Grade 8 Science, Quarter 1, Unit 1.1

Characteristics of Living Organisms and Human Development

Overview

Number of instructional days: 25 (1 day = 50 minutes)

Content to be learned

- Explain that specialized cells perform specialized functions.
- Compare individual cells of tissues.
- Recognize the similarities of cells and how they work together to perform specific functions.
- Explain how each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.
- Predict and explain the effect of biotic and abiotic factors affect human body systems.
- Research and report on how biotic and abiotic factors cause disease and affect human health.
- Explain reproduction as a fundamental process for passing on genetic information from parents.
- Describe the forms of asexual reproduction that involve the genetic contribution of only one parent.
- Describe sexual reproduction as process that combines the genetic information of two parents to produce a new organism.
- Compare and contrast sexual and asexual reproduction.
- Describe the stages of embryonic development.
- Compare and contrast the embryonic development in various life forms.
- Explain that genetic variation/traits are passed

Science processes to be integrated

- Explain the relationship between form (structure) and function.
- Using data and observations make predictions and provide explanations.
- Gather evidence through investigation and/or research.
- Compare and contrast.
- Communicate research findings.
- Identify patterns of change.

on through reproduction and random genetic changes.

- Gather evidence that demonstrates evolutionary relationships among organisms.
- Explain how natural selection leads to evolution.
- Describe how scientists' understandings of evolution have changed over time.

Essential questions

- What are the structural and functional relationships between cells, tissues, organs, and organ systems?
- Why are specialized cells important to the survival of an organism?
- What are the similarities and differences of cells that work together to perform specific functions?
- How are the genetic contributions of sexual and asexual reproduction similar and different?
- How do biotic and abiotic factors affect human body systems, health, and cause diseases?
- What are the functional relationships between cells, tissues, organs, and organ systems?
- Beginning with the first stage, how are the various stages of embryonic development different from each other?
- How does the embryonic development of different organisms compare?
- How are genetic variations, random genetic changes, natural selection, and evolution connected to each other?
- How can an evolutionary relationship between organisms be proven?
- How have scientists' understandings of evolution changed over time?

Written Curriculum

Grade-Span Expectations

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

LS1 (5-8) FAF –4

Explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.

LS1 (7-8)–4 Students demonstrate understanding of differentiation by…

4a explaining that specialized cells perform specialized functions. (e.g., muscle cells contract, nerve cells transmit impulses, skin cells provide protection).

4b comparing individual cells of tissues and recognizing the similarities of cells and how they work together to perform specific functions.

4c explaining how each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.

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

LS4 (5-8) INQ-10

Use data and observations to support the concept that environmental or biological factors affect human body systems (biotic & abiotic).

LS4 (7-8)-10 Students demonstrate an understanding of human body systems by …

10a predicting and explaining the effects of biotic factors (e.g., microbes, parasites, food availability, aging process) on human body systems.

10b predicting and explaining the effect of abiotic factors (e.g., drugs, environmental conditions) on human body systems.

10c researching and reporting on how biotic (e.g., microbes, parasites, food availability, aging process) and abiotic (e.g., radiation, toxic materials, carcinogens) factors cause disease and affect human health.

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

LS1 (5-8) POC -3

Compare and contrast sexual reproduction with asexual reproduction.

LS1 (7-8)–3 Students demonstrate an understanding of reproduction by …

3a explaining reproduction as a fundamental process by which the new individual receives genetic information from parent(s).

3b describing forms of asexual reproduction that involve the genetic contribution of only one parent (e.g., binary fission, budding, vegetative propagation, regeneration).

3c describing sexual reproduction as a process that combines genetic material of two parents to produce a new organism (e.g., sperm/egg, pollen/ova)

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

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…

12b describing the changes from one stage of embryonic development to the next.

12c comparing and contrasting embryonic development in various life forms (e.g., humans, frogs, chickens, sea urchins).

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

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 …

9a explaining that genetic variations/traits of organisms are passed on through reproduction and random genetic changes.

9b gathering evidence that demonstrates evolutionary relationships among organisms (e.g., similarities in body structure, early development, traits).

9d explaining how natural selection leads to evolution (e.g., survival of the fittest).

9e describing how scientists' understanding of the way species originate or become extinct has changed over time.

Clarifying the Standards

Prior Learning

In grades K–2, students demonstrate an understanding of reproduction by labeling and sequencing the life cycle of a plant and animal. Students demonstrate an understanding structure and function-survival requirements by identifying specific functions of the physical structures of a plant or animal. Students demonstrated an understanding of human heredity by observing and comparing their own physical features with those of parents, classmates, and other organisms. They also identified that some behaviors are learned.

