

**Grade 7 Science, Quarter 4, Unit 4.1**  
**Heredity and Human Development**

**Overview**

**Number of instructional days:** 15 (1 day = 45 minutes)

**Content to be learned**

- Select evidence that supports the concept that human genetic information is passed from both parents to offspring.
- Recognize that some characteristics of an organism result from inherited traits of one or more genes from the parents.
- Recognize that some characteristics of an organism result from interactions with the environment.
- Trace a genetic characteristic through a given pedigree to demonstrate the passage of traits.
- Identify that genetic material, such as chromosomes and genes, is located in the cell's nucleus.
- Identify and sequence the stages of human embryonic development to demonstrate and understand patterns of human development.
- Compare the patterns of human development after birth to the life stages of other species.

**Science processes to be integrated**

- Examine patterns of change.
- Make scientific comparisons.
- Use data as evidence to support concepts.
- Participate in inquiry activities.

**Essential questions**

- What kinds of evidence support the idea that human genetic information is passed from both parents?
- What information is needed to determine the causes of all of an organism's characteristics?
- How can pedigrees be used to demonstrate the passage of traits?
- What are the major changes that occur over time in human development from single cell through embryonic development to newborn?
- How do the life stages of humans after birth compare to the life stages of other species?

## Written Curriculum

### Grade Span Expectations

**LS 4 - Humans are similar to other species in many ways, and yet are unique among Earth's life forms.**

***LS4 (5-8) INQ+POC-11***

*Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring.*

**LS4 (7-8)-11 Students demonstrate an understanding of human heredity by ...**

**11a** recognizing that characteristics of an organism result from inherited traits of one or more genes from the parents and others result from interactions with the environment.

**11b** tracing a genetic characteristic through a given pedigree (e.g., genealogical chart, Queen Victoria – hemophilia or hypothetical example) to demonstrate the passage of traits.

**11c** identifying that genetic material (i.e. chromosomes and genes) is located in the cell's nucleus.

***LS4 (5-8) POC-12***

*Describe the major changes that occur over time in human development from single cell through embryonic development to new born (i.e., trimesters: 1<sup>st</sup> – group of cells, 2<sup>nd</sup> - organs form, 3<sup>rd</sup> - organs mature.*

**LS4 (7-8) -12 Students demonstrate an understanding of patterns of human development by...**

**12a** identifying and sequencing the stages of human embryonic development.

**12d** comparing the patterns of human development after birth to life stages of other species.

### Clarifying the Standards

#### *Prior Learning*

In grades K–4, students learned the stages of the life cycle. Given a set of pictures/data, they labeled, sequenced, and recorded data to create and compare life cycles of plants and animals. In grades 3–4, students identified characteristics inherited from a biological parent.

In grades 5–6, students investigated and compared a variety of plant and animal life cycles. They also identified cells as the building blocks of organisms. Students differentiated between inherited and acquired traits. They also observed, recorded, and compared different inherited traits. Dominant and recessive genes were not covered previously.

#### *Current Learning*

The instructional level for this unit of study is developmental. Students' understanding of the genetic explanation for how traits are passed on from one generation to the next begins at this level and continues into high school. Direct observations of generational similarities and differences of plants and animals is an effective way to have students make connections between the traits of parents and their offspring. The

interaction between heredity and environment in determining plant and animal characteristics will be introduced to students. Students must recognize that some traits are a direct result of genes while some are a combination of the environment as well as genes. Students will need to be provided with pedigrees that they can use to prove that traits are passed from parents to offspring. Students trace traits through multiple generations. They make connections between the presence of genetic materials in the nucleus of the cell and the passage of characteristics from parent to offspring. As part of this instruction, they need to pose questions, plan parts of investigations, and draw conclusions based on the data they analyze. Students will need to identify patterns that exist in the pedigrees as well as patterns that exist in characteristics that are inherited from genes and those that are the result of interactions with the environment.

The study of human development from a single cell through embryonic development and after birth will be taught at the developmental level of instruction. Students will need to identify the stages and sequences of human embryonic development. Students will then need to compare patterns of development between humans and other species. Students will need to recognize patterns in development as part of their work with embryologic development as well as with development after birth.

### *Future Learning*

By the end of middle school, students should know that in some organisms, all genes come from a single parent, whereas in organisms that have sexes, each parent typically contributes half of the genes to the offspring. In sexual reproduction, a single cell from a female merges with a cell from a male. Therefore, a fertilized egg carries genetic information from each parent.

