All students are expected to demonstrate mastery of the Biology topics listed below. Honors Biology students must also demonstrate mastery of the topics listed under Honors Biology. Biology students may engage in the Honors Biology topics but will not be assessed on these.

| Biology | Honors Biology |
| --- | --- |
| Unit: Interdependent Relationships in Ecosystems |
| **Interdependent Relationships in Ecosystems**LS2.A E1 | **Interdependent Relationships in Ecosystems**LS2.A E1 |
| * Apply knowledge of biotic and abiotic limiting factors to predict how a population’s carrying capacity is impacted.
* Identify trends within a population from provided data.
 | * Apply knowledge of biotic and abiotic limiting factors to predict how a population’s carrying capacity is impacted.
* Identify trends within a population from provided data.
* Examine density-dependent and density-independent limiting factors to predict how a population’s carrying capacity is impacted.
* Justify their reasoning which may include graphing the population’s trends.
 |
| **Ecosystem Dynamics, Functioning, and Resilience**LS2.C E1 | **Ecosystem Dynamics, Functioning, and Resilience**LS2.C E1 |
| * Demonstrate knowledge of how complex interactions between biotic and abiotic factors help maintain stability in an ecosystem.
* Examine how disturbances (mild to extreme) may result in the ecosystem returning to its original state or becoming a new ecosystem.
 | * Demonstrate knowledge of how complex interactions between biotic and abiotic factors help maintain stability in an ecosystem.
* Examine how disturbances (mild to extreme) may result in the ecosystem returning to its original state or becoming a new ecosystem.
* Apply knowledge of the stages of succession to explain the resiliency of ecosystems.
* Distinguish between primary and secondary succession.
 |
| **Ecosystem Dynamics, Functioning, and Resilience**LS2.C E2 | **Ecosystem Dynamics, Functioning, and Resilience**LS2.C E2 |
| * Examine provided examples of human impact on biodiversity and ecosystem stability.
* Evaluate proposed solutions to mitigating human impact on the environment.
 | * Examine provided examples of human impact on biodiversity and ecosystem stability.
* Evaluate proposed solutions to mitigating human impact on the environment.
* Investigate multiple anthropogenic environmental changes, current impacts and predict potential biological consequences.
* Propose and/or research a solution to a chosen human-caused problem.
 |
| **Social Interactions and Group Behavior**LS2.D E1 | **Social Interactions and Group Behavior**LS2.D E1 |
| * Explain how group behavior helps survival of individuals within a population.
 | * Explain how group behavior helps survival of individuals within a population.
* Analyze how individual and group behavior impacts population survival using provided examples.

This topic may also be applied to concepts in second semester. |
| **Adaptation**LS4.C E4 | **Adaptation**LS4.C E4 |
| * Describe how disturbances in the environment can lead to the emergence of new species and the decline, sometimes extinction, of some species.
 | * Describe how disturbances in the environment can lead to the emergence of new species and the decline, sometimes extinction, of some species.
 |
| **Biodiversity and Humans**LS4.D E1 | **Biodiversity and Humans**LS4.D E1 |
| * Explain how the loss of and/or emergence of new species impacts biodiversity.
 | * Explain how the loss of and/or emergence of new species impacts biodiversity.
 |
| **Biodiversity and Humans**LS4.D E2 | **Biodiversity and Humans**LS4.D E2 |
| * Identify the adverse effects of human activity on biodiversity. These include overpopulation, overexploitation, habitat destruction, pollution, invasive species, and climate change.
 | * Investigate the adverse effects of human activity on biodiversity. These include overpopulation, overexploitation, habitat destruction, pollution, invasive species, and climate change.
* Investigate the influence human activity has on biodiversity and identify how these activities influence competition between species.