In grades 3–4, students observed changes and recorded data to scientifically draw and label the stages in the life cycle of a familiar plant and animal. They compared the life cycles of two plants and/or two animals when given a set of data/pictures. Students demonstrated an understanding of structure and function-survival requirements by explaining how the physical structure/characteristic of an organism allows it to survive and defend itself. Students also analyzed the structures needed for survival of population of plants and animals in a particular habitat/environment. Students demonstrated an understanding of human heredity by identifying similarities that are inherited from a biological parent and by identifying that some behaviors are learned and some are instinctive.

In grades 5–6, students defined reproduction as a process through which organisms produce offspring and described it in terms of being essential for the continuation of a species. Students also investigated and compared a variety of plant and animal life cycles. Students demonstrated an understanding of differentiation by identifying cells as the building blocks of organisms and recognizing and illustrating the structural organization of an organism from a cell to tissue to organ to systems to organisms. Students demonstrated an understanding of natural selection/evolution by explaining how a population's species traits affect their ability to survive over time. They also researched and reported on possible causes for the extinction of an animal or plant and explained how fossil evidence can be used to understand the history of life on earth. Students demonstrated an understanding of human body systems by identifying the biotic and abiotic factors that have an effect on human body systems, cause disease, and affect human health.

In grade 7, students demonstrated an understanding of natural selection/evolution by differentiating between acquired and inherited characteristics and giving examples of each. Students demonstrated an understanding of patterns of human development by identifying and sequencing the stages of human embryonic development. Students also compared the patterns of human development after birth.

Current Learning

The appropriate level of instruction for the content in this unit of study is the reinforcement level. Students have been introduced to this content in previous grade levels, therefore students should be able to use that content as a basis for this new content. Students deepen their knowledge of the cells and the structural organization of an organism to include the importance of cell specialization to the survival of an organism. By examining cells that work together to perform specific functions, students will determine how these cells are similar and how they are different. They also explore the ways that systems work together to serve an organism as a whole. A flow chart or building blocks where students make connections between structure and function among each level of organization could be used to help students visualize the structural and functional relationships between each of these levels.

Students expand their understanding of reproduction to include the ways that asexual and sexual reproduction processes differ in the transfer of genetic information and material from parent(s) to offspring. For instance, offspring of species that reproduce sexually contain half of their genetic material from each parent while offspring from asexual reproduction are genetic clones of the parent. Asexual and sexual forms of reproduction have not been addressed in prior grade levels, and should be taught at the developmental level of instruction.

Students will make connections between the survival advantage of a trait and the increased probability of survival in an environment. Students will explain that these genetic variations are the result of the passing of genetic material through the process of reproduction. Students need to understand that some of these variations are the result of random changes in genetic material. Genetic variations passed on through reproduction and random genetic changes are explored through patterns of change. Students will develop an understanding of how natural selection can leads to evolution if the genetic variations that are inherited result in a survival advantage in a specific environment. By gathering evidence through research or some other source, students will examine organisms to show that similar body structures, early development, or other traits may be the result of an evolutionary relationship. For example, how the beaks of various finches in the Galapagos Islands are adapted to access limited food sources for survival. Students will also need to examine historical evidence to be able to describe how, over time, scientists' have adjusted their views of the ways that species originate or become extinct. These concepts have not been addressed in prior grade levels, and should be taught at the developmental level of instruction.

Students predict and explain the effects of biotic and abiotic factors on human body systems. Students research and report on how biotic and abiotic factors cause disease and affect human health. Therefore, these concepts should be taught at the reinforcement level. For examples, students explain how environmental factors such as alcohol affect fetal and life development.

All concepts in this unit of study should be taught using patterns of change from a developmental evolutionary perspective. Students understand that every organism includes similar structures at various stages in their embryonic development process. These structures then change as development continues. For example, embryonic gill slits are present in mammals in embryonic development then disappear during the duration of the developmental process. In this unit, comparisons between different species at different embryonic stages are made. Similarities and differences are identified at each developmental

stage. These concepts have not been addressed in prior grade levels, and should be taught at the developmental level of instruction.

Visual representations that can be used to analyze and make connections between cells, tissues, organs, and organ systems include use of tracing paper to peel away layers of an organism's body with an explanation at each level of organization; use of a foldable, photo story, or shortcut which includes an explanation at each level of organization of the organism.