Grade 8 students will explain reproduction as a fundamental process by which the new individual receives genetic information from the parent(s). They will describe sexual reproduction as a process that combines genetic material of two parents to produce a new organism (e.g., sperm/egg, pollen/ova). They will describe forms of asexual reproduction that involve the genetic contribution of only one parent (e.g., binary fission, budding, vegetative propagation, regeneration). Students will explain that genetic variations/traits of organisms are passed on through reproduction and random genetic changes. They will gather evidence that demonstrates evolutionary relationships among organisms (e.g., similarities in body structure, early development, traits). Students will describe the changes from one stage of embryonic development to the next. They will compare and contrast embryonic development in various life forms (humans, frogs, chickens, sea urchins).

Students in high school science courses will describe the DNA structure and relate the DNA sequence to the genetic code. They will describe how DNA contains the code for the production of specific proteins. Students will explain how DNA may be altered and how this affects genes/heredity (e.g., substitution, insertion, or deletion). They will use given data (diagrams, charts, narratives, etc.) and advances in technology to explain how our understanding of genetic variation has developed over time. Students will investigate how information is passed from parents to offspring by encoded molecules (e.g., evidence from electrophoresis, DNA fingerprinting). They will investigate how the sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations in the offspring of any two parents (e.g., manipulate models to represent and predict genotypes and phenotypes, Punnett Squares, probability activities). They will research scientific information to explain how such things as radiation, chemicals, and other factors can cause gene mutations or disease. Students will explain the relationships between and among the specialized structures of the cell and their functions (e.g., transport of materials, energy transfer, protein building, waste disposal, information feedback, and even movement).

### **Additional Research Findings**

According to *Making Sense of Secondary Science*:

“Boys may believe that the male parent passes down more traits than the female” (p. 51).

According to *Benchmarks for Science Literacy*:

“Building an observational base for heredity ought to be the first undertaking ... The organisms children recognize are themselves, their classmates, and their pets.” The text suggests handling these discussions delicately because it may be embarrassing for some students (p. 106).

“Another challenge is that children do not recognize that substances taken in are the basis for growth, transformation, and incorporation into the body. The majority of children believe that there is a structurally pre-formed organism that is growing inside an egg” (pp. 37, 40).

According to the *Atlas of Science Literacy, Volume 1*:

In middle school, an understanding of sexual reproduction and the mechanism of inheritance is developed. Students learn at an early age that similar animals have similar offspring. They develop an understanding of the explanation of genes and DNA. They also identify which characteristics are inheritable and the mechanism by which inherited characteristics are passed along from parent to offspring (pp. 68–71).

## **Notes About Resources and Materials**

### **Textbook Resources**

- Prentice Hall, *Cells & Inheritance*, Chapter 3, Section 1
- Prentice Hall, *Human Inheritance*, Chapter 4, Section 1

### **Online Teacher Resources**

- Cell theory and natural selection  
[www.slideshare.net/melissamercer/topic-4-cell-theory-and-natural-selection](http://www.slideshare.net/melissamercer/topic-4-cell-theory-and-natural-selection)
- Evolution  
[www.slideshare.net/Jmason1/evolution-part-i](http://www.slideshare.net/Jmason1/evolution-part-i)
- Evolution and natural selection  
[www.slideshare.net/jamiehworlman/evolution-natural-selectionandspeciation-6-kings](http://www.slideshare.net/jamiehworlman/evolution-natural-selectionandspeciation-6-kings)

## Grade 7 Science, Quarter 4, Unit 4.2

# Biodiversity and Evolution

### Overview

**Number of instructional days:** 8 (1 day = 45 minutes)

#### Content to be learned

- Illustrate, compare, or interpret possible relationships among groups of organisms.
- Sort organisms with similar characteristics into groups based on internal and external structures.
- Explain how species with similar evolutionary histories and characteristics are classified more closely together with some organisms than others.
- Recognize the classification system used in modern biology.
- Understand natural selection and evolution by differentiating between acquired and inherited characteristics.

#### Science processes to be integrated

- Use a classification system.
- Use models.
- Relate form and function.
- Identify patterns of change.

#### Essential questions

- What kinds of relationships can be identified among different groups of organisms?
- What internal and external features can be used as a basis for classifying organisms?
- How can the classification of organisms be used to explain evolutionary histories?
- What is the basis for the classification system used in modern biology?
- What do acquired and inherited characteristics compare to each other?
- How does an understanding of the difference between acquired and inherited characteristics contribute to an understanding of natural selection and evolution?

