



Science Standard 7
Diversity and Continuity of Living Things
Grade Level Expectations

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>	<ol style="list-style-type: none"> 1. The offspring of some plants and animals resemble the parents (i.e., a tree seedling resembles a mature tree). 2. 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). 3. 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. 	<ol style="list-style-type: none"> 1. Physical characteristics are passed on from parent to offspring. Organisms with two parents inherit characteristics of both. 2. An organism's physical appearance can change without the change being passed on to its offspring (e.g., dyed hair, loss of a claw). 3. Most plants go through a life cycle of germination, growth, development, reproduction, and death. 	<ol style="list-style-type: none"> 1. Reproduction is a characteristic of all living systems and is essential to the continuation of every species. 2. 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. 3. 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. 4. In sexual reproduction after the egg is fertilized, each of the new cells in the developing organism receives an exact copy 	<ol style="list-style-type: none"> 1. 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. 2. Known patterns of inheritance can be used to make predictions about genetic variation. 3. 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. 4. 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.

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<p><u>Reproduction, Heredity and Development</u> continued from previous page</p>			<p>of the genetic information contained in the nucleus of a fertilized egg.</p> <p>5. 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.</p> <p>6. 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.</p> <p>7. 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.</p>	<p>5. 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.</p> <p>6. 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.</p> <p>7. 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.</p>

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<p><u>Reproduction, Heredity and Development</u> continued from previous page</p>			<p>8. 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.</p> <p>9. 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.</p> <p>10. 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.</p> <p>11. Mendelian genetics can be used to predict genotypes and phenotypes of offspring resulting from sexual reproduction.</p>	<p>8. The sex chromosomes contain different genes, and therefore, certain traits will show patterns of inheritance based on gender.</p> <p>9. 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.</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>1. Many different kinds of plants and animals live throughout the world. These plants and animals can be grouped according to the characteristics they share.</p>	<p>1. Organisms of the same type vary in appearance. These variations may provide an advantage in reproduction and survival.</p>	<p>1. 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.</p> <p>2. 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.</p> <p>3. Small genetic differences between parents and offspring accumulate over many generations, and ultimately new species may arise.</p>	<p>1. 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.</p> <p>2. 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.</p> <p>3. 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.</p>

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<p><u><i>Diversity and Evolution</i></u> continued from previous page</p>			<p>4. 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.</p> <p>5. 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.</p> <p>6. The great variety of body forms and structures found in different species enable organisms to survive in diverse environments.</p>	<p>When populations become isolated, these changes may accumulate and eventually result in new species.</p> <p>4. 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.</p> <p>5. Organisms are classified into a hierarchy of groups and subgroups based on similarities in structure, comparisons in DNA and protein and evolutionary relationships.</p> <p>6. Genetically diverse populations are more likely to survive changing environments.</p> <p>7. Biological evolution is the foundation for modern biology and is used to make predictions for medical, environmental, agricultural and other societal purposes.</p>

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Strand	Grades K-3	Grades 4-5	Grades 6-8	Grades 9-12
<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>1. 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).</p>	<p>1. Through the use of biotechnology, scientists engineer plants and manipulate growing conditions to meet human needs and wants (e.g., fruits without seeds, hydroponics).</p>	<p>1. Selective breeding is used to cultivate plants and domesticated animals with desirable traits.</p> <p>2. 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.</p>	<p>1. The expanding ability to manipulate genetic material, reproductive processes, and embryological development creates choices that raise ethical, legal, social, and public policy questions.</p> <p>2. 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.</p> <p>3. DNA is analyzed to determine evolutionary relationships, study populations, identify individuals, and diagnose genetic disorders.</p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades K-3

