Biology Tutorials offer targeted instruction, practice, and review designed to help students develop fluency, deepen conceptual understanding, and apply scientific thinking skills. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing their ability to explain and analyze biological scenarios, students build the depth of knowledge and higher-order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible through focused content, guided analysis, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high-impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

This Tutorial is aligned to state standards and the Next Generation Science Standards for Biology.

Unit 1: Nature of Life

- **FROM ATOMS TO BIOSPHERE**
  - HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **CHARACTERISTICS OF LIFE**
  - HS-LS1-1: Structure and Function 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.
  - HS-LS1-3: Structure and Function Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
  - HS-LS1-6: Matter and Energy in Organisms and Ecosystems 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.
- **BIOMOLECULES**
  - HS-LS1-6: Matter and Energy in Organisms and Ecosystems 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.

Unit 2: Cell Structure and Function

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- **PROKARYOTIC AND EUKARYOTIC CELLS**
  - HS-LS1-3: Structure and Function Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
  - HS-LS1-1: Structure and Function 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.
  - HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **PLANT AND ANIMAL CELLS**
  - HS-LS1-5: Matter and Energy in Organisms and Ecosystems Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
  - HS-LS1-7: Matter and Energy in Organisms and Ecosystems 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.

Unit 3: Cellular Energetics

- **PHOTOSYNTHESIS**
  - HS-LS1-5: Matter and Energy in Organisms and Ecosystems Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- **CELLULAR RESPIRATION**
  - HS-LS1-7: Matter and Energy in Organisms and Ecosystems 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.
  - HS-LS2-3: Matter and Energy in Organisms and Ecosystems Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Unit 4: Cell Growth and Reproduction

- **THE CELL CYCLE**
  - HS-LS1-4: Inheritance and Variation of Traits Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
  - HS-LS1-1: Structure and Function 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.
- **MITOSIS**
  - HS-LS1-4: Inheritance and Variation of Traits Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Unit 5: DNA Structure and Function

- **COMPONENTS OF DNA**

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- HS-LS1-1: Structure and Function 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.

- **THE GENETIC CODE**
  - HS-LS1-1: Structure and Function 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.
  - HS-LS3-1: Inheritance and Variation of Traits Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **DNA REPLICATION**
  - HS-LS1-1: Structure and Function 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.
  - HS-LS3-1: Inheritance and Variation of Traits Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
  - HS-LS3-2: Inheritance and Variation of Traits 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.

Unit 6: Gene Expression

- **TRANSCRIPTION**
  - HS-LS1-1: Structure and Function 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.
  - HS-LS3-1: Inheritance and Variation of Traits Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **TRANSLATION**
  - HS-LS1-1: Structure and Function 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.

Unit 7: Mutations

- **GENETIC CHANGES IN DNA**
  - HS-LS3-2: Inheritance and Variation of Traits 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.

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- **GENETIC CHANGES IN CHROMOSOMES**
  - HS-LS3-1: Inheritance and Variation of Traits Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
  - HS-LS3-2: Inheritance and Variation of Traits 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.

Unit 8: Heredity

- **MENDELIAN LAWS OF HEREDITY**
  - HS-LS3-3: Inheritance and Variation of Traits Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
  - HS-LS3-1: Inheritance and Variation of Traits Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **MULTIPLE ALLELES AND ALLELES WITHOUT DOMINANCE**
  - HS-LS3-3: Inheritance and Variation of Traits Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
  - HS-LS3-1: Inheritance and Variation of Traits Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Unit 9: Reproduction

- **MEIOSIS**
  - HS-LS3-1: Inheritance and Variation of Traits Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
  - HS-LS3-2: Inheritance and Variation of Traits 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.
  - HS-LS4-2: Natural Selection and Evolution 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.
- **SEXUAL AND ASEXUAL REPRODUCTION**
  - HS-LS4-2: Natural Selection and Evolution 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

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reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Unit 10: Evolution

- **MULTIPLE LINES OF EVIDENCE**
  - HS-LS4-1: Natural Selection and Evolution Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
  - HS-ESS2-7: Earths Systems Construct an argument based on evidence about the simultaneous coevolution of Earths systems and life on Earth.
  - HS-ESS2-7: Earths Systems Construct an argument based on evidence about the simultaneous coevolution of Earths systems and life on Earth.
  - HS-ESS2-7: Earths Systems Construct an argument based on evidence about the simultaneous coevolution of Earths systems and life on Earth.
- **THE FOSSIL RECORD**
  - HS-LS4-1: Natural Selection and Evolution Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
  - HS-LS4-5: Natural Selection and Evolution 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.

Unit 11: Mechanisms of Evolution

- **NATURAL SELECTION**
  - HS-LS2-8: Interdependent Relationships in Ecosystems Evaluate the evidence for the role of group behavior on individual and species chances to survive and reproduce.
  - HS-LS4-2: Natural Selection and Evolution 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.
  - HS-LS4-4: Natural Selection and Evolution Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
  - HS-LS2-8: Interdependent Relationships in Ecosystems Evaluate the evidence for the role of group behavior on individual and species chances to survive and reproduce.
  - HS-LS3-3: Inheritance and Variation of Traits Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
  - HS-LS2-8: Interdependent Relationships in Ecosystems Evaluate the evidence for the role of group behavior on individual and species chances to survive and reproduce.
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- HS-LS4-3: Natural Selection and Evolution 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.

- **EVOLUTION OF SPECIES**
  - HS-LS4-2: Natural Selection and Evolution 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.
  - HS-LS4-5: Natural Selection and Evolution 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.
  - HS-LS4-1: Natural Selection and Evolution Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
  - HS-LS4-3: Natural Selection and Evolution 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.
  - HS-LS2-8: Interdependent Relationships in Ecosystems Evaluate the evidence for the role of group behavior on individual and species chances to survive and reproduce.
  - HS-LS3-3: Inheritance and Variation of Traits Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
  - HS-LS4-4: Natural Selection and Evolution Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Unit 12: Homeostasis

- **HOMEOSTASIS AND DYNAMIC EQUILIBRIUM**
  - HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
  - HS-LS1-3: Structure and Function Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- **FEEDBACK MECHANISMS IN ANIMALS**
  - HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
  - HS-LS1-3: Structure and Function Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Unit 13: Functions of Animal Systems

- **THE NERVOUS SYSTEM**

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- HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

- **THE IMMUNE AND LYMPHATIC SYSTEMS**
  - HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Unit 14: Functions of Plant Systems

- **PLANT TISSUES**
  - HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **PLANT RESPONSES**
  - HS-LS1-2: Structure and Function Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Unit 15: Cycles in Nature

- **THE CARBON CYCLE**
  - HS-LS2-4: Matter and Energy in Organisms and Ecosystems Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
  - HS-LS2-5: Matter and Energy in Organisms and Ecosystems Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
  - HS-ESS2-6: Earths Systems Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
  - HS-LS2-6: Interdependent Relationships in Ecosystems 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.
  - HS-LS2-7: Interdependent Relationships in Ecosystems Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
  - HS-ESS2-6: Earths Systems Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- **THE NITROGEN AND PHOSPHORUS CYCLES**
  - HS-LS2-4: Matter and Energy in Organisms and Ecosystems Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
  - HS-LS2-6: Interdependent Relationships in Ecosystems 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.
  - HS-LS2-7: Interdependent Relationships in Ecosystems Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

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Unit 16: Matter and Energy

- **FOOD CHAINS AND WEBS**
  - HS-LS2-4: Matter and Energy in Organisms and Ecosystems Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
  - HS-LS2-1: Interdependent Relationships in Ecosystems Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- **PYRAMIDS OF ENERGY, NUMBERS, AND BIOMASS**
  - HS-LS2-4: Matter and Energy in Organisms and Ecosystems Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
  - HS-LS2-1: Interdependent Relationships in Ecosystems Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
  - HS-LS2-2: Interdependent Relationships in Ecosystems Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
  - HS-LS2-6: Interdependent Relationships in Ecosystems 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.
  - HS-LS2-7: Interdependent Relationships in Ecosystems Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
  - HS-LS4-5: Natural Selection and Evolution 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.

Unit 17: Ecology of Succession

- **SUCCESSION IN COMMUNITIES**
  - HS-LS2-6: Interdependent Relationships in Ecosystems 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.
  - HS-LS4-5: Natural Selection and Evolution 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.
- **NATURAL IMPACTS ON ECOSYSTEMS**
  - HS-LS2-6: Interdependent Relationships in Ecosystems 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.

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- HS-LS4-5: Natural Selection and Evolution 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.

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