Future Learning

At the high school level, students will extend their knowledge about the transfer of genetic information to include the molecular basis for heredity (DNA, etc.). They will learn how genetic information is passed from parent to offspring through the sorting and recombination of genes in sexual reproduction (phenotype, genotype, Punnett squares, probability, etc.). They will explore in more detail the functions of subcellular structures in both unicellular and multicellular organisms. Students will also extend their knowledge of natural selection by citing evidence of past and present life forms on earth (Gallapagos Islands, geographic isolation).

Additional Findings

Now is the time to begin the study of genetic traits and what offspring get from parents. This topic can be handled as a natural part of the study of human reproduction. Students should examine examples of lineages for which breeding has been used to emphasize or suppress certain features of organisms (for example, pineapples bred to fit in a can, sweeter-tasting corn) (*Benchmarks for Science Literacy* p. 108).

Students at this level are mainly focused on the human body. Begin with as many different kinds of body cells as possible—nerve, bone, muscle, skin—and then move on to examining cells in other animals and plants. This activity can show students that cells are the fundamental building blocks of their own bodies and of other living things as well. Once students see that tissue in other animals looks pretty much the same as tissue in humans, two important claims of science will be reinforced—the ubiquity of cells and the unity of nature (*Benchmarks,* p. 112).

Students can now develop more sophisticated understandings of how organs and organ systems work together. It's a good time to ask "what if?" questions such as: "What might happen if some other parts weren't there or weren't working?" Such questions encourage students to reflect on connections among organs (*Benchmarks,* p. 137).

Students can relate knowledge of organs and organ systems to their growing knowledge of cells. The specialization of cells serves the operation of the organs, and the organs serve the needs of cells (*Benchmarks*, p. 137).

Students of all ages have mistaken ideas about the structure and function of blood, the structure and function of the heart, the circulatory pattern, the circulatory/respiratory relationships, and the closed system of circulation. Misconceptions concerning the circulatory pattern, the circulatory/respiratory relationships, and the closed system of circulation are difficult to change (for example, the misconception that blood is blue) (*Atlas of Science Literacy*, Basic Functions, p. 41).

Before students have an early understanding of genetics, they may believe that a baby exists in the sperm, but requires the egg for food and protection, or that the baby exists in the egg and requires the sperm as a

trigger to grow. Many U.S. adults accept the idea that plants and animals have evolved, but reject the idea that humans have evolved. This appears to be related both to religious beliefs and to a lack of understanding about the molecular basis of heredity (*Atlas*, Human Identity, p. 37).

Students should know how abiotic factors have influenced life functions such as reproduction including survival rates. Students will also learn how biotic factors will affect human body systems. (*Atlas*, Human Identity, p. 130)

Notes About Resources and Materials

Websites

- www.cposcience.com
- www.science-class.net
- www.sciencespot.net
- www.discoveryeducation.com
- http://www.middleschoolscience.com/
- http://teach.genetics.utah.edu/content/begin/traits/traitsinventory.pdf
- http://sciencespot.net/Pages/otrail.html

  Challenge your students to create a "Wanted" poster about an organ. This website provides project guidelines, links for students, and project worksheets.

- http://genetics-education-partnership.mbt.washington.edu/download/toothpickfish.pdf

  Teach genetics and natural selection in the context of an environmental disaster that pollutes a stream. Note: This 15-page document is the most recent version (April 2001) of this activity and supersedes the earlier version contained in the Genetics Education Guide.

- www.science-class.net/Biology/Genetics.htm
- http://www.nsta.org/publications/interactive/galapagos/ (Welcome to the Galapagos)
- www.science-class.net/PowerPoints/Types%20of%20Reproduction_files/frame.htm

  PowerPoint on sexual and asexual reproduction

Books

- *Science Explorer*: Cells, Tissues, Organs, Organ Systems. Upper Saddle River, NJ: Prentice Hall.

  Human Biology and Health, Chapter 1, Section 1

- *Science Explorer*: Sexual and Asexual Reproduction. Upper Saddle River, NJ: Prentice Hall.

  Bacteria to Plants, pp. 59, 60, 83, 97, 98, 116

  Cells and Heredity, Chapter 3, Section 3

- *Science Explorer*: Natural Selection/Evolution. Upper Saddle River, NJ: Prentice Hall.

  Cells and Heredity, Chapter 5, Sections 1 and 3

  Environmental Science, pp. 32–36

Grade 8 Science, Quarter 1, Unit 1.2

Processes Within an Ecosystem

Overview

Number of instructional days: 9 (1 day = 50 minutes)

Content to be learned

- Describe the basic processes of photosynthesis and respiration.
- Recognize the names and chemical formulas of substances involved in photosynthesis and respiration.
- Explain the relationship between photosynthesis and respiration.
- Explain the inverse nature or complementary aspects of photosynthesis/respiration in relation to carbon dioxide, water, and oxygen exchange.
- Using a scenario, trace the flow of energy in an ecosystem using photosynthesis and respiration.
- Trace how matter cycles among and between organisms and the physical environment.