<p>Essential Questions: Why do offspring resemble their parents? How do organisms change as they go through their life cycles? Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? Essential Question: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>			
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring. 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. 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>			
All students in Kindergarten will be able to:	Building upon the Kindergarten expectations, all students in Grade 1 will be able to:	Building upon the K-1 expectations, all students in Grade 2 will be able to:	Building upon the K-2 expectations, all students in Grade 3 will be able to:
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Observe and describe similarities and differences between parents and offspring (e.g., roots on a mature tree vs. roots on a seedling). Use a hand lens (magnifier) as an appropriate instrument for observing in closer detail.</p> <p>Realize that organisms reproduce organisms of the same kind (e.g., dogs have puppies).</p> <p>Construct, through the use of pictorials, the life cycle of a tree. Describe the tree in different stages of its life cycle.</p>	<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Recognize that organisms change over time. Record and communicate changes observed in living things over time.</p> <p>Construct, through the use of pictorials, the life cycle of guppies. Describe the guppy in different stages of its life cycle.</p> <p>Describe similarities and differences between parents and offspring, such as size and color.</p>	<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Observe the life cycle of a selected organism (e.g., plant, butterfly, frog, etc.) and recognize that the stages of the life cycle are predictable and describable.</p> <p>Identify the stages in a life cycle of an organism that goes through complete metamorphosis (e.g., butterfly, mealworm). Describe the similarities and differences in the structures and behaviors of the egg, larvae, pupae, and adult insect.</p> <p>Identify the stages in the life cycle of an organism that goes through simple (incomplete) metamorphosis (e.g., grasshopper, cricket). Describe the similarities and differences in the structures and behaviors of the egg, nymph, and adult insect.</p>	<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Observe and describe similarities and differences in the skeleton of an infant to that of an adult human. Recognize that as a human grows and develops the number of bones does not change but the sizes of the bones do change.</p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades K-3

<p>Essential Questions: Why do offspring resemble their parents? How do organisms change as they go through their life cycles?</p> <p>Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive?</p> <p>Essential Question: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>			
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</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>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>All students in Kindergarten will be able to:</p>	<p>Building upon the Kindergarten expectations, all students in Grade 1 will be able to:</p>	<p>Building upon the K-1 expectations, all students in Grade 2 will be able to:</p>	<p>Building upon the K-2 expectations, all students in Grade 3 will be able to:</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>Recognize that there are many different kinds of trees in the world. While there are many similarities and differences among the trees, they are all trees.</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p>Identify and list the many different ways in which trees are used by people to meet human wants and needs (i.e., food, shelter, shade, paper products, wood for fuel, furniture, etc.).</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>Recognize that there are many different kinds of plants and animals in the world. Sort terrestrial animals from aquatic animals. Identify the characteristics used to separate the terrestrial from aquatic animals.</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p>Recognize that some plants and animals are maintained in artificial environments to meet human wants and needs (i.e., scientific study, education, food).</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>Recognize that there are many different kinds of animals in the world, of which insects are one grouping. Sort insects from animals that are not insects. Identify the characteristics used to sort the insects (i.e., three body parts, six legs).</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p>Recognize that some insects are considered harmful to humans, plants, and other animals while other insects can be beneficial. Technology allows us to help control the harmful insects (i.e., control of mosquitoes, termites, ticks, etc.).</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>Recognize that there are many different kinds of vertebrates in the world. One way to sort or group vertebrates is according to the structure and function of their skeletons (i.e., bird wings and human arms).</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p>Recognize that technology extends the sense of sight for observing bones, muscles and joints in greater detail (i.e., X-Rays).</p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 4-5

<p>Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?</p> <p>Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive?</p> <p>Essential Question: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>	
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</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>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>Building upon the K-3 expectations, all students in Grade 4 will be able to:</p>	<p>Building upon the K-4 expectations, all students in Grade 5 will be able to:</p>
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Compare the similarities and differences of offspring to their parents (e.g. crayfish, bean sprouts). Know that offspring receive characteristics from both parents.</p> <p>Recognize that some characteristics acquired by the parents are not inherited by the offspring (i.e., a lost claw does not mean offspring are born with only one claw).</p> <p>Construct the life cycle of a bean plant through the use of diagrams. Describe the plant in different stages of its life cycle from seed, to seedling, to mature plant, to death, and explain how the structures of the plant change over time. Recognize that these stages of the life cycle are predictable and describable.</p> <p>Research the life cycle of an organism. Diagram the life cycle of the organism and describe how the organism changes over time. Compare the life cycle of this organism to the life cycle of various other organisms. Recognize that all organisms go through a life cycle.</p> <p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Describe how similar structures found on different organisms (e.g., eyes, ears, mouths) have similar functions and enable those organisms to survive and reproduce in different environments (e.g., eyes of owls versus eyes of crustaceans).</p> <p>Recognize that there are variations among organisms of the same kind. Observe organisms of the same kind and describe how their physical appearances differ.</p>	<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Identify plants and animals in an ecosystem (i.e., beach, woodland, marsh, meadow). Examine the life cycles of the plants and animals and identify factors in the ecosystem that are beneficial or harmful to the organisms at various stages in its life cycle (i.e., young fish are small which makes them able to hide in plants, but this characteristic also makes them more vulnerable to predators).</p> <p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Recognize that there are many different kinds of vertebrates and invertebrates in the world’s ecosystem with a diverse variety of organisms in each group.</p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 4-5