  |

| Biology | Honors Biology |
| --- | --- |
| Unit: Matter and Energy in Organisms and Ecosystems |
| **Organization for Matter & Energy Flow in Organisms**LS1.C E1 | **Organization for Matter & Energy Flow in Organisms** LS1.C E1 |
| * Identify the inputs and outputs of photosynthesis.
 | * Identify the inputs (reactants) and outputs (products) of photosynthesis.
* Identify the reactants and products of the Light Dependent and Light Independent reactions in the chloroplast.
 |
| **Organization for Matter & Energy Flow in Organisms** LS1.C E2 | **Organization for Matter & Energy Flow in Organisms** LS1.C E2 |
| * Examine how the carbon, hydrogen, and oxygen from the sugar created in photosynthesis is rearranged to build macromolecules such as protein and DNA. These macromolecules can be used to form new cells.
 | * Examine how the carbon, hydrogen, and oxygen from the sugar created in photosynthesis is rearranged to build macromolecules such as protein and DNA. These macromolecules can be used to form new cells.
* Identify other macromolecules necessary to build cell parts (e.g. lipids, carbohydrates, nucleic acids, and enzymes) and the need for Nitrogen in some of these.
 |
| **Organization for Matter & Energy Flow in Organisms** LS1.C E3 | **Organization for Matter & Energy Flow in Organisms** LS1.C E3 |
| * Distinguish between the matter and energy flowing through living systems.
* Identify how chemical elements are recombined to form different products.
* Recognize the conservation of matter through biological processes.
 | * Distinguish between the matter and energy flowing through living systems.
* Identify how chemical elements are recombined to form different products.
* Recognize the conservation of matter through biological processes.
 |
| **Organization for Matter & Energy Flow in Organisms**LS1.C E4 | **Organization for Matter & Energy Flow in Organisms**LS1.C E4 |
| * Identify the inputs and outputs of aerobic cellular respiration.
* Identify the transfer of energy from the sun to carbon-based molecules (sugar/glucose) to new compounds (ATP) which can transport energy to cells throughout the organism.
* Analyze how this energy allows for organisms to maintain internal stability (e.g. maintaining body temperature).
 | * Identify the inputs (reactants) and outputs (products) of aerobic cellular respiration.
* Identify the transfer of energy from the sun to carbon-based molecules (sugar/glucose) to new compounds (ATP) which can transport energy to cells throughout the organism.
* Analyze how this energy allows for organisms to maintain internal stability (e.g. maintaining body temperature).
* Identify the reactants and products of Glycolysis.
* Identify the reactants and products of the processes occurring inside the mitochondria.
 |
| **Cycles of Matter & Energy Transfer in Ecosystems**LS2.B E1 | **Cycles of Matter & Energy Transfer in Ecosystems**LS2.B E1 |
| * Explain the relationship between photosynthesis and cellular respiration and its role in providing energy to support life on Earth.
* Evaluate the differences between aerobic and anaerobic processes including the energy yields of both processes.
 | * Explain the relationship between photosynthesis and cellular respiration and its role in providing energy to support life on Earth.
* Evaluate the differences between aerobic and anaerobic processes including the energy yields of both processes.
 |
| **Cycles of Matter & Energy Transfer in Ecosystems**LS2.B E2 | **Cycles of Matter & Energy Transfer in Ecosystems**LS2.B E2 |
| * Trace the transfer of matter as it moves up the food web and explain why most consumed matter is not transferred to the above trophic level.
* Diagram why this inefficiency generally results in fewer organisms at higher levels of the food web.
* Demonstrate the conservation of matter and energy as matter moves into organisms to be incorporated into newly made structures, reacts to release energy for life functions, or is discarded. Follow the atoms as they pass through food webs, into and out of the atmosphere and soil, and are combined and recombined in different ways.
 | * Trace the transfer of matter as it moves up the food web and explain why most consumed matter is not transferred to the above trophic level.
* Diagram why this inefficiency generally results in fewer organisms at higher levels of the food web.
* Demonstrate the conservation of matter and energy as matter moves into organisms to be incorporated into newly made structures, reacts to release energy for life functions, or is discarded. Follow the atoms as they pass through food webs, into and out of the atmosphere and soil, and are combined and recombined in different ways.

  |
| **Cycles of Matter and Energy Transfer in Ecosystems**LS2.B E3 | **Cycles of Matter and Energy Transfer in Ecosystems**LS2.B E3 |
| * Trace the path of carbon through photosynthesis and cellular respiration.
* Identify how carbon moves through the spheres (biosphere, atmosphere, geosphere, and hydrosphere) in biological processes.
 | * Trace the path of carbon through photosynthesis and cellular respiration.
* Identify how carbon moves through the spheres (biosphere, atmosphere, geosphere, and hydrosphere) in biological processes.
 |

