

Middle School Curriculum Standards: The Living Environment

Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

Key Idea 1:

Living things are both similar to and different from each other and from nonliving things.

Introduction: Living things are similar to each other yet different from nonliving things. The cell is a basic unit of structure and function of living things (cell theory). For all living things, life activities are accomplished at the cellular level. Human beings are an interactive organization of cells, tissues, organs, and systems. Viruses lack cellular organization.

PERFORMANCE INDICATOR 1.1

Compare and contrast the parts of plants, animals, and one-celled organisms.

Major Understandings:

1.1a Living things are composed of cells. Cells provide structure and carry on major functions to sustain life. Cells are usually microscopic in size.

1.1b The way in which cells function is similar in all living things. Cells grow and divide, producing more cells. Cells take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.

1.1c Most cells have cell membranes, genetic material, and cytoplasm. Some cells have a cell wall and/or chloroplasts. Many cells have a nucleus.

1.1d Some organisms are single cells; others, including humans, are multicellular.

1.1e Cells are organized for more effective functioning in multicellular organisms. Levels of organization for structure and function of a multicellular organism include cells, tissues, organs, and organ systems.

1.1f Many plants have roots, stems, leaves, and reproductive structures. These organized groups of tissues are responsible for a plant's life activities.

1.1g Multicellular animals often have similar organs and specialized systems for carrying out major life activities.

1.1h Living things are classified by shared characteristics on the cellular and organism level. In classifying organisms, biologists consider details of internal and external structures. Biological classification systems are arranged from general (kingdom) to specific (species).

**PERFORMANCE
INDICATOR 1.2**

Explain the functioning of the major human organ systems and their interactions.

Major Understandings:

1.2a Each system is composed of organs and tissues which perform specific functions and interact with each other, e.g., digestion, gas exchange, excretion, circulation, locomotion, control, coordination, reproduction, and protection from disease.

1.2b Tissues, organs, and organ systems help to provide all cells with nutrients, oxygen, and waste removal.

1.2c The digestive system consists of organs that are responsible for the mechanical and chemical breakdown of food. The breakdown process results in molecules that can be absorbed and transported to cells.

1.2d During respiration, cells use oxygen to release the energy stored in food. The respiratory system supplies oxygen and removes carbon dioxide (gas exchange).

1.2e The excretory system functions in the disposal of dissolved waste molecules, the elimination of liquid and gaseous wastes, and the removal of excess heat energy.

1.2f The circulatory system moves substances to and from cells, where they are needed or produced, responding to changing demands.

1.2g Locomotion, necessary to escape danger, obtain food and shelter, and reproduce, is accomplished by the interaction of the skeletal and muscular systems, and coordinated by the nervous system.

1.2h The nervous and endocrine systems interact to control and coordinate the body's responses to changes in the environment, and to regulate growth, development, and reproduction. Hormones are chemicals produced by the endocrine system; hormones regulate many body functions.

1.2i The male and female reproductive systems are responsible for producing sex cells necessary for the production of offspring.

1.2j Disease breaks down the structures or functions of an organism. Some diseases are the result of failures of the system. Other diseases are the result of damage by infection from other organisms (germ theory). Specialized cells protect the body from infectious disease. The chemicals they produce identify and destroy microbes that enter the body.

Key Idea 2:

Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.

Introduction: Every organism requires a set of instructions for specifying its traits. This information is found in the genes of cells. As organisms reproduce, these instructions are passed from one generation to the next.

PERFORMANCE INDICATOR 2.1 Describe sexual and asexual mechanisms for passing genetic materials from generation to generation.

Major Understandings:

2.1a Hereditary information is contained in genes. Genes are composed of DNA that makes up the chromosomes of cells.

2.1b Each gene carries a single unit of information. A single inherited trait of an individual can be determined by one pair or by many pairs of genes. A human cell contains thousands of different genes.

2.1c Each human cell contains a copy of all the genes needed to produce a human being.

2.1d In asexual reproduction, all the genes come from a single parent. Asexually produced offspring are genetically identical to the parent.

2.1e In sexual reproduction typically half of the genes come from each parent. Sexually produced offspring are not identical to either parent.

PERFORMANCE INDICATOR 2.2 Describe simple mechanisms related to the inheritance of some physical traits in offspring.

Major Understandings:

2.2a In all organisms, genetic traits are passed on from generation to generation.

2.2b Some genes are dominant and some are recessive. Some traits are inherited by mechanisms other than dominance and recessiveness.

2.2c The probability of traits being expressed can be determined using models of genetic inheritance. Some models of prediction are pedigree charts and Punnett squares.

Key Idea 3:

Individual organisms and species change over time.

Introduction: Evolution is the change in a species over time. Millions of diverse species are alive today. Generally this diversity of species developed through gradual processes of change occurring over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations (natural selection). Biological adaptations are differences in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

PERFORMANCE INDICATOR 3.1 Describe sources of variation in organisms and their structures and relate the variations to survival.

