Tennessee Tutorials are designed specifically for the Tennessee Academic Standards to prepare students for the Tennessee Comprehensive Assessment Program (TCAP) and the TNReady assessments.

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 concentrate 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.

Unit 1: Nature of Life

- **FROM ATOMS TO BIOSPHERE**
  - BIO1.LS1.1: From Molecules to Organisms: Structures and Processes Compare and contrast existing models, identify patterns, and use structural and functional evidence to analyze the characteristics of life. Engage in argument about the designation of viruses as non-living based on these characteristics.
- **CHARACTERISTICS OF LIFE**
  - BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.
  - BIO1.LS1.1: From Molecules to Organisms: Structures and Processes Compare and contrast existing models, identify patterns, and use structural and functional evidence to analyze the characteristics of life. Engage in argument about the designation of viruses as non-living based on these characteristics.
  - BIO1.LS1.6: From Molecules to Organisms: Structures and Processes Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multicellular organisms.
  - BIO1.LS1.7: From Molecules to Organisms: Structures and Processes Utilize a model of a cell plasma membrane to compare the various types of cellular transport and test predictions

about the movement of molecules into or out of a cell based on the homeostasis of energy and matter in cells.

Unit 2: The Chemistry of Life

- **BIOMOLECULES**
  - BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.
  - BIO1.LS1.1: From Molecules to Organisms: Structures and Processes Compare and contrast existing models, identify patterns, and use structural and functional evidence to analyze the characteristics of life. Engage in argument about the designation of viruses as non-living based on these characteristics.
  - BIO1.LS1.3: From Molecules to Organisms: Structures and Processes Integrate evidence to develop a structural model of a DNA molecule. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information.
  - BIO1.LS1.5: From Molecules to Organisms: Structures and Processes Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled investigation to test predictions about factors, which should cause an effect on the structure and function of a protein.
- **ENZYMES**
  - BIO1.LS1.5: From Molecules to Organisms: Structures and Processes Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled investigation to test predictions about factors, which should cause an effect on the structure and function of a protein.

Unit 3: Cell Structure and Function

- **PROKARYOTIC AND EUKARYOTIC CELLS**
  - BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.
  - BIO1.LS1.7: From Molecules to Organisms: Structures and Processes Utilize a model of a cell plasma membrane to compare the various types of cellular transport and test predictions about the movement of molecules into or out of a cell based on the homeostasis of energy and matter in cells.
  - BIO1.LS1.6: From Molecules to Organisms: Structures and Processes Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multicellular organisms.

- **PLANT AND ANIMAL CELLS**
  - BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.

Unit 4: Passive and Active Transport

- **PASSIVE TRANSPORT**
  - BIO1.LS1.7: From Molecules to Organisms: Structures and Processes Utilize a model of a cell plasma membrane to compare the various types of cellular transport and test predictions about the movement of molecules into or out of a cell based on the homeostasis of energy and matter in cells.
  - BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.
- **ACTIVE TRANSPORT**
  - BIO1.LS1.7: From Molecules to Organisms: Structures and Processes Utilize a model of a cell plasma membrane to compare the various types of cellular transport and test predictions about the movement of molecules into or out of a cell based on the homeostasis of energy and matter in cells.

Unit 5: Cellular Energetics

- **PHOTOSYNTHESIS**
  - BIO1.LS1.8: From Molecules to Organisms: Structures and Processes Create a model of photosynthesis demonstrating the net flow of matter and energy into a cell. Use the model to explain energy transfer from light energy into stored chemical energy in the product.
- **CELLULAR RESPIRATION**
  - BIO1.LS1.8: From Molecules to Organisms: Structures and Processes Create a model of photosynthesis demonstrating the net flow of matter and energy into a cell. Use the model to explain energy transfer from light energy into stored chemical energy in the product.
  - BIO1.LS1.9: From Molecules to Organisms: Structures and Processes Create a model of aerobic respiration demonstrating flow of matter and energy out of a cell. Use the model to explain energy transfer mechanisms. Compare aerobic respiration to alternative processes of glucose metabolism.
  - BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.