| Biology | Honors Biology |
| --- | --- |
| Unit: Structure and Function |
| **Structure and Function**LS1.A E1 | **Structure and Function**LS1.A E1 |
| * Identify the differences between cells in an organism to explain how they work together to perform the essential functions of life.
 | * Identify the differences between cells in an organism to explain how they work together to perform the essential functions of life.
 |
| **Structure and Function**LS1.A E2 | **Structure and Function**LS1.A E2 |
| * Explain how information is coded in the DNA molecule for the formation of proteins. (Central Dogma)
* Trace the process of protein synthesis from a gene on the DNA to the sequence of amino acids which compose that protein.
* Explain that proteins (e.g. Enzymes, hormones, structural proteins) are carrying out most of the work of cells.
 | * Explain how information is coded in the DNA molecule for the formation of proteins. (Central Dogma)
* Trace the process of protein synthesis from a gene on the DNA to the sequence of amino acids which compose that protein.
* Explain that proteins (e.g. Enzymes, hormones, structural proteins) are carrying out most of the work of cells.
* Summarize the steps in Transcription and Translation including the key enzymes involved.
 |
| **Structure and Function**LS1.A E3 | **Structure and Function**LS1.A E3 |
| * Describe the levels of organization from cells to organisms.
* Investigate the interactions of systems within an organism.
* Describe at least two major body systems in terms of contributions to overall functions of an organism.
 | * Describe the levels of organization from atoms to organisms and ecosystems.
* Investigate the interactions of systems within an organism.
* Describe at least two major body systems in terms of contributions to overall functions of an organism.
 |
| **Structure and Function**LS1.A E4 | **Structure and Function**LS1.A E4 |
| * Describe the mechanisms organisms use to maintain stable internal conditions even as external conditions change (homeostasis).
 | * Describe the mechanisms organisms use to maintain stable internal conditions even as external conditions change (homeostasis).
* Apply knowledge of feedback loops to identify positive and negative feedback mechanisms in given examples.
 |

| Biology | Honors Biology |
| --- | --- |
| Unit: Inheritance and Variation of Traits |
| **Structure and Function**LS1.A E2 | **Structure and Function**LS1.A E2 |
| * Explain how information is coded in the DNA molecule for the formation of proteins. (Central Dogma)
* Trace the process of protein synthesis from a gene on the DNA to the sequence of amino acids which compose that protein.
* Explain that proteins (e.g. Enzymes, hormones, structural proteins) are carrying out most of the work of cells.
 | * Explain how information is coded in the DNA molecule for the formation of proteins. (Central Dogma)
* Trace the process of protein synthesis from a gene on the DNA to the sequence of amino acids which compose that protein.
* Explain that proteins (e.g. Enzymes, hormones, structural proteins) are carrying out most of the work of cells.
* Summarize the steps in Transcription and Translation including the key enzymes involved.
 |
| **Growth and Development of Organisms**LS1.B E1 | **Growth and Development of Organisms**LS1.B E1 |
| * Explain the role mitosis plays in growth, development and repair of tissues in multicellular organisms.
* Identify why daughter cells from mitosis are genetically identical to the parent cell.
* Explain the importance of differentiation in producing and maintaining a complex organism.
 | * Explain the role mitosis plays in growth, development and repair of tissues in multicellular organisms.
* Identify why daughter cells from mitosis are genetically identical to the parent cell.
* Explain the importance of differentiation in producing and maintaining a complex organism.
 |
| **Inheritance of Traits**LS3.A E1 | **Inheritance of Traits**LS3.A E1 |
| * Differentiate between chromosomes, DNA and genes.
* Explain how all cells in an organism have the same genetic content, but the genes expressed by the cell depend on the cell’s function.
 | * Differentiate between chromosomes, DNA and genes.
* Explain how all cells in an organism have the same genetic content, but the genes expressed by the cell depend on the cell’s function.
* Explain how segments of DNA may code for proteins, regulate processes, provide structure, or have an unknown function.
 |
| **Variation of Traits**LS3.B E1 | **Variation of Traits**LS3.B E1 |
| * Explain the role meiosis plays in sexual reproduction.
* Explain how crossing over, mutations from DNA replication and environmental mutagens increase a population’s genetic variation.
* Differentiate between viable and nonviable mutations.
* Explain how genetic variations produced by meiosis and mutations can be inherited.
* Recognize sex and chromosomal mutations in karyotypes.
* Apply concepts of statistics and probability using data from Punnett squares and pedigree charts to analyze genetic scenarios. Examples may include dominant/recessive, codominant, incomplete dominance, sex-linked, multiple alleles, and sex-influenced.
 | * Explain the role meiosis plays in sexual reproduction.
* Explain how crossing over, mutations from DNA replication and environmental mutagens increase a population’s genetic variation.
* Differentiate between viable and nonviable mutations.
* Explain how genetic variations produced by meiosis and mutations can be inherited.
* Recognize sex and chromosomal mutations in karyotypes.
* Apply concepts of statistics and probability using data from Punnett squares and pedigree charts to analyze genetic scenarios. Examples include dominant/recessive, codominant, incomplete dominance, sex-linked, multiple alleles, and sex-influenced.
* Create Punnett squares and pedigree charts from data to identify and explain patterns of inheritance.
 |
| **Variation of Traits**LS3.B E2 | **Variation of Traits**LS3.B E2 |
| * Explain how environmental factors can affect the expression of traits in a population.
 | * Explain how environmental factors can affect the expression of traits in a population.
* Explain the role of epigenetics in gene regulation.
 |
|  | **Science is a Human Endeavor**Demonstrate how technological advances have influenced the progress of science. These may include conducting electrophoresis, pGLO, and/or CRISPR in a lab investigation or simulation. |
| Unit: Natural Selection and Evolution |
| **Evidence of Common Ancestry and Diversity**LS4.A E1 | **Evidence of Common Ancestry and Diversity**LS1.4 E1 |
| * Compare DNA sequences of different organisms to identify evolutionary similarities supported by multiple lines of descent.
* Communicate that the patterns observed through multiple evidences provide evidence for relationships of common ancestry.
* Compare and contrast the similarities and differences in anatomical evidence, embryological evidence and patterns of amino acid sequences to support common ancestry and evolution.
 | * Compare DNA sequences of different organisms to identify evolutionary similarities supported by multiple lines of descent.
* Communicate that the patterns observed through multiple evidences provide evidence for relationships of common ancestry.
* Compare and contrast the similarities and differences in anatomical evidence, embryological evidence and patterns of amino acid sequences to support common ancestry and evolution.
* Predict and provide reasoning for the placement of an organism in a cladogram and/or phylogenic tree.
 |
| **Natural Selection**LS4.B E1 | **Natural Selection**LS4.B E1 |
| * Demonstrate how natural selection occurs in a population when phenotypic variation results in differences in performance among individuals.
* Explain how the process of natural selection works on genetic variation which already exists in the population, not variation which appears in response to need.
 | * Demonstrate how natural selection occurs in a population when phenotypic variation results in differences in performance among individuals.
* Explain how the process of natural selection works on genetic variation which already exists in the population, not variation which appears in response to need.
 |
| **Natural Selection**LS4.B E2 | **Natural Selection**LS4.B E2 |
| * Demonstrate how beneficial traits are more likely to be seen in the next generation because individuals with this trait are more successful in their environment.
* Analyze data and/or graphs of allele frequencies to explain changes in the population.
 | * Demonstrate how beneficial traits are more likely to be seen in the next generation because individuals with this trait are more successful in their environment.
* Analyze data and/or graphs of allele frequencies to explain changes in the population.
* Explain the principles of Hardy-Weinberg equilibrium using allele frequencies.
 |
| **Adaptation**LS4.C E1 | **Adaptation**LS4.C E1 |
| * Explain that evolution is a consequence of the interaction of four factors:

(1) the potential of species to increase in number (2) genetic variation exists due to mutation and sexual reproduction (3) competition occurs for limited resources needed to survive and reproduce (4) organisms better able to survive and reproduce increase in number | * Explain that evolution is a consequence of the interaction of four factors:

(1) the potential of species to increase in number (2) genetic variation exists due to mutation and sexual reproduction (3) competition occurs for limited resources needed to survive and reproduce (4) organisms better able to survive and reproduce increase in number* Explain other mechanisms of evolution. Examples may include genetic drift (bottleneck, founder effect), gene flow, and/or co-evolution.
 |
| **Adaptation**LS4.C E2 | **Adaptation**LS4.C E2 |
| * Demonstrate how, over time, natural selection leads to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment.
* Explain how individuals in a population with an advantageous heritable trait increase in number while those who do not, decrease in number.
 | * Demonstrate how, over time, natural selection leads to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment.
* Explain how individuals in a population with an advantageous heritable trait increase in number while those who do not, decrease in number.
 |
| **Adaptation**LS4.C E3 | **Adaptation**LS4.C E3 |
| * Elaborate on how changes in the environment can change which heritable traits are advantageous. This will lead to a shift in the distribution of traits.
 | * Elaborate on how changes in the environment can change which heritable traits are advantageous. This will lead to a shift in the distribution of traits.
* Predict and justify the resulting change in a population given an environmental change.
 |
| **Adaptation**LS4.C E4 | **Adaptation**LS4.C E4 |
| * Analyze how natural or human-caused changes in the environment can lead to the emergence of new species, expansion of an existing species and/or the decline of other species over time.
 | * Analyze how natural or human-caused changes in the environment can lead to the emergence of new species, expansion of an existing species and/or the decline of other species over time.
* Identify and differentiate between the different causes of speciation. Examples may include geographic isolation, mechanical isolation, and/or behavioral isolation.
* Elaborate on how reproductive isolation results in speciation.
 |
| **Adaptation**LS4.C E5 | **Adaptation**LS4.C E5 |
| * Explain how species become extinct because they can no longer survive and reproduce due to rapid or drastic changes in their environment.
 | * Explain how species become extinct because they can no longer survive and reproduce due to rapid or drastic changes in their environment.
* Investigate a scenario where a species may or may not become extinct due to a change in the environment.
* Examine the impact of humans on the extinction of species to identify whether a correlation or direct causation exists.
 |