Science processes to be integrated

- Create and use diagram and/or flowchart.
- Use symbols and formulas.
- Communicate differences and similarities.
- Cite evidence to demonstrate understanding.
- Make scientific comparisons.
- Explain cause-and-effect relationships.
- Analyze a given scenario.
- Describe the interactions between the structures and energy/processes within a system.

Essential questions

- How does energy from the sun flow through an ecosystem?
- How are the processes of photosynthesis and respiration involved in the flow of energy and cycling of matter in an ecosystem?
- What are the names and chemical formulas for the substances involved in photosynthesis and respiration and how are the used to show these processes?
- What is the relationship between the sun and organisms in the food web, and ecosystems in the environment?

Written Curriculum

Grade-Span Expectations

LS2 - Matter cycles and energy flows through an ecosystem.

LS2 (5-8) SAE– 6

Given a scenario trace the flow of energy through an ecosystem, beginning with the sun, through organisms in the food web, and into the environment (includes photosynthesis and respiration).

LS2 (7-8) –6 Students demonstrate an understanding of energy flow in an ecosystem by …

6b describing the basic processes and recognizing the names and chemical formulas of the substances involved in photosynthesis and respiration.

6c explaining the relationship between photosynthesis and respiration.

LS2 (5-8) SAE-7

*Given an ecosystem, trace how matter cycles among and between organisms and the physical environment (includes water, oxygen, food web, decomposition, recycling but **not** carbon cycle or nitrogen cycle).*

LS2 (7-8)-7 Students demonstrate an understanding of recycling in an ecosystem by …

7c explaining the inverse nature or complementary aspects of photosynthesis/respiration in relation to carbon dioxide, water and oxygen exchange.

Clarifying the Standards

Prior Learning

In grades K–2, students demonstrated an understanding of energy flow within an ecosystem and food webs. Students learned how to care for plants and animals by identifying and providing for their needs. Students conducted an experiment to test the growth of a plant by varying the amount of light. Students used information about a simple food web to determine how the basic needs are met by the habitat/environment. They constructed and demonstrated a diagram showing simple food webs.

In grades 3–4, students demonstrated an understanding of energy flow within an ecosystem by identifying sources of energy for survival of organisms. Students identified the sun as the initial source of energy within the food web. Students designed and explained how the habitat provides for the needs of the organisms that live there and how they are dependent on each other.

In grades 5–6, students demonstrated an understanding of equilibrium in an ecosystem by identifying and defining the relationships like predator, prey, consumer, producer, decomposer, or host as they occur within the ecosystem. Students sequenced the energy flow in the ecosystem and recognized the substances involved in photosynthesis and respiration. Students demonstrated an understanding of recycling in an ecosystem by completing a basic food web within the ecosystem.

In grade 7, students demonstrated an understanding of equilibrium in an ecosystem by identifying, analyzing, and predicting abiotic factors like weather, climate, light, water, temperature, soil composition, or catastrophic events, and biotic factors like bacteria, fungi, plants, or animals which affect a given ecosystem. Students used a visual model to track population changes in an ecosystem. Students also explained the transfer of the sun's energy through living systems and its effect upon these systems. Students created and interpreted a model that traced the flow of energy in a food web. Students diagrammed and sequenced the series of steps showing how matter cycles among and between organisms and the physical environment. Students developed a model for a food web of local aquatic and terrestrial environments. Students also conducted a controlled investigation showing that the amount of matter remains constant even though its form and location changes as matter is transferred among and between organisms and the physical environment (closed system over time—conservation of mass).

Current Learning

Students in grade 8 know that energy flows within an ecosystem and that there is equilibrium within an ecosystem. The concepts in this unit of study should be taught at the drill-and-practice level of instruction. Students expand their knowledge by analyzing a scenario to trace the flow of energy through an ecosystem. At this grade level, students must include the processes of photosynthesis and respiration. Photosynthesis and respiration have been introduced to students in previous grade levels, however the recognition of the processes involved and the chemical formulas used to represent these processes have not been addressed in prior grade levels and should be taught on the developmental level.

