Grade 7 Science, Quarter 3, Unit 3.1

Cells

Overview

Number of instructional days: 7 (1 day = 50 minutes)

Content to be learned

- 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, providing for defense).
- Observe and describe by drawing and labeling individual cells as seen through a microscope, targeting the cell membrane, cell wall, nucleus, and chloroplast.
- Observe, describe, and chart the growth, motion, and responses of living organisms.

Science processes to be integrated

- Use data and make observations.
- Participate in inquiry activities.
- Examine system interactions.
- Relate form to function.
- Make scientific comparisons.
- Create scientific drawings.

Essential questions

- How are the needs of a unicellular organism similar to the survival needs of a multicellular 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) 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. Students observed that plants need water, air, food, and light to grow and that animals need water, air, food, and shelter to grow. Students 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.

In grades 3 and 4, students cited evidence to distinguish between living and nonliving things. They observed that plants need water, air, food, light, and space to grow and reproduce. Students identified and explained how the physical structures/characteristics of an organism allow it to survive and defend itself.

In grades 5 and 6, students identified cells as the building blocks of organisms. Students described structures or behaviors that help organisms survive in their environment through defense, obtaining nutrients, reproduction, and eliminating waste.

Current Learning

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. The purpose for this is to help students explain how the cell membrane, cell wall, nucleus, and chloroplast make it possible for cells to meet their survival needs. Students need to be able to explain that some cells

have structures that function in ways that make it possible for them to meet their survival needs, while others are organized into tissues, organs, and systems that make it possible for them to meet their survival needs.

Students demonstrate an understanding of the relationship between structure and function-survival requirements by observing, describing, and charting the growth, motion, and responses of living organisms.

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 are the use of graphic organizers, frequent assessments, hands-on activities, pictures, and slides.

Future Learning

Students will explain 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, movement). Students will also explain that most multicellular organisms have specialized cells to survive, while unicellular organisms perform all survival functions. For example, nerve cells communicate with other cells, muscle cells contract, and unicellular organisms are not specialized. Students will demonstrate an understanding by comparing the role of various subcellular structures in unicellular organisms to comparable structures in multicellular organisms.

Additional Findings

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." (*Benchmarks for Science Literacy*, p. 104)

According to *Benchmarks for Science Literacy,*

> "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)
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> "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." (p. 122)
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> "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 *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 and 76)

Grade 7 Science, Quarter 3, Unit 3.2

Heredity and Human Development

Overview

Number of instructional days: 23 (1 day = 50 minutes)

Content to be learned

- Select evidence that supports the concept that human genetic information is passed from both parents to offspring.
- Recognize that characteristics of an organism result from inherited traits of one or more genes from the parents.
- Recognize that 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 (chromosomes and genes) is located in the cell's nucleus.
- Identify and sequence the stages of human embryonic development to demonstrate an understanding of 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

- Where is genetic information found in multicellular organisms?
- How do the life stages of humans compare to the life stages of other organisms?
- 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 a 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: 1st – group of cells, 2nd - organs form, 3rd - 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 and 4, students identified characteristics inherited from a biological parent.

In grades 5 and 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 are 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 is introduced. 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 need to be provided with pedigrees that they can use to prove that traits are passed from parents to offspring. They should have opportunities to trace traits through multiple generations.

Students make connections between the presence of genetic materials in the nucleus of the cell and the passage of characteristics from parent to offspring. It is important to have students make connections between their prior experiences with cells in Unit 3.1. As part of this instruction, they need to pose questions, plan parts of investigations, and draw conclusions based on the data they analyze. For example, students can participate in activities where they use fictional organisms to observe how the genes in cells from parents are recombined to form offspring that are not identical to the parents. Some examples of these activities are Dinosaur DNA and Monster DNA. It is important for students use the processes described above as they work through these types of activities.

Students 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 is taught at the developmental level of instruction. Students need to identify the stages and sequences of human embryonic development and compare the patterns of development between humans and other species. Students need to recognize patterns in development as part of their work with embryologic development as well as with development after birth. Students can compare these patterns to those found in other organisms.

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.

In 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). Students will describe forms of asexual reproduction that involve the genetic contribution of only one parent (e.g., binary fission, budding, vegetative propagation, regeneration). They will explain that genetic variations/traits of organisms are passed on through reproduction and random genetic changes. Students will gather evidence that demonstrates evolutionary relationships among organisms (e.g., similarities in body structure, early development, traits). They will describe the changes from one stage of embryonic development to the next. Students 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, deletion). They will use given data (diagrams, charts, narratives, etc.) and advances in technology to explain how 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). Students 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, movement).

Additional 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." (p. 106) The text suggests handling these discussions delicately because it may be embarrassing for some students.
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> "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 and 40)

According to the *Atlas of Science Literacy, Vol. 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. Students also identify which characteristics are inheritable and the mechanism by which inherited characteristics are passed along from parent to offspring. (pp. 68–71)