

Georgia Tutorials are designed specifically for the Georgia Standards of Excellence and the Georgia Performance Standards to prepare students for the Georgia Milestones.

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.

## 1. THE NATURE OF LIFE

### ● FROM ATOMS TO BIOSPHERE

- **SB5.b** *Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).*

### ● CHARACTERISTICS OF LIFE

- **SB1.b** *Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis, and meiosis) in maintaining genetic continuity.*
- **SB2.c** *Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture.*
- **SB5.e** *Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).*
- **SB6.d** *Develop and use mathematical models to support explanations of how undirected genetic changes in natural selection and genetic drift have led to changes in populations of organisms.*
- **SB1.d** *Plan and carry out investigations to determine the role of cellular transport (e.g., active, passive, and osmosis) in maintaining homeostasis.*

### ● HOMEOSTASIS AND DYNAMIC EQUILIBRIUM

- **SB5.e** *Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).*
- **SB1.d** *Plan and carry out investigations to determine the role of cellular transport (e.g., active, passive, and osmosis) in maintaining homeostasis.*

## 2. THE CHEMISTRY OF LIFE

### ● BIOMOLECULES

- **SB1.c** *Construct arguments supported by evidence to relate the structure of macromolecules (carbohydrates, proteins, lipids, and nucleic acids) to their interactions in carrying out cellular processes.*
- **SB5.b** *Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).*

- **ENZYMES**

- **SB1.c** Construct arguments supported by evidence to relate the structure of macromolecules (carbohydrates, proteins, lipids, and nucleic acids) to their interactions in carrying out cellular processes.

### 3. CELL STRUCTURE

- **PROKARYOTIC AND EUKARYOTIC CELLS**

- **SB1.a** Construct an explanation of how cell structures and organelles (including nucleus, cytoplasm, cell membrane, cell wall, chloroplasts, lysosome, Golgi, endoplasmic reticulum, vacuoles, ribosomes, and mitochondria) interact as a system to maintain homeostasis.

- **PLANT AND ANIMAL CELLS**

- **SB1.a** Construct an explanation of how cell structures and organelles (including nucleus, cytoplasm, cell membrane, cell wall, chloroplasts, lysosome, Golgi, endoplasmic reticulum, vacuoles, ribosomes, and mitochondria) interact as a system to maintain homeostasis.

### 4. ACTIVE AND PASSIVE TRANSPORT

- **PASSIVE TRANSPORT**

- **SB1.d** Plan and carry out investigations to determine the role of cellular transport (e.g., active, passive, and osmosis) in maintaining homeostasis.

- **ACTIVE TRANSPORT**

- **SB1.d** Plan and carry out investigations to determine the role of cellular transport (e.g., active, passive, and osmosis) in maintaining homeostasis.

### 5. CELLULAR ENERGETICS

- **PHOTOSYNTHESIS**

- **SB1.e** Ask questions to investigate and provide explanations about the roles of photosynthesis and respiration in the cycling of matter and flow of energy within the cell (e.g., single-celled alga).
- **SB5.b** Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).

- **CELLULAR RESPIRATION**

- **SB1.e** Ask questions to investigate and provide explanations about the roles of photosynthesis and respiration in the cycling of matter and flow of energy within the cell (e.g., single-celled alga).
- **SB5.b** Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).

### 6. CELL GROWTH AND REPRODUCTION

- **THE CELL CYCLE**

- **SB1.b** Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis, and meiosis) in maintaining genetic continuity.

- **MITOSIS**

- **SB1.b** Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis, and meiosis) in maintaining genetic continuity.

## 7. DNA STRUCTURE AND FUNCTION

### ● COMPONENTS OF DNA

- **SB2.a** Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.

### ● THE GENETIC CODE

- **SB2.a** Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.
- **SB2.c** Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture.

### ● DNA REPLICATION

- **SB2.a** Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.

## 8. GENE EXPRESSION

### ● TRANSCRIPTION

- **SB2.a** Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.