<p>Essential Questions: Why do offspring resemble their parents? How do organisms change as they go through their life cycles?</p> <p>Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive?</p> <p>Essential Question: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>	
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</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>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>Building upon the K-3 expectations, all students in Grade 4 will be able to:</p>	<p>Building upon the K-4 expectations, all students in Grade 5 will be able to:</p>
<p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p>Explore how plants are grown using hydroponics. Identify the benefits of hydroponic agriculture in meeting human wants and needs.</p> <p>Observe seeded and seedless varieties of fruits (i.e., watermelon). Provide reasoning for why seedless fruits have been developed by scientists.</p>	<p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p><i>There are no grade level expectations for this understanding. They are incorporated into Standards 8 where prior knowledge of diversity and continuity of life is critical.</i></p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 6-8

<p>Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?</p> <p>Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? How does natural selection encourage inter and intra-specific diversity over time?</p> <p>Essential Questions: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>		
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p>		
<p>Building upon the K-5 expectations, all students in Grade 6 will be able to:</p>	<p>Building upon the K-6 expectations, all students in Grade 7 will be able to:</p>	<p>Building upon the K-7 expectations, all students in Grade 8 will be able to:</p>
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p><i>There are no grade level expectations for this understanding. They are incorporated into Standard 6 where prior knowledge of structure/function is critical.</i></p>	<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Recognize that reproduction is a process that occurs in all living systems and is essential to the continuation of the species. Use models or diagrams to identify the structures of a flowering plant that produce eggs and sperm and explain that plants, as well as, animals can reproduce sexually.</p> <p>Given varied scenarios (including one or two parent reproduction, and having traits identical to or different than the parents), classify offspring as either sexually or asexually produced and justify your response.</p> <p>Compare and contrast asexual and sexual reproduction in terms of potential variation and adaptation to a static or changing environment. Relate advantages and/or disadvantages of each strategy.</p> <p>Make a simple labeled drawing of human reproductive cells. Indicate that the sex cells (sperm and egg) each have half of the chromosomal number (23) as a fertilized egg (46). The fertilized egg has the same number of chromosomes as each of the body cells of the new organism. Recognize that different organisms may have different numbers of chromosomes and that the number of chromosomes does not relate to the complexity of the organism.</p>	<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Relate the advantages and disadvantages of different reproductive strategies in terms of energy expenditure per offspring and survival rates of that offspring.</p> <p>Research and report on reproductive strategies of different organisms (i.e., broadcast spawning versus nurturing parenting) that allow them to be successful.</p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 6-8

Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?

Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? How does natural selection encourage inter and intra-specific diversity over time?

Essential Questions: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?

Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.

Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.

Building upon the K-5 expectations, all students in **Grade 6** will be able to:

Building upon the K-6 expectations, all students in **Grade 7** will be able to:

Building upon the K-7 expectations, all students in **Grade 8** will be able to:

- Make a simple labeled drawing of asexual reproduction as it occurs in sexually produced organisms at the cellular level. Indicate that resulting cells contain an identical copy of genetic information from the parent cell.

- Describe the relationship between genes, chromosomes, and DNA in terms of location and relative size.

- Explain how the sex chromosomes inherited from each parent determines the gender of the offspring.