## Written Curriculum

### Grade Span Expectations

#### **LS3 - Groups of organisms show evidence of change over time (structures, behaviors, and biochemistry).**

##### ***LS3 (5-8) MAS+FAF – 8***

*Use a model, classification system, or dichotomous key to illustrate, compare, or interpret possible relationships among groups of organisms (e.g., internal and external structures, anatomical features).*

##### **LS3 (7-8) – 8 Students demonstrate an understanding of classification of organisms by ...**

**8a** sorting organisms with similar characteristics into groups based on internal and external structures.

**8b** explaining how species with similar evolutionary histories/characteristics are classified more closely together with some organisms than others (e.g., a fish and human have more common with each other than a fish and jelly fish)

**8c** recognizing the classification system used in modern biology.

##### ***LS3 (5-8) POC-9***

*Cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring.*

##### **LS3 (7-8) -9 Students demonstrate an understanding of Natural Selection/ evolution by ...**

**9c** differentiating between acquired and inherited characteristics and giving examples of each.

### Clarifying the Standards

#### *Prior Learning*

In grades K–2, students observed, identified, and recorded external features of humans and other animals. They observed and compared their own physical features with those of parents, classmates, and other organisms.

In grades 3–4, students showed connections between external and internal body structures (i.e., organs and systems) and how they help humans survive. They compared and analyzed external features and characteristics of humans and other animals. Students observed and compared their own physical features with those of parents, classmates, and other organisms.

In grades 5–6, students recognized that organisms have different features and behaviors for meeting their survival needs (e.g., fish have gills for respiration; mammals have lungs; bears hibernate). They stated the value of and reasons for classification systems. Students followed a taxonomic key to identify a given organism (e.g., flowering and non-flowering plants). They explained how the traits of a population or species affect its ability to survive over time. Students researched or reported on possible causes for the extinction of an animal or plant. They differentiated between inherited and acquired traits. Students also observed, recorded, and compared differences in inherited traits.

### *Current Learning*

The concepts that focus on the classification of organisms should be taught at the reinforcement level. Students have learned the basis for content that will be studied in grade 7. In previous years, students have focused on external features, therefore the new content for this grade level is the focus on internal features in addition to external features.

Students have learned that organisms become extinct and have studied evidence from fossils to explain the history of life on earth, however this is their first introduction to the concept of evolution. Therefore, this new content should be taught at the developmental level. In this introduction to evolution, students are to make connections to their previous learning about the history of life on earth and how this information can be used to look for similar evolutionary histories/characteristics of organisms. The focus for this unit will be to help students understand that some organisms are more similar to others because they share similar evolutionary histories. Students will need to differentiate between acquired and inherited characteristics and give examples of each. Students also need to provide examples of how these traits may provide a survival advantage in a specific environment. It will be important that they make connections between the possible survival advantage of an organism, because of these traits, and the probability that they will or will not produce offspring. While learning this content, students need to make connections between form and function as well as looking for patterns of change.

Students will need to recognize the classification system used in modern biology. Students will need to understand that biologists must have a system for naming organisms to organize these living things into groups that have biological meaning. This discipline, known as taxonomy, uses the two-word naming system called binomial nomenclature. Students also need to recognize the hierarchical levels of classification used for grouping organisms based on internal and external structures. Students will need to focus on patterns of change as they move from one level to the next in this hierarchical system.

### *Future Learning*

In grades 8–12, students will use their current knowledge of classification, natural selection, and evolution as a foundation to acquire new knowledge related to specific biological factors and environmental issues. Students will explain that genetic variations/traits of organisms are passed on through reproduction and random genetic changes. They will gather evidence that demonstrates evolutionary relationships among organisms (e.g., similarities in body structure, early development, traits). Students will explain how natural selection leads to evolution (e.g., survival of the fittest). They will describe how scientists' understanding of the way species originate or become extinct has changed over time. Students will describe the changes from one stage of embryonic development to the next. They will compare and contrast embryonic development in various life forms (humans, frogs, chickens, sea urchins). Students will distinguish between microevolution (on a small scale within a single population (e.g., change in gene frequency within a population) and macroevolution (on a scale that transcends boundaries of a single species such as diversity of all beetle species within the order of insects) and explain how macroevolution accounts for speciation and extinction. Students will also illustrate how the survival advantage or disadvantage of specific characteristics depends on how the environment itself develops and changes. Students will research scientific information to explain how such things as radiation, chemicals, and other factors can cause gene mutations or disease.

### **Additional Research Findings**

According to *Benchmarks for Science Literacy*:

Middle school students should distinguish between evolution and natural selection. “Students should first be familiar with the evidence of evolution so that they will have an informed basis for judging different explanations” regarding natural selection. Students should be familiar with Darwin’s thinking that differences between generations are cumulative. By the end of eighth grade, students should know that individual organisms with certain traits are more likely than others to survive and give rise to offspring. Changes in the environment can affect the survival of individual organisms and entire species (p. 122).

