOLOGY

Standard - 3.1.B.A1:

Describe the common characteristics of life.

Compare and contrast the cellular structures and degrees of complexity of prokaryotic and eukaryotic organisms.

Explain that some structures in eukaryotic cells developed from early prokaryotic cells (e.g., mitochondria, chloroplasts)

Assessment Anchor - BIO.A.1:

Basic Biological Principles

Anchor Descriptor - BIO.A.1.1:

Explain the characteristics common to all organisms.

Eligible Content

- BIO.A.1.1.1: Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.

Anchor Descriptor - BIO.A.1.2:

Describe relationships between structure and function at biological levels of organization.

▪ BIO.A.1.2.1:

Compare cellular structures and their functions in prokaryotic and eukaryotic cells.

- BIO.A.1.2.2: Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms).

Standard - 3.1.B.A2:

Identify the initial reactants, final products, and general purposes of photosynthesis and cellular respiration.

Explain the important role of ATP in cell metabolism.

Describe the relationship between photosynthesis and cellular respiration in photosynthetic organisms.

Explain why many biological macromolecules such as ATP and lipids contain high energy bonds.

Explain the importance of enzymes as catalysts in cell reactions.

Identify how factors such as pH and temperature may affect enzyme function.

Assessment Anchor - BIO.A.2:

The Chemical Basis for Life

Anchor Descriptor - BIO.A.2.1:

Describe how the unique properties of water support life on Earth.

- BIO.A.2.1.1: Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).

Anchor Descriptor - BIO.A.2.2:

Describe and interpret relationships between structure and function at various

levels of biochemical organization (i.e., atoms, molecules, and macromolecules).

- **BIO.A.2.2.1:** Explain how carbon is uniquely suited to form biological macromolecules.
- **BIO.A.2.2.2:** Describe how biological macromolecules form from monomers.
- **BIO.A.2.2.3:** Compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.

Anchor Descriptor - BIO.A.2.3:

Explain how enzymes regulate biochemical reactions within a cell.

- **BIO.A.2.3.1:** Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
- **BIO.A.2.3.2:** Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

Assessment Anchor - BIO.A.3:

Bioenergetics

Anchor Descriptor - BIO.A.3.1:

Identify and describe the cell structures involved in processing energy.

- **BIO.A.3.1.1:** Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.

Anchor Descriptor - BIO.A.3.2:

Identify and describe how energy is captured and transformed in organisms to drive their life processes.

- **BIO.A.3.2.1:** Compare and contrast the basic transformation of energy during photosynthesis and cellular respiration.
- **BIO.A.3.2.2:** Describe the role of ATP in biochemical reactions.

Assessment Anchor - BIO.A.4:

Homeostasis and Transport

Anchor Descriptor - BIO.A.4.1:

Identify and describe the cell structures involved in transport of materials into, out of and throughout a cell.

- **BIO.A.4.1.1:** Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.
- **BIO.A.4.1.2:** Compare and contrast the mechanisms that transport materials across the plasma membrane (i.e., passive transport -- diffusion, osmosis, facilitated diffusion; active transport -- pumps, endocytosis, exocytosis).
- **BIO.A.4.1.3:** Describe how endoplasmic reticulum, Golgi apparatus, and other membrane-bound cellular organelles facilitate transport of materials within cells.

Anchor Descriptor - BIO.A.4.2:

Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

- **BIO.A.4.2.1:** Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Assessment Anchor - BIO.B.4:

Ecology

Anchor Descriptor - BIO.B.4.1:

Describe ecological levels of organization in the biosphere.

- **BIO.B.4.1.1:** Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, biosphere).
- **BIO.B.4.1.2:** Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.

Anchor Descriptor - BIO.B.4.2:

Describe interactions and relationships in an ecosystem.

- **BIO.B.4.2.1:** Describe how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids).
- **BIO.B.4.2.2:** Describe biotic interactions in an ecosystem (e.g., competition, predation, symbiosis).
- **BIO.B.4.2.3:** Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, nitrogen cycle).
- **BIO.B.4.2.4:** Describe how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires).
- **BIO.B.4.2.5:** Describe the effects of limiting factors on population dynamics and potential species extinction.

Standard - 3.1.B.A3: Explain how all organisms begin their life cycles as a single cell and that in multicellular organisms, successive generations of embryonic cells form by cell division.

Standard - 3.1.B.A4:

Summarize the stages of the cell cycle.

Examine how interactions among the different molecules in the cell cause the distinct stages of the cell cycle which can also be influenced by other signaling molecules.

Explain the role of mitosis in the formation of new cells and its importance in maintaining chromosome number during asexual reproduction.

Compare and contrast a virus and a cell. Relate the stages of viral cycles to the cell cycle.

Assessment Anchor - BIO.A.4:

Homeostasis and Transport

Anchor Descriptor - BIO.A.4.1:

Identify and describe the cell structures involved in transport of materials into, out of and throughout a cell.