Major Understandings:

3.1a The processes of sexual reproduction and mutation have given rise to a variety of traits within a species.

3.1b Changes in environmental conditions can affect the survival of individual organisms with a particular trait. Small differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors. Individual organisms with certain traits are more likely to survive and have offspring than individuals without those traits.

3.1c Human activities such as selective breeding and advances in genetic engineering may affect the variations of species.

PERFORMANCE INDICATOR 3.2 Describe factors responsible for competition within species and the significance of that competition.

Major Understandings:

3.2a In all environments, organisms with similar needs may compete with one another for resources.

3.2b Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to permit its survival. Extinction of species is common. Fossils are evidence that a great variety of species existed in the past.

3.2c Many thousands of layers of sedimentary rock provide evidence for the long history of Earth and for the long history of changing lifeforms whose remains are found in the rocks. Recently deposited rock layers are more likely to contain fossils resembling existing species.

3.2d Although the time needed for change in a species is usually great, some species of insects and bacteria have undergone significant change in just a few years.

Key Idea 4:

The continuity of life is sustained through reproduction and development.

Introduction: The survival of a species depends on the ability of a living organism to produce offspring. Living things go through a life cycle involving both reproductive and developmental stages. Development follows an orderly sequence of events.

PERFORMANCE INDICATOR 4.1 Observe and describe the variations in reproductive patterns of organisms, including asexual and sexual reproduction.

Major Understandings:

4.1a Some organisms reproduce asexually. Other organisms reproduce sexually. Some organisms can reproduce both sexually and asexually.

4.1b There are many methods of asexual reproduction, including division of a cell into two cells, or separation of part of an animal or plant from the parent, resulting in the growth of another individual.

4.1c Methods of sexual reproduction depend upon the species. All methods involve the merging of sex cells to begin the development of a new individual. In many species, including plants and humans, eggs and sperm are produced.

4.1d Fertilization and/or development in organisms may be internal or external.

PERFORMANCE INDICATOR 4.2 Explain the role of sperm and egg cells in sexual reproduction.

Major Understandings:

4.2a The male sex cell is the sperm. The female sex cell is the egg. The fertilization of an egg by a sperm results in a fertilized egg.

4.2b In sexual reproduction, sperm and egg each carry one-half of the genetic information for the new individual. Therefore, the fertilized egg contains genetic information from each parent.

PERFORMANCE INDICATOR 4.3 Observe and describe developmental patterns in selected plants and animals (e.g., insects, frogs, humans, seed-bearing plants).

Major Understandings:

4.3a Multicellular organisms exhibit complex changes in development, which begin after fertilization. The fertilized egg undergoes numerous cellular divisions that will result in a multicellular organism, with each cell having identical genetic information.

4.3b In humans, the fertilized egg grows into tissue which develops into organs and organ systems before birth.

4.3c Various body structures and functions change as an organism goes through its life cycle.

PERFORMANCE INDICATOR 4.3

continued

4.3d Patterns of development vary among animals. In some species the young resemble the adult, while in others they do not. Some insects and amphibians undergo metamorphosis as they mature.

4.3e Patterns of development vary among plants. In seed-bearing plants, seeds contain stored food for early development. Their later development into adulthood is characterized by varying patterns of growth from species to species.

4.3f As an individual organism ages, various body structures and functions change.

PERFORMANCE INDICATOR 4.4

Observe and describe cell division at the microscopic level and its macroscopic effects.

Major Understandings:

4.4a In multicellular organisms, cell division is responsible for growth, maintenance, and repair. In some one-celled organisms, cell division is a method of asexual reproduction.

4.4b In one type of cell division, chromosomes are duplicated and then separated into two identical and complete sets to be passed to each of the two resulting cells. In this type of cell division, the hereditary information is identical in all the cells that result.

4.4c Another type of cell division accounts for the production of egg and sperm cells in sexually reproducing organisms. The eggs and sperm resulting from this type of cell division contain one-half of the hereditary information.

4.4d Cancers are a result of abnormal cell division.

Key Idea 5:

Organisms maintain a dynamic equilibrium that sustains life.

Introduction: All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment. Organisms respond to internal or environmental stimuli.

PERFORMANCE INDICATOR 5.1

Compare the way a variety of living specimens carry out basic life functions and maintain dynamic equilibrium.

Major Understandings:

5.1a Animals and plants have a great variety of body plans and internal structures that contribute to their ability to maintain a balanced condition.

5.1b An organism's overall body plan and its environment determine the way that the organism carries out the life processes.

**PERFORMANCE
INDICATOR 5.1**

continued

5.1c All organisms require energy to survive. The amount of energy needed and the method for obtaining this energy vary among cells. Some cells use oxygen to release the energy stored in food.

5.1d The methods for obtaining nutrients vary among organisms. Producers, such as green plants, use light energy to make their food. Consumers, such as animals, take in energy-rich foods.

