

Kentucky Tutorials are designed specifically for the Kentucky Academic Standards to prepare students for the K-PREP, EOC exams, ACT, and ACT Plan.

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

- **HS-LS1-2** *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** *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** *Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*
- **HS-LS1-6** *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** *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.*

## 2. CELL STRUCTURE AND FUNCTION

### • PROKARYOTIC AND EUKARYOTIC CELLS

- **HS-LS1-3** *Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*
- **HS-LS1-1** *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** *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-LS1-2** *Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.*
- **HS-LS1-5** *Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.*

- **HS-LS1-7** 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.

### 3. CELLULAR ENERGETICS

- **PHOTOSYNTHESIS**

- **HS-LS1-5** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

- **CELLULAR RESPIRATION**

- **HS-LS1-7** 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** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

### 4. CELL GROWTH AND REPRODUCTION

- **THE CELL CYCLE**

- **HS-LS1-4** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- **HS-LS1-1** 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** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

### 5. DNA STRUCTURE AND FUNCTION

- **COMPONENTS OF DNA**

- **HS-LS1-1** 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** 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** 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** 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** 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** 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.

### 6. GENE EXPRESSION

- **TRANSCRIPTION**

- **HS-LS1-1** 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** 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** 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.

## 7. MUTATIONS

- **GENETIC CHANGES IN DNA**

- **HS-LS3-2** 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.

- **GENETIC CHANGES IN CHROMOSOMES**

- **HS-LS3-1** 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** 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.

## 8. HEREDITY

- **MENDELIAN LAWS OF HEREDITY**

- **HS-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- **HS-LS3-1** 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** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- **HS-LS3-1** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

## 9. REPRODUCTION

- **MEIOSIS**

- **HS-LS3-1** 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** 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** 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** 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.

## 10. EVOLUTION

### • MULTIPLE LINES OF EVIDENCE

- **HS-LS4-1** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

### • THE FOSSIL RECORD

- **HS-LS4-1** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- **HS-LS4-5** 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.

## 11. MECHANISMS OF EVOLUTION

### • NATURAL SELECTION

- **HS-LS4-2** 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** Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- **HS-LS2-8** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- **HS-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- **HS-LS4-3** 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** 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** 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** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- **HS-LS4-3** 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-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- **HS-LS4-4** Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- **HS-LS2-8** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

## 12. HOMEOSTASIS

### • HOMEOSTASIS AND DYNAMIC EQUILIBRIUM

- **HS-LS1-2** *Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.*
- **HS-LS1-3** *Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*

- **FEEDBACK MECHANISMS IN ANIMALS**

- **HS-LS1-2** *Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.*
- **HS-LS1-3** *Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*

### 13. FUNCTIONS OF ANIMAL SYSTEMS

- **THE NERVOUS SYSTEM**

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

### 14. FUNCTIONS OF PLANT SYSTEMS

- **PLANT TISSUES**

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

### 15. CYCLES IN NATURE

- **THE CARBON CYCLE**

- **HS-LS2-4** *Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.*
- **HS-LS2-5** *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-LS2-6** *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** *Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

- **THE NITROGEN AND PHOSPHORUS CYCLES**

- **HS-LS2-4** *Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.*
- **HS-LS2-6** *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** *Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

## 16. MATTER AND ENERGY

### • FOOD CHAINS AND WEBS

- **HS-LS2-4** Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- **HS-LS2-1** 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** Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- **HS-LS2-1** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- **HS-LS2-2** 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** 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** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- **HS-LS4-5** 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.

## 17. ECOLOGY OF SUCCESSION

### • SUCCESSION IN COMMUNITIES

- **HS-LS2-6** 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** 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** 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** 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.