- Model a random process (e.g., coin toss) that illustrates which alleles can be passed from parent to offspring.

- Use single trait Punnett squares to examine the genotypes of individuals and indicate which individuals will express dominant or recessive traits. Justify the indication by relating that dominant alleles appearing heterozygously or homozygously are expressed or that two recessive alleles (homozygous) are required for an offspring to express a recessive trait phenotypically.

- Use pedigrees to illustrate the heritability of dominant and recessive alleles over several generations.

- Research and report on the contributions of Gregor Mendel and other genetic researchers and how their contributions altered the body of scientific knowledge.

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 6-8

<p>Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?</p> <p>Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? How does natural selection encourage inter and intra-specific diversity over time?</p> <p>Essential Questions: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>		
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p>		
<p>Building upon the K-5 expectations, all students in Grade 6 will be able to:</p>	<p>Building upon the K-6 expectations, all students in Grade 7 will be able to:</p>	<p>Building upon the K-7 expectations, all students in Grade 8 will be able to:</p>
<p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Recognize that fossils indicate that many organisms that lived long ago are extinct. Use index fossils to determine the relative age of rock sequences, and environmental conditions at the time of formation. Recognize, through fossil evidence, that some species can be traced back in geologic time.</p>	<p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Explain through the use of models or diagrams, why sexually-produced offspring are not identical to their parents.</p> <p>Identify “kingdom” as the first main level of the standard classification system. Observe a variety of living organisms and determine into which kingdom they would be classified.</p>	<p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Recognize that species acquire many of their unique characteristics through biological adaptations, which involve the selection of naturally occurring variations in populations.</p> <p>Observe a variety of organisms and explain how a specific trait could increase an organism’s chances of survival.</p> <p>Explain how the extinction of a species occurs when the environment changes and the adaptation of a species is insufficient to allow for its survival.</p> <p>Conduct a natural selection simulation to demonstrate how physical adaptations (i.e., protective camouflage, long neck for food gathering, muscular legs for running, heavy beak for nut cracking, etc.) have selective advantages for an organism. Research and report on beneficial physical adaptations of a variety of organisms.</p> <p>Investigate and discuss how short-term physiological changes of an organism (e.g., skin tanning, muscle development, formation of calluses) differ from long-term evolutionary adaptations (e.g., white coloration of polar bears, seed formation in plants) that occur in populations of organisms over generations.</p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 6-8

<p>Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?</p> <p>Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? How does natural selection encourage inter and intra-specific diversity over time?</p> <p>Essential Questions: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?</p>		
<p>Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.</p> <p>Enduring Understanding: The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p>		
<p>Building upon the K-5 expectations, all students in Grade 6 will be able to:</p>	<p>Building upon the K-6 expectations, all students in Grade 7 will be able to:</p>	<p>Building upon the K-7 expectations, all students in Grade 8 will be able to:</p>
<p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p><i>There are no grade level expectations for this understanding.</i></p>	<p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.</p> <p>Research and report on selective breeding. Select an organism (e.g., race horses, pedigree dogs, drought resistant plants) and trace its history of development and the traits of the plant or animal that were enhanced by selective breeding.</p> <p>Recognize that the health profession uses pedigree charts to trace genetic disorders in past generations make predictions for future generations. Research and report on a chromosomal disorder. Complete a simulated pedigree for a fictional family based on your research.</p>	<p>Conduct simulations to investigate how organisms fulfill basic needs (i.e., food, shelter, air, space light/dark, and water) in a competitive environment. Relate how competition for resources can determine survival.</p> <p>Examine an assortment of plants and animals and use simple classification keys, based on observable features, to sort and group the organisms.</p> <p>Identify a variety of reasons for extinction of a species. Use research on a variety of extinct organisms to speculate causes of extinction (i.e., inability to adapt to environmental changes).</p> <p>Enduring Understanding: The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs</p> <p><i>There are no grade level expectations for this understanding.</i></p>

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 9-12

Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?

Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? How does natural selection encourage inter and intra-specific diversity over time?

Essential Questions: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?

Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

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.

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.

Building upon the K-9 expectations, all students in **Grade 10** will be able to:

Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

Describe the relationship between DNA, genes, chromosomes and proteins.