5.1e Herbivores obtain energy from plants. Carnivores obtain energy from animals. Omnivores obtain energy from both plants and animals. Decomposers, such as bacteria and fungi, obtain energy by consuming wastes and/or dead organisms.

5.1f Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required for survival. Regulation includes a variety of nervous and hormonal feedback systems.

5.1g The survival of an organism depends on its ability to sense and respond to its external environment.

**PERFORMANCE
INDICATOR 5.2** Describe the importance of major nutrients, vitamins, and minerals in maintaining health and promoting growth, and explain the need for a constant input of energy for living organisms.

Major Understandings:

5.2a Food provides molecules that serve as fuel and building material for all organisms. All living things, including plants, must release energy from their food, using it to carry on their life processes.

5.2b Foods contain a variety of substances, which include carbohydrates, fats, vitamins, proteins, minerals, and water. Each substance is vital to the survival of the organism.

5.2c Metabolism is the sum of all chemical reactions in an organism. Metabolism can be influenced by hormones, exercise, diet, and aging.

5.2d Energy in foods is measured in Calories. The total caloric value of each type of food varies. The number of Calories a person requires varies from person to person.

5.2e In order to maintain a balanced state, all organisms have a minimum daily intake of each type of nutrient based on species, size, age, sex, activity, etc. An imbalance in any of the nutrients might result in weight gain, weight loss, or a diseased state.

5.2f Contraction of infectious disease, and personal behaviors such as use of toxic substances and some dietary habits, may interfere with one's dynamic equilibrium. During pregnancy these conditions may also affect the development of the child. Some effects of these conditions are immediate; others may not appear for many years.

Key Idea 6:

Plants and animals depend on each other and their physical environment.

Introduction: An environmentally aware citizen should have an understanding of the natural world. All organisms interact with one another and are dependent upon their physical environment. Energy and matter flow from one organism to another. Matter is recycled in ecosystems. Energy enters ecosystems as sunlight, and is eventually lost from the community to the environment, mostly as heat.

PERFORMANCE INDICATOR 6.1 Describe the flow of energy and matter through food chains and food webs.

Major Understandings:

6.1a Energy flows through ecosystems in one direction, usually from the Sun, through producers to consumers and then to decomposers. This process may be visualized with food chains or energy pyramids.

6.1b Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem.

6.1c Matter is transferred from one organism to another and between organisms and their physical environment. Water, nitrogen, carbon dioxide, and oxygen are examples of substances cycled between the living and nonliving environment.

PERFORMANCE INDICATOR 6.2 Provide evidence that green plants make food and explain the significance of this process to other organisms.

Major Understandings:

6.2a Photosynthesis is carried on by green plants and other organisms containing chlorophyll. In this process, the Sun's energy is converted into and stored as chemical energy in the form of a sugar. The quantity of sugar molecules increases in green plants during photosynthesis in the presence of sunlight.

6.2b The major source of atmospheric oxygen is photosynthesis. Carbon dioxide is removed from the atmosphere and oxygen is released during photosynthesis.

6.2c Green plants are the producers of food which is used directly or indirectly by consumers.

Key Idea 7:

Human decisions and activities have had a profound impact on the physical and living environment.

Introduction: The number of organisms an ecosystem can support depends on the resources available and physical factors: quantity of light, air, and water; range of temperatures; soil composition. To ensure the survival of our planet, people have a responsibility to consider the impact of their actions on the environment.

PERFORMANCE INDICATOR 7.1

Describe how living things, including humans, depend upon the living and nonliving environment for their survival.

Major Understandings:

7.1a A population consists of all individuals of a species that are found together at a given place and time. Populations living in one place form a community. The community and the physical factors with which it interacts compose an ecosystem.

7.1b Given adequate resources and no disease or predators, populations (including humans) increase. Lack of resources, habitat destruction, and other factors such as predation and climate limit the growth of certain populations in the ecosystem.

7.1c In all environments, organisms interact with one another in many ways. Relationships among organisms may be competitive, harmful, or beneficial. Some species have adapted to be dependent upon each other with the result that neither could survive without the other.

7.1d Some microorganisms are essential to the survival of other living things.

7.1e The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. Therefore, the good health of environments and individuals requires the monitoring of soil, air, and water, and taking steps to keep them safe.

PERFORMANCE INDICATOR 7.2

Describe the effects of environmental changes on humans and other populations.

Major Understandings:

7.2a In ecosystems, balance is the result of interactions between community members and their environment.

7.2b The environment may be altered through the activities of organisms. Alterations are sometimes abrupt. Some species may replace others over time, resulting in long-term gradual changes (ecological succession).

7.2c Overpopulation by any species impacts the environment due to the increased use of resources. Human activities can bring about environmental degradation through resource acquisition, urban growth, land-use decisions, waste disposal, etc.

7.2d Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources.