

Science Standard 7 Diversity and Continuity of Living Things

The natural world consists of a diversity of organisms that transmit their characteristics to future generations. Living things reproduce, develop, and transmit traits, and theories of evolution explain the unity and diversity of species found on Earth. Knowledge of genetics, reproduction, and development is applied to improve agriculture and human health.

Strand	Grades K-3	Grades 4-5	Grades 6-8	Grades 9-12
<p><u>Reproduction, Heredity and Development</u></p> <p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Essential Questions: Grades K-5: Why do offspring resemble their parents? Grades 6-8: What are the advantages and disadvantages of different reproductive strategies? Grades K-12: How do organisms change as they go through their life cycles?</p>	<p>A. The offspring of some plants and animals resemble the parents (i.e., a tree seedling resembles a mature tree). Level: Essential</p> <p>B. The offspring of some plants and animals do not resemble the parents. Similarities between parents and their offspring become more apparent as their life cycle continues (i.e., caterpillars become butterflies). Level: Essential</p> <p>C. All plants and animals go through a life cycle of birth, growth, development, reproduction, and death. This cycle is predictable and describable, but differs from organism to organism. Level: Essential</p>	<p>A. Physical characteristics are passed on from parent to offspring. Organisms with two parents inherit characteristics of both. Level: Important</p> <p>B. An organism's physical appearance can change without the change being passed on to its offspring (e.g., dyed hair, loss of a claw). Level: Compact</p> <p>C. Most plants go through a life cycle of germination, growth, development, reproduction, and death. Level: Essential</p>	<p>A. Reproduction is a characteristic of all living systems and is essential to the continuation of every species. Level: Essential</p> <p>B. Some organisms reproduce asexually involving one parent. Asexual reproduction results in offspring that are genetically identical to the parent organism (clones). This process is advantageous in maintaining the genetic make-up of organisms that are successful in a specific environment. Level: Essential</p> <p>C. Some organisms reproduce sexually involving two parents. Sexual reproduction results in offspring that have greater genetic diversity than those resulting from asexual reproduction. One-half of the offspring's genetic information comes from the "male" parent and one-half comes from the "female" parent. These genetic differences help to ensure the survival of offspring in varied environments. Level: Essential</p> <p>D. In sexual reproduction after the egg is fertilized, each of the new cells in the developing organism receives an exact copy of the genetic information contained in the nucleus of a fertilized egg. Level: Essential</p>	<p>A. Hereditary/genetic information in chromosomes is contained in molecules of DNA. Genes are sections of DNA that direct syntheses of specific proteins associated with traits in organisms. These consist of various combinations of four different nucleotides that encode this information through their sequences. Level: Essential</p> <p>B. Known patterns of inheritance can be used to make predictions about genetic variation. Level: Important</p> <p>C. Mutations in DNA of organisms normally occur spontaneously at low rates, but can occur at higher rates (i.e., exposure to pathogens, radiation and some chemicals). Most mutations have no effect on the organism, but some may be beneficial or harmful depending on the environment. Level: Essential</p> <p>D. Only random mutations in gametes can create the variation that is inherited by an organism's offspring. Somatic mutations are not inherited, but may lead to cell death, uncontrolled cell growth, or cancer. Level: Important</p>

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<p><u>Reproduction, Heredity and Development</u> (Continued from previous page)</p>			<p>E. Organisms have different reproductive strategies to ensure their offspring's survival. Some organisms produce many offspring and provide little parental care. Other organisms produce few offspring and invest much time and energy in care of their offspring. Level: Compact</p> <p>F. Chromosomes are found in the nucleus of the cell and contain genes that are made of DNA. Inherited traits of individuals are controlled by genes. Level: Essential</p> <p>G. Chromosomes can be arranged in pairs (one-half of each pair from each parent). These pairs are approximately the same size and shape, and have similar sequences of genes. Humans have 23 pairs (46) of chromosomes. Other organisms may have different numbers of chromosomes. Level: Important</p>	<p>E. During the cell cycle, DNA of the parent cell replicates and the cell divides into two cells that are identical to the parent. This process is used for growth and repair of body tissues and for asexual reproduction. Level: Essential</p> <p>F. Meiosis is the production of sex cells (gametes). The production and release of these gametes is controlled by hormones. In meiosis, the number of chromosomes is reduced by one-half and chromosomes may randomly exchange homologous parts to create new chromosomes with combinations not necessarily found in the parent cell. This may increase variation within the species. Level: Essential</p> <p>G. Upon fertilization, the fusion of the gametes restores the original chromosome number, and new gene combinations lead to increased genetic variation, which, in turn, increases the likelihood of survival of the species. Level: Essential</p>