Unit 6: Cell Growth and Reproduction

- **THE CELL CYCLE**

- BIO1.LS1.6: From Molecules to Organisms: Structures and Processes Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multicellular organisms.
- BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.

- **MITOSIS**
  - BIO1.LS1.2: From Molecules to Organisms: Structures and Processes Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures.
  - BIO1.LS1.6: From Molecules to Organisms: Structures and Processes Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multicellular organisms.
  - BIO1.ETS2.2: Links Among Engineering, Technology, Science, and Society Investigate the means by which karyotypes are utilized in diagnostic medicine.

Unit 7: DNA Structure and Function

- **COMPONENTS OF DNA**
  - BIO1.LS1.3: From Molecules to Organisms: Structures and Processes Integrate evidence to develop a structural model of a DNA molecule. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information.
  - BIO1.LS1.4: From Molecules to Organisms: Structures and Processes Demonstrate how DNA sequence information is decoded through transcriptional and translational processes within the cell in order to synthesize proteins. Examine the relationship of structure and function of various types of RNA and the importance of this relationship in these processes.
- **THE GENETIC CODE**
  - BIO1.LS1.4: From Molecules to Organisms: Structures and Processes Demonstrate how DNA sequence information is decoded through transcriptional and translational processes within the cell in order to synthesize proteins. Examine the relationship of structure and function of various types of RNA and the importance of this relationship in these processes.
  - BIO1.LS1.3: From Molecules to Organisms: Structures and Processes Integrate evidence to develop a structural model of a DNA molecule. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information.
  - BIO1.LS1.5: From Molecules to Organisms: Structures and Processes Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled

investigation to test predictions about factors, which should cause an effect on the structure and function of a protein.

- **DNA REPLICATION**
  - BIO1.LS1.3: From Molecules to Organisms: Structures and Processes Integrate evidence to develop a structural model of a DNA molecule. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information.

Unit 8: Gene Expression

- **TRANSCRIPTION**
  - BIO1.LS1.4: From Molecules to Organisms: Structures and Processes Demonstrate how DNA sequence information is decoded through transcriptional and translational processes within the cell in order to synthesize proteins. Examine the relationship of structure and function of various types of RNA and the importance of this relationship in these processes.
- **TRANSLATION**
  - BIO1.LS1.4: From Molecules to Organisms: Structures and Processes Demonstrate how DNA sequence information is decoded through transcriptional and translational processes within the cell in order to synthesize proteins. Examine the relationship of structure and function of various types of RNA and the importance of this relationship in these processes.
  - BIO1.LS1.5: From Molecules to Organisms: Structures and Processes Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled investigation to test predictions about factors, which should cause an effect on the structure and function of a protein.

Unit 9: Mutations

- **GENETIC CHANGES IN DNA**
  - BIO1.LS3.2: Heredity: Inheritance and Variation of Traits Explain how protein formation results in phenotypic variation and discuss how changes in DNA can lead to somatic or germ line mutations.
- **GENETIC CHANGES IN CHROMOSOMES**
  - BIO1.ETS2.2: Links Among Engineering, Technology, Science, and Society Investigate the means by which karyotypes are utilized in diagnostic medicine.
  - BIO1.LS3.1: Heredity: Inheritance and Variation of Traits Model chromosome progression through meiosis and fertilization in order to argue how the processes of sexual reproduction lead to both genetic similarities and variation in diploid organisms. Compare and contrast the processes of sexual and asexual reproduction, identifying the advantages and disadvantages of each.
  - BIO1.ETS2.3: Links Among Engineering, Technology, Science, and Society Analyze scientific and ethical arguments to support the pros and cons of application of a specific biotechnology

technique such as stem cell usage, in vitro fertilization, or genetically modified organisms.