“Middle school students hold a much more restrictive meaning for the word ‘plant.’ Students often do not recognize trees, vegetables, and grass as plants” (p. 341).

According to the *Atlas of Science Literacy, Volume 2*:

Middle school provides an understanding of natural selection, but because of the complexity of scientific evidence and arguments that must be examined, a thorough understanding of species and evolution probably cannot be achieved earlier than high school (p. 84).

According to *Making Sense of Secondary Science*:

Sexual reproduction is not recognized as a source of variation in a population ... students attribute observable variation to environmental factors (p. 52).

Students rely on everyday use of common names to determine which species belong in which group (e.g., jellyfish and starfish are fish) (p. 25).

“Students had difficulty classifying plants and thought that a tree was not a plant except when it was little” (p. 23).

## **Notes About Resources and Materials**

### **Cells and Heredity**

- Chapter 5, Section 1, Darwin’s Voyage

### **Bacteria to Plants**

- Chapter 1, Section 3, Classifying Organisms
- Chapter 1, Section 4, The Six Kingdoms

Grade 7 Science, Quarter 4, Unit 4.3  
**Characteristics of Living Organisms**

**Overview**

**Number of instructional days:** 17 (1 day = 45 minutes)

**Content to be learned**

- Understand biodiversity, adaptations, niches, and ecosystems.
- Understand that organisms have roles that contribute to other's survivability and the stability of the ecosystem.
- Understand how cells have the same survival needs as organisms.
- Identify the parts of a cell.
- Understand that organisms grow and respond to stimuli.

**Science processes to be integrated**

- Provide examples of organisms and their niches.
- Explain relationships among organisms and classify organisms based on outcomes.
- Differentiate between the survival needs of a cell and the survival needs of an organism.
- Observe and describe organelles of an animal cell.
- Observe and describe organelles of a plant cell.
- Chart the growth, motion, and responses of a living organism.

**Essential questions**

- How do adaptations allow organisms to contribute to the stability of an ecosystem?
- What is a keystone species and why is it important?
- What is a niche and how do various niches contribute to the ecosystem?
- How are the needs of the cell specifically related to the needs of the organism?
- How are animal and plant cells alike and different?
- How do organisms grow and respond to stimuli?

## Written Curriculum

### Grade Span Expectations

**LS1 - All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).**

***LS1 (5-8) – INQ+ SAE- 1***

*Using data and observations about the biodiversity of an ecosystem make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem.*

**LS1 (7-8) – 1 Students demonstrate understanding of biodiversity by...**

**1a** giving examples of adaptations or behaviors that are specific to a niche (role) within an ecosystem.

**1b** explaining how organisms with different structures and behaviors have roles that contribute to each other's survival and the stability of the ecosystem.

***LS1 (5-8) SAE+FAF –2***

*Describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems).*

**LS1 (7-8) – 2 Students demonstrate understanding of structure and function-survival requirements by...**

**2a** explaining how the cell, as the basic unit of life, has the same survival needs as an organism (i.e., obtain energy, grow, eliminate waste, reproduce, provide for defense).

**2b** observing and describing (e.g., drawing, labeling) individual cells as seen through a microscope targeting cell membrane, cell wall, nucleus, and chloroplasts.

**2c** observing, describing and charting the growth, motion, responses of living organisms

### Clarifying the Standards

#### *Prior Learning*

In grades K–2, students distinguished between living and nonliving things. They observed and recorded the external features that make up living things. They observed that plants need water, air, food, and light to grow and that animals need water, air, food, and shelter to grow. Students identified and sorted based on similar or different external features. They sequenced the life cycle of a plant or animal when given a set of pictures. Students observed and scientifically drew and labeled the stages in the life cycle of a familiar plant and animal. They cared for plants and/or animals by identifying and providing for their needs. They experimented with a plant's growth under different conditions, including light and no light. Students acted out or constructed diagrams that showed a simple food web. They used information about a simple food web to determine how basic needs are met by the habitat or environment. Students observed and compared their physical features with those of parents and classmates. They cited evidence to draw

conclusions explaining why organisms are or are not grouped together. Students identified that some behaviors are learned.