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<p><u>Reproduction, Heredity and Development</u> <i>(Continued from previous page)</i></p>			<p>H. In humans, gender is determined by a pair of sex chromosomes. Females possess two X chromosomes; males an X and a Y chromosome. The sex of an embryo is determined by the sex chromosome found in the sperm cell. Level: Important</p> <p>I. Alternative versions of genes (different alleles) account for variations in inherited characteristics (i.e., flower color). Pairs of chromosomes that have the same allele present on both chromosomes are homozygous. Pairs of chromosomes with different alleles are heterozygous. Level: Essential</p> <p>J. A dominant trait will be expressed if the organism is heterozygous or homozygous for the trait. A recessive trait will only be expressed if the organism is homozygous for the trait. Level: Essential</p> <p>K. Mendelian genetics can be used to predict genotypes and phenotypes of offspring resulting from sexual reproduction. Level: Essential</p>	<p>H. The sex chromosomes contain different genes, and therefore, certain traits will show patterns of inheritance based on gender. Level: Important</p> <p>I. Embryological development in plants and animals involves a series of orderly changes in which cells divide and differentiate. Development is controlled by genes whose expression is influenced by internal factors (i.e., hormones) and may also be influenced by environmental factors (i.e., nutrition, alcohol, radiation, drugs, and pathogens). Alteration in this balance may interfere with normal growth and development. Level: Compact</p>

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<p><u>Diversity and Evolution</u></p> <p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring.</p> <p>Essential Questions: Grades K-5: How are organisms of the same kind different from each other? How does this help them reproduce and survive?</p> <p>Grades 6-12: How does natural selection encourage inter and intra-specific diversity over time?</p>	<p>A. Many different kinds of plants and animals live throughout the world. These plants and animals can be grouped according to the characteristics they share. Level: Compact</p>	<p>A. Organisms of the same type vary in appearance. These variations may provide an advantage in reproduction and survival. Level: Compact</p>	<p>A. The Earth's present day species evolved from earlier, distinctly different species. Many thousands of layers of sedimentary rock provide evidence for the long history of the Earth and for the long history of changing life forms whose remains are found in the rocks. More recently deposited rock layers are more likely to contain fossils resembling existing species. Level: Compact</p> <p>B. Natural selection is the process by which some individuals with certain traits are more likely to survive and produce greater numbers of offspring than other organisms of the same species. Competition for resources and mates and conditions in the environment can affect which individuals survive, reproduce and pass their traits on to future generations. Level: Essential</p> <p>C. Small genetic differences between parents and offspring accumulate over many generations, and ultimately new species may arise. Level: Important</p>	<p>A. Evolution is a change in allelic frequencies of a population over time. The theory of evolution is supported by extensive biochemical, structural, embryological, and fossil evidence. Level: Essential</p> <p>B. The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms. The millions of different species of plants, animals, and microorganisms that live on Earth today are related by descent with modification from common ancestors. Level: Essential</p> <p>C. The process of natural selection occurs when some heritable variations that arise from random mutation and recombination give individuals within a species some survival advantages over others. These offspring with advantageous adaptations are more likely to survive and reproduce, thus increasing the proportion of individuals within a population with advantageous characteristics. Level: Essential</p>

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<p><u>Diversity and Evolution</u> <i>(Continued from previous page)</i></p>			<p>D. Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Most of the species that have lived on Earth no longer exist. Level: Important</p> <p>E. There is a wide diversity of organisms on Earth. These organisms may be classified in a number of ways. One classification system places organisms into five kingdoms (monera, protista, fungi, plantae, animalia) based on similarities in structure. Level: Important</p> <p>F. The great variety of body forms and structures found in different species enable organisms to survive in diverse environments. Level: Essential</p>	<p>When populations become isolated, these changes may accumulate and eventually result in new species. Level: Essential</p> <p>D. Evolution does not proceed at the same rate in all populations; nor does it progress in a linear or set direction. Environmental changes have a strong influence on the evolutionary process. Other factors that influence evolution include: sexual selection, mutation, genetic drift, and genetic modification. Level: Important</p> <p>E. Organisms are classified into a hierarchy of groups and subgroups based on similarities in structure, comparisons in DNA and protein and evolutionary relationships. Level: Compact</p> <p>F. Genetically diverse populations are more likely to survive changing environments. Level: Essential</p> <p>G. Biological evolution is the foundation for modern biology and is used to make predictions for medical, environmental, agricultural and other societal purposes. Level: Essential</p>

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<p><u>Technology Applications</u></p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human needs and wants.</p> <p>Essential Question: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>	<p>A. People use the variety of plants and animals found throughout the world for food, clothing, and shelter (e.g., silk for clothing, wood for building shelters). Level: Compact</p>	<p>A. Through the use of biotechnology, scientists engineer plants and manipulate growing conditions to meet human needs and wants (e.g., fruits without seeds, hydroponics). Level: Compact</p>	<p>A. Selective breeding is used to cultivate plants and domesticated animals with desirable traits. Level: Essential</p> <p>B. Knowledge gained from research in genetics is being applied to areas of human health. Geneticists and genetic counselors may use pedigrees and Punnett squares to help predict the possibility of genetic disorders in future generations. Level: Essential</p>	<p>A. The expanding ability to manipulate genetic material, reproductive processes, and embryological development creates choices that raise ethical, legal, social, and public policy questions. Level: Compact</p> <p>B. Recombinant DNA technology, which is a form of genetic engineering, involves the insertion of DNA from one cell into a cell of a different organism where the inserted DNA is expressed. Genetic engineering is being applied in biology, agriculture, and medicine in order to meet human wants and needs. Level: Important</p> <p>C. DNA is analyzed to determine evolutionary relationships, study populations, identify individuals, and diagnose genetic disorders. Level: Important</p>