- **BIO.A.4.1.1:** Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.
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Anchor Descriptor - BIO.A.4.2:

Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

- **BIO.A.4.2.1:** Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Assessment Anchor - BIO.B.1:

Cell Growth and Reproduction

Anchor Descriptor - BIO.B.1.1:

Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.

- **BIO.B.1.1.1:** Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.
- **BIO.B.1.1.2:** Compare and contrast the processes and outcomes of mitotic and meiotic nuclear divisions.

Anchor Descriptor - BIO.B.1.2:

Explain how genetic information is inherited.

- **BIO.B.1.2.1:** Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.
- **BIO.B.1.2.2:** Explain the functional relationships among DNA, genes, alleles, and chromosomes and their roles in inheritance.

Standard - 3.1.B.A5:

Relate the structure of cell organelles to their function (energy capture and release, transport, waste removal, protein synthesis, movement, etc).

Explain the role of water in cell metabolism.

Explain how the cell membrane functions as a regulatory structure and protective barrier for the cell.

Describe transport mechanisms across the plasma membrane.

Assessment Anchor - BIO.A.1:

Basic Biological Principles

Anchor Descriptor - BIO.A.1.1:

Explain the characteristics common to all organisms.

- **BIO.A.1.1.1:** Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.

Anchor Descriptor - BIO.A.1.2:

Describe relationships between structure and function at biological levels of organization.

- **BIO.A.1.2.1:**
Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
- **BIO.A.1.2.2:** Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms).

Assessment Anchor - BIO.A.2:

The Chemical Basis for Life

Anchor Descriptor - BIO.A.2.1:

Describe how the unique properties of water support life on Earth.

- **BIO.A.2.1.1:** Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).

Anchor Descriptor - BIO.A.2.2:

Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).

- **BIO.A.2.2.1:** Explain how carbon is uniquely suited to form biological macromolecules.
- **BIO.A.2.2.2:** Describe how biological macromolecules form from monomers.
- **BIO.A.2.2.3:** Compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.

Anchor Descriptor - BIO.A.2.3:

Explain how enzymes regulate biochemical reactions within a cell.

- **BIO.A.2.3.1:** Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
- **BIO.A.2.3.2:** Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

Assessment Anchor - BIO.A.3:

Bioenergetics

Anchor Descriptor - BIO.A.3.1:

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Anchor Descriptor - BIO.A.3.2:

Identify and describe how energy is captured and transformed in organisms to drive their life processes.

- **BIO.A.3.2.1:** Compare and contrast the basic transformation of energy during photosynthesis and cellular respiration.
- **BIO.A.3.2.2:** Describe the role of ATP in biochemical reactions.

Assessment Anchor - BIO.A.4:

Homeostasis and Transport

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- **BIO.A.4.1.1:** Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.
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- **BIO.A.4.1.3:** Describe how endoplasmic reticulum, Golgi apparatus, and other membrane-bound cellular organelles facilitate transport of materials within cells.

Anchor Descriptor - BIO.A.4.2:

Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

- **BIO.A.4.2.1:** Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Assessment Anchor - BIO.B.1:

Cell Growth and Reproduction

Anchor Descriptor - BIO.B.1.1:

Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.

- **BIO.B.1.1.1:** Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.
- **BIO.B.1.1.2:** Compare and contrast the processes and outcomes of mitotic and meiotic nuclear divisions.

Anchor Descriptor - BIO.B.1.2:

Explain how genetic information is inherited.

- **BIO.B.1.2.1:** Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.
- **BIO.B.1.2.2:** Explain the functional relationships among DNA, genes, alleles, and chromosomes and their roles in inheritance.

Assessment Anchor - BIO.B.2:

Genetics

Anchor Descriptor - BIO.B.2.1:

Compare and contrast Mendelian and non-Mendelian patterns of inheritance.

- **BIO.B.2.1.1:** Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).
- **BIO.B.2.1.2:** Describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and inversion).

Anchor Descriptor - BIO.B.2.2:

Explain the process of protein synthesis (i.e., transcription, translation, and protein modification).

- **BIO.B.2.2.1:** Describe how the processes of transcription and translation are similar in all organisms.
- **BIO.B.2.2.2:** Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in

the production of specific types of proteins.

Anchor Descriptor - BIO.B.2.3:

Explain how genetic information is expressed.

- **BIO.B.2.3.1:** Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frame-shift).

Anchor Descriptor - BIO.B.2.4:

Apply scientific thinking, processes, tools, and technologies in the study of genetics.

- **BIO.B.2.4.1:** Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).

Standard - 3.1.B.A6: Explain how cells differentiate in multicellular organisms.

Assessment Anchor - BIO.A.1:

Basic Biological Principles

Anchor Descriptor - BIO.A.1.1:

Explain the characteristics common to all organisms.

- **BIO.A.1.1.1:** Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.

Anchor Descriptor - BIO.A.1.2:

Describe relationships between structure and function at biological levels of organization.