In grades 3–4, students cited evidence to distinguish between living and nonliving things. They identified, sorted, and compared these things based on similar and/or different external features; they compared and analyzed external features and characteristics of humans and other animals. Students cited evidence to draw conclusions, explaining why organisms are or are not grouped together. They observed that plants need water, air, food, light, and space to grow and reproduce. They identified and explained how the physical structures/characteristics of an organism allow it to survive and defend itself. Students analyzed the structures needed for populations of plants and animals to survive in a particular habitat/environment. They identified the sources of energy necessary for organisms to survive and explained the ways that plants and animals in that habitat depend on each other. Students used information about organisms to design a habitat and explained how the habitat provides for the needs of the organisms that live there. Students explained how the balance of an ecosystem might be disturbed. Students identified characteristics that are inherited from a biological parent. They identified that some behaviors are learned while some behaviors are instinctual.

In grades 5–6, students recognized that organisms have different features and behaviors for meeting their survival needs, describing structures or behaviors that help organisms survive in their environment. Students identified and defined an ecosystem and the variety of relationships within it. They defined reproduction as a process through which organisms produce offspring and recognized it as essential for the continuation of a species. They also identified cells as the building blocks of organisms.

### *Current Learning*

The instructional level for this unit of study is developmental. Students give examples of adaptations or behaviors that are specific to a niche (role) within an ecosystem. They explain how organisms with different structures and behaviors have roles that contribute to each other's survival and the stability of the ecosystem. Students explain how the cell, as the basic unit of life, has the same survival needs as an organism (e.g., obtaining energy, growing, eliminating waste, reproducing). Students observe and describe individual cells as seen through a microscope, targeting the cell membrane, cell wall, nucleus, and chloroplasts. They observe, describe, and chart the growth, motion, and responses of living organisms.

Processes in this unit include: providing examples of organisms and their niches, explaining relationships among organisms and classifying them based on outcomes, differentiating between the survival needs of a cell and the survival needs of an organism, observing and describing organelles of a plant and animal cell, and charting the growth, motion, and response of a living organism.

Common classroom activities may include collaborative learning, discussion, student investigation, and inquiry.

Some strategies to help students and teachers overcome the challenges presented by this unit of study would be the use of graphic organizers, frequent assessments, hands-on activities, pictures, and slides.

### *Future Learning*

Students will use their knowledge of biodiversity, adaptations, niches, and ecosystems as a foundation to acquire new knowledge related to the balance of nature.

### **Additional Research Findings**

According to *Benchmarks for Science Literacy*:

By the end of middle school, students should know that “one of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. Some kinds of organisms, many of them microscopic, cannot be neatly classified as either plants or animals” (p. 104).

“Students’ attention should be drawn to the transfer of energy that occurs as one organism eats another. It is important that students learn the differences between how plants and animals obtain food, and from it the energy they need” (p. 120).

“Before natural selection is proposed as a mechanism for evolution, students must recognize the diversity and apparent relatedness of species. Students take years to acquire sufficient knowledge of living organisms and the fossil record. Natural selection should be offered as an explanation for familiar phenomena and then revisited as new phenomena are explored” (pp. 122).

“Middle school students hold a much more restrictive meaning for the word ‘plant.’ Students often do not recognize trees, vegetables, and grass as plants” (p. 341).

According to the *Atlas of Science Literacy*:

“In middle school, the idea comes together that the basic functions of organisms are carried out in cells. Students have difficulty with the idea that plants actually produce their own food from water and air and that the product of photosynthesis is the sole source of energy/food for the plant” (pp. 72, 76).

## Notes About Resources and Materials

### Textbook Resources

- Prentice Hall, *Environmental Science*, Chapter 1, Section 3, pp. 32–34, 97–105
- Prentice Hall, *Animals*, Chapter 1, Section 1
- Prentice Hall, *Cells & Heredity*, pp. 16–17, 20, 24–29, 54

### Online Resources

#### Adaptations

- <http://www.the-aps.org/education/k12curric/activities/pdfs/krysl.pdf>

#### Traits

- <http://utahscience.oremjr.alpine.k12.ut.us/sciber01/7th/cells/html/inhvsacq.htmf>

#### Cells

- <http://www.earthlife.net/cells.html>
- <http://www.cellsalive.com/howbig.htm>

#### Cell Nucleus

- <http://www.brighthub.com/education/k-12/articles/57972.aspx>

#### Onion Cell

- [http://www.edu.pe.ca/gray/class\\_pages/rcfleming/cells/lab.htm](http://www.edu.pe.ca/gray/class_pages/rcfleming/cells/lab.htm)

#### K-W-L Chart

- [http://www.sciencewithmrjones.com/downloads/introductory\\_materials/kwl\\_chart.pdf](http://www.sciencewithmrjones.com/downloads/introductory_materials/kwl_chart.pdf)