### ● TRANSLATION

- **SB2.a** Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.

## 9. MUTATIONS

### ● GENETIC CHANGES IN DNA

- **SB2.b** Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: new genetic combinations through meiosis (crossing over, nondisjunction); non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).
- **SB2.c** Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture.

### ● GENETIC CHANGES IN CHROMOSOMES

- **SB2.b** Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: new genetic combinations through meiosis (crossing over, nondisjunction); non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).
- **SB2.c** Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture.

## 10. HEREDITY

### ● MENDELIAN LAWS OF HEREDITY

- **SB3.a** Use Mendel's laws (segregation and independent assortment) to ask questions and define problems that explain the role of meiosis in reproductive variability.
- **SB3.b** Use mathematical models to predict and explain patterns of inheritance.

### ● MULTIPLE ALLELES AND ALLELES WITHOUT DOMINANCE

- **SB3.a** Use Mendel's laws (segregation and independent assortment) to ask questions and define problems that explain the

role of meiosis in reproductive variability.

- **SB3.b** Use mathematical models to predict and explain patterns of inheritance.

## 11. REPRODUCTION

### • MEIOSIS

- **SB1.b** Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis, and meiosis) in maintaining genetic continuity.
- **SB3.a** Use Mendel's laws (segregation and independent assortment) to ask questions and define problems that explain the role of meiosis in reproductive variability.
- **SB2.b** Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: new genetic combinations through meiosis (crossing over, nondisjunction); non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).

### • SEXUAL AND ASEXUAL REPRODUCTION

- **SB1.b** Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis, and meiosis) in maintaining genetic continuity.
- **SB3.c** Construct an argument to support a claim about the relative advantages and disadvantages of sexual and asexual reproduction.

## 12. EVOLUTION

### • MULTIPLE LINES OF EVIDENCE

- **SB6.c** Construct an argument using valid and reliable sources to support the claim that evidence from comparative morphology (analogous vs. homologous structures), embryology, biochemistry (protein sequence) and genetics support the theory that all living organisms are related by way of common descent.
- **SB6.a** Construct an explanation of how new understandings of Earth's history, the emergence of new species from pre-existing species, and our understanding of genetics have influenced our understanding of biology.
- **SB6.b** Analyze and interpret data to explain patterns in biodiversity that result from speciation.

### • THE FOSSIL RECORD

- **SB6.c** Construct an argument using valid and reliable sources to support the claim that evidence from comparative morphology (analogous vs. homologous structures), embryology, biochemistry (protein sequence) and genetics support the theory that all living organisms are related by way of common descent.
- **SB6.a** Construct an explanation of how new understandings of Earth's history, the emergence of new species from pre-existing species, and our understanding of genetics have influenced our understanding of biology.
- **SB6.b** Analyze and interpret data to explain patterns in biodiversity that result from speciation.

## 13. MECHANISMS OF EVOLUTION

### • NATURAL SELECTION

- **SB2.b** Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: new genetic combinations through meiosis (crossing over, nondisjunction); non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).
- **SB6.a** Construct an explanation of how new understandings of Earth's history, the emergence of new species from pre-existing species, and our understanding of genetics have influenced our understanding of biology.
- **SB6.b** Analyze and interpret data to explain patterns in biodiversity that result from speciation.
- **SB6.d** Develop and use mathematical models to support explanations of how undirected genetic changes in natural selection and genetic drift have led to changes in populations of organisms.

### • EVOLUTION OF SPECIES

- **SB6.c** Construct an argument using valid and reliable sources to support the claim that evidence from comparative

morphology (analogous vs. homologous structures), embryology, biochemistry (protein sequence) and genetics support the theory that all living organisms are related by way of common descent.