- **BIO.A.1.2.1:**
Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
- **BIO.A.1.2.2:** Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms).

Standard - 3.1.B.A7:

Analyze the importance of carbon to the structure of biological macromolecules.

Compare and contrast the functions and structures of proteins, lipids, carbohydrates, and nucleic acids.

Explain the consequences of extreme changes in pH and temperature on cell proteins.

Assessment Anchor - BIO.A.2:

The Chemical Basis for Life

Anchor Descriptor - BIO.A.2.1:

Describe how the unique properties of water support life on Earth.

- **BIO.A.2.1.1:** Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).

Anchor Descriptor - BIO.A.2.2:

Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).

- **BIO.A.2.2.1:** Explain how carbon is uniquely suited to form biological macromolecules.
- **BIO.A.2.2.2:** Describe how biological macromolecules form from monomers.
- **BIO.A.2.2.3:** Compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.

Anchor Descriptor - BIO.A.2.3:

Explain how enzymes regulate biochemical reactions within a cell.

- BIO.A.2.3.1: Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
- BIO.A.2.3.2: Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

Assessment Anchor - BIO.A.4:

Homeostasis and Transport

Anchor Descriptor - BIO.A.4.1:

Identify and describe the cell structures involved in transport of materials into, out of and throughout a cell.

- BIO.A.4.1.1: Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.
- BIO.A.4.1.2: Compare and contrast the mechanisms that transport materials across the plasma membrane (i.e., passive transport -- diffusion, osmosis, facilitated diffusion; active transport -- pumps, endocytosis, exocytosis).
- BIO.A.4.1.3: Describe how endoplasmic reticulum, Golgi apparatus, and other membrane-bound cellular organelles facilitate transport of materials within cells.

Anchor Descriptor - BIO.A.4.2:

Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

- BIO.A.4.2.1: Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Standard - 3.1.B.A8:

CHANGE AND CONSTANCY

Recognize that systems within cells and multicellular organisms interact to maintain homeostasis.

PATTERNS

Demonstrate the repeating patterns that occur in biological polymers.

SYSTEMS

Describe how the unique properties of water support life.

Assessment Anchor - BIO.A.2:

The Chemical Basis for Life

Anchor Descriptor - BIO.A.2.1:

Describe how the unique properties of water support life on Earth.

- BIO.A.2.1.1: Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).

Anchor Descriptor - BIO.A.2.2:

Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).

- BIO.A.2.2.1: Explain how carbon is uniquely suited to form biological macromolecules.
- BIO.A.2.2.2: Describe how biological macromolecules form from monomers.
- BIO.A.2.2.3: Compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.

Anchor Descriptor - BIO.A.2.3:

Explain how enzymes regulate biochemical reactions within a cell.

- BIO.A.2.3.1: Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
- BIO.A.2.3.2: Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

Assessment Anchor - BIO.A.4:

Homeostasis and Transport

Anchor Descriptor - BIO.A.4.1:

Identify and describe the cell structures involved in transport of materials into, out of and throughout a cell.

- **BIO.A.4.1.1:** Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.
- **BIO.A.4.1.2:** Compare and contrast the mechanisms that transport materials across the plasma membrane (i.e., passive transport -- diffusion, osmosis, facilitated diffusion; active transport -- pumps, endocytosis, exocytosis).
- **BIO.A.4.1.3:** Describe how endoplasmic reticulum, Golgi apparatus, and other membrane-bound cellular organelles facilitate transport of materials within cells.

Anchor Descriptor - BIO.A.4.2:

Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

- **BIO.A.4.2.1:** Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Standard - 3.1.B.A9:

- **Compare and contrast scientific theories.**
- **Know that both direct and indirect observations are used by scientists to study the natural world and universe.**
- **Identify questions and concepts that guide scientific investigations.**
- **Formulate and revise explanations and models using logic and evidence.**
- **Recognize and analyze alternative explanations and models.**
- **Explain the importance of accuracy and precision in making valid measurements.**
- **Examine the status of existing theories.**
- **Evaluate experimental information for relevance and adherence to science processes.**
- **Judge that conclusions are consistent and logical with experimental conditions.**
- **Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.**
- **Communicate and defend a scientific argument.**

Assessment Anchor - BIO.B.3:

Theory of Evolution

Anchor Descriptor - BIO.B.3.1:

Explain the mechanisms of evolution.

- **BIO.B.3.1.1:** Explain how natural selection can impact allele frequencies of a population.
- **BIO.B.3.1.2:** Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration).
- **BIO.B.3.1.3:** Explain how genetic mutations may result in genotypic and phenotypic variations within a population.

Anchor Descriptor - BIO.B.3.2:

Analyze the sources of evidence for biological evolution.

- **BIO.B.3.2.1:** Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).

Anchor Descriptor - BIO.B.3.3:

Apply scientific thinking, processes, tools, and technologies in the study of evolution.

- **BIO.B.3.3.1:** Distinguish among the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.