Unit 10: Heredity and Biotechnology

- **MENDELIAN LAWS OF HEREDITY**
  - BIO1.LS3.1: Heredity: Inheritance and Variation of Traits Model chromosome progression through meiosis and fertilization in order to argue how the processes of sexual reproduction lead to both genetic similarities and variation in diploid organisms. Compare and contrast the processes of sexual and asexual reproduction, identifying the advantages and disadvantages of each.
  - BIO1.LS4.2: Biological Change: Unity and Diversity Using a model that demonstrates the change in allele frequencies resulting in evolution of a population over many generations, identify causative agents of change.
  - BIO1.LS3.3: Heredity: Inheritance and Variation of Traits Through pedigree analysis, identify patterns of trait inheritance to predict family member genotypes. Use mathematical thinking to predict the likelihood of various types of trait transmission.
- **MULTIPLE ALLELES AND ALLELES WITHOUT DOMINANCE**
  - BIO1.LS3.3: Heredity: Inheritance and Variation of Traits Through pedigree analysis, identify patterns of trait inheritance to predict family member genotypes. Use mathematical thinking to predict the likelihood of various types of trait transmission.
- **BIOTECHNOLOGY**
  - BIO1.ETS2.3: Links Among Engineering, Technology, Science, and Society Analyze scientific and ethical arguments to support the pros and cons of application of a specific biotechnology technique such as stem cell usage, in vitro fertilization, or genetically modified organisms.
  - BIO1.ETS2.1: Links Among Engineering, Technology, Science, and Society Obtain, evaluate, and communicate information on how molecular biotechnology may be used in a variety of fields.

Unit 11: Reproduction

- **MEIOSIS**
  - BIO1.LS3.1: Heredity: Inheritance and Variation of Traits Model chromosome progression through meiosis and fertilization in order to argue how the processes of sexual reproduction lead to both genetic similarities and variation in diploid organisms. Compare and contrast the processes of sexual and asexual reproduction, identifying the advantages and disadvantages of each.
- **SEXUAL AND ASEXUAL REPRODUCTION**
  - BIO1.LS3.1: Heredity: Inheritance and Variation of Traits Model chromosome progression through meiosis and fertilization in order to argue how the processes of sexual reproduction lead to both genetic similarities and variation in diploid organisms. Compare and contrast the processes of sexual and asexual reproduction, identifying the advantages and disadvantages of each.

Unit 12: Evolution

- **MULTIPLE LINES OF EVIDENCE**
  - BIO1.LS4.1: Biological Change: Unity and Diversity Evaluate scientific data collected from analysis of molecular sequences, fossil records, biogeography, and embryology. Identify chronological patterns of change and communicate that biological evolution is supported by multiple lines of empirical evidence that identify similarities inherited from a common ancestor (homologies).
- **THE FOSSIL RECORD**
  - BIO1.LS4.1: Biological Change: Unity and Diversity Evaluate scientific data collected from analysis of molecular sequences, fossil records, biogeography, and embryology. Identify chronological patterns of change and communicate that biological evolution is supported by multiple lines of empirical evidence that identify similarities inherited from a common ancestor (homologies).

Unit 13: Mechanisms of Evolution

- **NATURAL SELECTION**
  - BIO1.LS2.1: Ecosystems: Interactions, Energy, and Dynamics Analyze mathematical and/or computational representations of population data that support explanations of factors that affect population size and carrying capacities of populations within an ecosystem. Examine a representative ecosystem and, based on interdependent relationships present, predict population size effects due to a given disturbance.
  - BIO1.LS4.2: Biological Change: Unity and Diversity Using a model that demonstrates the change in allele frequencies resulting in evolution of a population over many generations, identify causative agents of change.
- **EVOLUTION OF SPECIES**
  - BIO1.LS4.1: Biological Change: Unity and Diversity Evaluate scientific data collected from analysis of molecular sequences, fossil records, biogeography, and embryology. Identify chronological patterns of change and communicate that biological evolution is supported by multiple lines of empirical evidence that identify similarities inherited from a common ancestor (homologies).

Unit 14: Cycles in Nature

- **THE CARBON CYCLE**
  - BIO1.LS2.2: Ecosystems: Interactions, Energy, and Dynamics Create a model tracking carbon atoms between inorganic and organic molecules in an ecosystem. Explain human impacts on climate based on this model.
  - BIO1.LS2.3: Ecosystems: Interactions, Energy, and Dynamics Analyze through research the cycling of matter in our biosphere and explain how biogeochemical cycles are critical for ecosystem function.

- BIO1.LS1.8: From Molecules to Organisms: Structures and Processes Create a model of photosynthesis demonstrating the net flow of matter and energy into a cell. Use the model to explain energy transfer from light energy into stored chemical energy in the product.
- BIO1.LS4.3: Biological Change: Unity and Diversity Identify ecosystem services and assess the role of biodiversity in support of these services. Analyze the role human activities have on disruption of these services.

- **THE NITROGEN AND PHOSPHORUS CYCLES**
  - BIO1.LS2.3: Ecosystems: Interactions, Energy, and Dynamics Analyze through research the cycling of matter in our biosphere and explain how biogeochemical cycles are critical for ecosystem function.

Unit 15: Matter and Energy

- **FOOD CHAINS AND WEBS**
  - BIO1.LS2.1: Ecosystems: Interactions, Energy, and Dynamics Analyze mathematical and/or computational representations of population data that support explanations of factors that affect population size and carrying capacities of populations within an ecosystem. Examine a representative ecosystem and, based on interdependent relationships present, predict population size effects due to a given disturbance.
  - BIO1.LS2.4: Ecosystems: Interactions, Energy, and Dynamics Analyze data demonstrating the decrease in biomass observed in each successive trophic level. Construct an explanation considering the laws of conservation of energy and matter and represent this phenomenon in a mathematical model to describe the transfer of energy and matter between trophic levels.
- **PYRAMIDS OF ENERGY, NUMBERS, AND BIOMASS**
  - BIO1.LS1.8: From Molecules to Organisms: Structures and Processes Create a model of photosynthesis demonstrating the net flow of matter and energy into a cell. Use the model to explain energy transfer from light energy into stored chemical energy in the product.
  - BIO1.LS2.4: Ecosystems: Interactions, Energy, and Dynamics Analyze data demonstrating the decrease in biomass observed in each successive trophic level. Construct an explanation considering the laws of conservation of energy and matter and represent this phenomenon in a mathematical model to describe the transfer of energy and matter between trophic levels.
  - BIO1.LS2.1: Ecosystems: Interactions, Energy, and Dynamics Analyze mathematical and/or computational representations of population data that support explanations of factors that affect population size and carrying capacities of populations within an ecosystem. Examine a representative ecosystem and, based on interdependent relationships present, predict population size effects due to a given disturbance.
  - BIO1.LS1.9: From Molecules to Organisms: Structures and Processes Create a model of aerobic respiration demonstrating flow of matter and energy out of a cell. Use the model to explain energy transfer mechanisms. Compare aerobic respiration to alternative processes of glucose metabolism.

Unit 16: Ecology of Succession

- **SUCCESSION IN COMMUNITIES**
  - BIO1.LS2.5: Ecosystems: Interactions, Energy, and Dynamics Analyze examples of ecological succession, identifying and explaining the order of events responsible for the formation of a new ecosystem in response to extreme fluctuations in environmental conditions or catastrophic events.
  - BIO1.LS2.1: Ecosystems: Interactions, Energy, and Dynamics Analyze mathematical and/or computational representations of population data that support explanations of factors that affect population size and carrying capacities of populations within an ecosystem. Examine a representative ecosystem and, based on interdependent relationships present, predict population size effects due to a given disturbance.
- **NATURAL IMPACTS ON ECOSYSTEMS**
  - BIO1.LS2.2: Ecosystems: Interactions, Energy, and Dynamics Create a model tracking carbon atoms between inorganic and organic molecules in an ecosystem. Explain human impacts on climate based on this model.
  - BIO1.LS2.5: Ecosystems: Interactions, Energy, and Dynamics Analyze examples of ecological succession, identifying and explaining the order of events responsible for the formation of a new ecosystem in response to extreme fluctuations in environmental conditions or catastrophic events.