In addition to describing the basic processes involved in photosynthesis and respiration, students recognize the names and chemical formulas of the substances and are able to explain the relationship between photosynthesis and respiration. Students should be able to explain the inverse nature or complementary aspects of photosynthesis/respiration in relation to carbon dioxide, water, and oxygen exchange. This is also a developmental concept. Students create and use diagrams and flow charts, as well as use symbols and formulas to represent the flow of energy and cycling of matter.

All concepts in this unit of study should be taught from a systems perspective. Students explain that a system includes structures and processes that interact. For example, energy from the sun flows through organisms in the food web and into the environment by the processes of photosynthesis. Each of the steps in this energy exchange is a subsystem of the bigger ecosystem. In order for students to understand this, they could be asked to consider what would happen to the overall system of any one of these smaller systems fails to function properly.

Students recognize and identify the transfer of energy, flow of energy in a food web, and its effect upon them. Using drill-and-practice strategies, students apply their understanding of these concepts by using diagrams to sequence the series of steps that show how matter cycles among and between organisms and the physical environment. This gives students the opportunity to demonstrate their knowledge and understanding of cycles within the physical environment that include water, oxygen, food webs, decomposition, and recycling. This will not include the carbon or nitrogen cycles. Using flow charts, diagrams, and written responses, students will describe the interactions between the structures and energy/processes within a system. In this unit, students observe models and diagrams, and use manipulatives to look at the various chemical formulas to understand concepts on a fundamental level. Utilizing media and technology resources, students observe concepts that cannot be directly demonstrated in the classroom.

Future Learning

At the high school level, students will extend their knowledge about the transfer of genetic information to include the molecular basis for heredity (DNA, etc.). Students will also learn the causal factors of mutation. They will learn how genetic information is passed from parent to offspring through the sorting and recombination of genes in sexual reproduction (phenotype, genotype, Punnett squares, probability, etc.). They will explore in more detail the functions of subcellular structures in both unicellular and multicellular organisms. Students will also extend their knowledge of natural selection by citing evidence of past and present life forms on earth (Galapagos Islands, geographic isolation).

Additional Findings

Middle school and high school students have difficulty thinking of the human body as a chemical system and have little knowledge of the elements composing the living body. In particular, middle school students think organisms and materials in the environment are very different types of matter. Students see these substances as fundamentally different and not transformable into each other.

Students of all ages hold misconceptions about plant nutrition. They think that plants get their food from the environment rather than by manufacturing it internally and that food for plants is taken in from the outside. These misconceptions are particularly resistant to change. Even after traditional instruction, students have difficulty accepting that plants make food from water and air, and that this is their only source of food. Understanding that the food made by plants is very different from other nutrients such as water or minerals is a prerequisite for understanding the distinction between plants as producers and animals as consumers.

Middle school students have some awareness of the cyclical processes within an ecosystem. Some students make the mistake of seeing only chains of events rather than recognizing the matter involved in processes such as plant growth or animals eating plants.

Students may get stuck in thinking that matter is always created or destroyed rather than transformed. Other students recognize one form of recycling through soil minerals, but fail to incorporate water, oxygen, and carbon dioxide into matter cycles. Even after specially designed instruction, students cling to their misinterpretations. Instruction that emphasizes the flow of matter through the ecosystem as a basic pattern of the environment may help correct these difficulties.

Some students of all ages struggle to identify the energy sources for plants and animals. They may confuse energy and other concepts such as food, force, and temperature. As a result, students may not appreciate the uniqueness and importance of energy conversion processes like respiration and photosynthesis (*Atlas of Science Literacy*, pp. 77–79).

Notes About Resources and Materials

Additional Resources

- http://www.nclark.net/PhotoRespiration
- www.cpo http://www.pbs.org/wgbh/nova/nature/photosynthesis.htmlscience.com
- www.sciencespot.net
- www.discoveryeducation.com
- www.science-class.net/Biology/Photosynthesis.htm (click on "warm ups")
- www.science-class.net/PowerPoints/PandR_files/frame.htm
- www.science-class.net/Lessons/Photosynthesis_Cell_Resp/photosynthesis_elodea.pdf
- www.science-class.net/Lessons/Photosynthesis_Cell_Resp/evidence_of_photosynthesis.pdf
- Respiration in yeast (lab)

  http://www.science-class.net/Lessons/Photosynthesis_Cell_Resp/respiration%20in%20yeast.pdfGrade
- Evidence of Photosynthesis (lab)

  http://www.science-class.net/Lessons/Photosynthesis_Cell_Resp/evidence_of_photosynthesis.pdf

Books

Science Explorer: Cells, Tissues, Organs, Organ Systems. Upper Saddle River, NJ: Prentice Hall.