Keystone Tutorials are designed specifically to prepare students for the Keystone Exams.

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. NATURE OF LIFE

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

- **CHARACTERISTICS OF LIFE**
  - **BIO.A.1.1.1** *Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.*
  - **BIO.A.3.2.1** *Compare the basic transformation of energy during photosynthesis and cellular respiration.*
  - **BIO.A.4.2.1** *Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).*
  - **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).*
  - **BIO.B.3.2.1** *Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).*
  - **BIO.B.1.1.1** *Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.*

2. CHEMISTRY OF LIFE

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

- **ENZYMES**
  - **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.*

3. CELL STRUCTURE AND FUNCTION

- **PROKARYOTIC AND EUKARYOTIC CELLS**
  - **BIO.A.1.2.1** *Compare cellular structures and their functions in prokaryotic and eukaryotic cells.*
  - **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 the mechanisms that transport materials across the plasma membrane (i.e., passive transport-diffusion, osmosis, facilitated diffusion; and active transport-pumps, endocytosis, exocytosis).*
  - **BIO.A.3.1.1** *Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.*
  - **BIO.A.4.1.3** *Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.*
  - **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.*
  - **BIO.A.1.1.1** *Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.*

- **PLANT AND ANIMAL CELLS**
  - **BIO.A.4.1.3** *Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.*
  - **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.*
  - **BIO.A.1.2.1** *Compare cellular structures and their functions in prokaryotic and eukaryotic cells.*
  - **BIO.A.3.1.1** *Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.*

- **PASSIVE TRANSPORT**
  - **BIO.A.1.2.1** *Compare cellular structures and their functions in prokaryotic and eukaryotic cells.*
  - **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.4.1.3** *Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.*
  - **BIO.A.4.2.1** *Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).*
  - **BIO.A.4.1.2** *Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport-diffusion, osmosis, facilitated diffusion; and active transport-pumps, endocytosis, exocytosis).*

- **ACTIVE TRANSPORT**
  - **BIO.A.1.2.1** *Compare cellular structures and their functions in prokaryotic and eukaryotic cells.*
  - **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 the mechanisms that transport materials across the plasma membrane (i.e., passive transport-diffusion, osmosis, facilitated diffusion; and active transport-pumps, endocytosis, exocytosis).*
  - **BIO.A.4.2.1** *Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).*
  - **BIO.A.3.2.2** *Describe the role of ATP in biochemical reactions.*

4. CELLULAR ENERGETICS

- **PHOTOSYNTHESIS**
  - **BIO.A.3.1.1** *Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.*
  - **BIO.A.3.2.1** *Compare the basic transformation of energy during photosynthesis and cellular respiration.*
  - **BIO.A.3.2.2** *Describe the role of ATP in biochemical reactions.*

- **CELLULAR RESPIRATION**
  - **BIO.A.3.2.1** *Compare the basic transformation of energy during photosynthesis and cellular respiration.*
  - **BIO.A.3.2.2** *Describe the role of ATP in biochemical reactions.*
  - **BIO.A.1.2.1** *Compare cellular structures and their functions in prokaryotic and eukaryotic cells.*

- **BIO.A.3.1.1** *Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.*
- **BIO.A.4.1.3** *Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.*

5. CELL GROWTH AND REPRODUCTION

- **THE CELL CYCLE**
  - **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.1.2.1** *Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.*

- **MITOSIS**
  - **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 the processes and outcomes of mitotic and meiotic nuclear divisions.*

- **MEIOSIS**
  - **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 the processes and outcomes of mitotic and meiotic nuclear divisions.*
  - **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).*
  - **BIO.B.3.1.1** *Explain how natural selection can impact allele frequencies of a population.*

6. DNA STRUCTURE AND FUNCTION

- **COMPONENTS OF DNA**
  - **BIO.A.2.2.3** *Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.*
  - **BIO.B.1.2.2** *Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.*
  - **BIO.B.1.2.1** *Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.*

- **THE GENETIC CODE**
  - **BIO.A.2.2.3** *Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.*
  - **BIO.B.1.2.2** *Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.*
  - **BIO.B.2.2.1** *Describe how the processes of transcription and translation are similar in all organisms.*
  - **BIO.B.3.2.1** *Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).*

- **DNA REPLICATION**
  - **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 between DNA, genes, alleles, and chromosomes and their roles in inheritance.*

7. GENE EXPRESSION

- **TRANSCRIPTION**
  - **BIO.A.2.2.3** *Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.*
  - **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 between DNA, genes, alleles, and chromosomes and their roles in inheritance.*
- **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.*
- **BIO.B.2.2.1** *Describe how the processes of transcription and translation are similar in all organisms.*

- **TRANSLATION**
  - **BIO.A.2.2.3** *Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.*
  - **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.*
  - **BIO.A.2.3.1** *Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.*

8. MUTATIONS

- **GENETIC CHANGES IN DNA**
  - **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).*
  - **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).*
  - **BIO.B.3.1.3** *Explain how genetic mutations may result in genotypic and phenotypic variations within a population.*
  - **BIO.B.1.2.2** *Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.*

- **GENETIC CHANGES IN CHROMOSOMES**
  - **BIO.B.1.2.2** *Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.*
  - **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 the processes and outcomes of mitotic and meiotic nuclear divisions.*
  - **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).*
  - **BIO.B.3.1.3** *Explain how genetic mutations may result in genotypic and phenotypic variations within a population.*
  - **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).*
  - **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).*

9. HEREDITY

- **MENDELIAN LAWS OF HEREDITY**
  - **BIO.B.1.2.2** *Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in 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).*

- **MULTIPLE ALLELES AND ALLELES WITHOUT DOMINANCE**
  - **BIO.B.1.2.2** *Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in 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).*

10. EVOLUTION

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

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

11. MECHANISMS OF EVOLUTION

- **NATURAL SELECTION**
  - **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.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).*

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

12. HOMEOSTASIS

- **HOMEOSTASIS AND DYNAMIC EQUILIBRIUM**
  - **BIO.A.4.2.1** *Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).*
  - **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).*
  - **BIO.B.4.1.1** *Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, and biosphere).*

- **FEEDBACK MECHANISMS IN ANIMALS**
  - **BIO.A.4.2.1** *Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).*
  - **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).*
  - **BIO.B.4.1.1** *Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, and biosphere).*

13. CYCLES IN NATURE

- **THE CARBON CYCLE**
  - **BIO.A.3.2.1** *Compare the basic transformation of energy during photosynthesis and cellular respiration.*
  - **BIO.B.4.2.3** *Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and 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).*

- **THE NITROGEN AND PHOSPHORUS CYCLES**

- **BIO.B.4.2.3** *Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and 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).*

14. MATTER AND ENERGY

- **FOOD CHAINS AND WEBS**
  - **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.4.2.4** *Describe how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires).*

- **PYRAMIDS OF ENERGY, NUMBERS, AND BIOMASS**
  - **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.4.2.5** *Describe the effects of limiting factors on population dynamics and potential species extinction.*

15. ECOLOGY OF SUCCESSION

- **SUCCESSION IN COMMUNITIES**
  - **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).*

- **NATURAL IMPACTS ON ECOSYSTEMS**
  - **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.*