- **SB6.a** Construct an explanation of how new understandings of Earth's history, the emergence of new species from pre-existing species, and our understanding of genetics have influenced our understanding of biology.
- **SB6.b** Analyze and interpret data to explain patterns in biodiversity that result from speciation.
- **SB6.d** Develop and use mathematical models to support explanations of how undirected genetic changes in natural selection and genetic drift have led to changes in populations of organisms.

## 14. CLASSIFICATION

### ● TAXONOMY

- **SB2.c** Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture.
- **SB4.a** Construct an argument supported by scientific information to explain patterns in structures and function among clades of organisms, including the origin of eukaryotes by endosymbiosis. Clades should include: archaea, bacteria, eukaryotes - fungi, plants, animals.
- **SB4.b** Analyze and interpret data to develop models (i.e., cladograms and phylogenetic trees) based on patterns of common ancestry and the theory of evolution to determine relationships among major groups of organisms.
- **SB6.a** Construct an explanation of how new understandings of Earth's history, the emergence of new species from pre-existing species, and our understanding of genetics have influenced our understanding of biology.

### ● THE SIX KINGDOMS

- **SB4.a** Construct an argument supported by scientific information to explain patterns in structures and function among clades of organisms, including the origin of eukaryotes by endosymbiosis. Clades should include: archaea, bacteria, eukaryotes - fungi, plants, animals.
- **SB4.b** Analyze and interpret data to develop models (i.e., cladograms and phylogenetic trees) based on patterns of common ancestry and the theory of evolution to determine relationships among major groups of organisms.
- **SB6.a** Construct an explanation of how new understandings of Earth's history, the emergence of new species from pre-existing species, and our understanding of genetics have influenced our understanding of biology.
- **SB6.b** Analyze and interpret data to explain patterns in biodiversity that result from speciation.

## 15. FUNCTIONS OF ANIMAL SYSTEMS

### ● THE IMMUNE AND LYMPHATIC SYSTEMS

### ● THE NERVOUS SYSTEM

## 16. FUNCTIONS OF PLANT SYSTEMS

### ● PLANT TISSUES

### ● PLANT RESPONSES

## 17. MATTER AND ENERGY

### ● FOOD CHAINS AND WEBS

- **SB5.b** Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).
- **SB5.a** Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems.
- **SB5.d** Design a solution to reduce the impact of a human activity on the environment.
- **SB5.c** Construct an argument to predict the impact of environmental change on the stability of an ecosystem.

### ● PYRAMIDS OF ENERGY, NUMBERS, AND BIOMASS

- **SB5.b** Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of

energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).

- **SB5.a** Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems.
- **SB5.d** Design a solution to reduce the impact of a human activity on the environment.
- **SB5.c** Construct an argument to predict the impact of environmental change on the stability of an ecosystem.

## 18. CYCLES IN NATURE

### ● THE CARBON CYCLE

- **SB1.e** Ask questions to investigate and provide explanations about the roles of photosynthesis and respiration in the cycling of matter and flow of energy within the cell (e.g., single-celled alga).
- **SB5.b** Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).
- **SB5.d** Design a solution to reduce the impact of a human activity on the environment.
- **SB5.c** Construct an argument to predict the impact of environmental change on the stability of an ecosystem.

### ● THE NITROGEN AND PHOSPHORUS CYCLES

- **SB5.d** Design a solution to reduce the impact of a human activity on the environment.
- **SB5.b** Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration. Arranging components of a food web according to energy flow. Comparing the quantity of energy in the steps of an energy pyramid. Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).
- **SB5.c** Construct an argument to predict the impact of environmental change on the stability of an ecosystem.

## 19. ECOLOGY OF SUCCESSION

### ● SUCCESSION IN COMMUNITIES

- **SB5.a** Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems.
- **SB5.c** Construct an argument to predict the impact of environmental change on the stability of an ecosystem.

### ● NATURAL IMPACTS ON ECOSYSTEMS

- **SB5.a** Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems.
- **SB5.c** Construct an argument to predict the impact of environmental change on the stability of an ecosystem.
- **SB5.e** Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).