Explain that a gene is a section of DNA that directs the synthesis of a specific protein associated with a specific trait in an organism.

Trace how a DNA sequence, through transcription and translation, results in a sequence of amino acids.

Demonstrate that when DNA replicates, the complementary strands separate and the old strands serve as a template for the new complementary strands. Recognize that this results in two identical strands of DNA that are exact copies of the original.

Illustrate how a sequence of DNA nucleotides codes for a specific sequence of amino acids.

Use Punnett squares, including dihybrid crosses, and pedigree charts to determine probabilities and patterns of inheritance (i.e. dominant/recessive, co-dominance, sex-linkage, multi-allele inheritance).

Analyze a karyotype to determine chromosome numbers and pairs. Compare and contrast normal and abnormal karyotypes.

Explain how crossing over and Mendel's Laws of Segregation and Independent Assortment contribute to genetic variation in sexually reproducing organisms.

Describe how exposure to radiation, chemicals and pathogens can increase mutations.

Explain that mutations in the DNA sequence of a gene may or may not affect the expression of the gene. Recognize that mutations may be harmful, beneficial, or have no impact on the survival of the organism.

Explain how the type of cell (gamete or somatic) in which a mutation occurs determines heritability of the mutation.

Predict the possible consequences of a somatic cell mutation.

Describe the cell cycle as an orderly process that results in new somatic cells that contain an exact copy of the DNA that make up the genes and chromosomes found in the parent somatic cells.

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 9-12

Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?

Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? How does natural selection encourage inter and intra-specific diversity over time?

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Enduring Understanding: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

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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.

Building upon the K-9 expectations, all students in **Grade 10** will be able to:

Explain how the cell cycle contributes to reproduction and maintenance of the cell and/or organism.

Recognize that during the formation of gametes, or sex cells (meiosis), the number of chromosomes is reduced by one half, so that when fertilization occurs the diploid number is restored.

Explain why sex-linked traits are expressed more frequently in males.

Compare and contrast the processes of growth (cell division) and development (differentiation).

Recognize that any environmental factor that influences gene expression or alteration in hormonal balance may have an impact on development.

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.

Recognize random mutation (changes in DNA) and recombination within gametes as the sources of heritable variations that give individuals within a species survival and reproductive advantage or disadvantage over others in the species.

Analyze natural selection simulations and use data generated from them to describe how environmentally-favored traits are perpetuated over generations resulting in species survival, while less favorable traits decrease in frequency or may lead to extinction.

Explain how biochemical evidence, homologous structures, embryological development and fossil evidence support or refute prior hypotheses of common ancestry.

Describe that evolution involves changes in the genetic make-up of whole populations over time, not changes in the genes of an individual organism.

Explain how species evolve through descent with modification, thus allowing them to adapt to different environments.

Discuss how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process. Recognize that a change in a species over time does not follow a set pattern or timeline.

Compare and contrast the role of sexual selection to the role of natural selection on the evolutionary process.

Standard 7: Diversity and Continuity of Living Things, Grade Level Expectations Grades 9-12

Essential Questions: Why do offspring resemble their parents? What are the advantages and disadvantages of different reproductive strategies? How do organisms change as they go through their life cycles?

Essential Questions: How are organisms of the same kind different from each other? How does this help them reproduce and survive? How does natural selection encourage inter and intra-specific diversity over time?

Essential Questions: How does the understanding and manipulation of genetics, reproduction, development and evolution affect the quality of human life?

Enduring Understandings: Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

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.

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.

Building upon the K-9 expectations, all students in **Grade 10** will be able to:

Relate a population's survival to the reproductive success of adapted individuals in that population.

Explain the roles of geographical isolation and natural selection on the evolution of new species.

Predict possible evolutionary implications for a population due to environmental changes over time (e.g., volcanic eruptions, global climate change, industrial pollution).

Explain why homogeneous populations may be more vulnerable to environmental changes than heterogeneous populations.

Explain how evolutionary relationships between species are used to group organisms together.

Explain how antibiotic resistance populations evolve from common bacterial populations.

Research how invasive species have genetically altered an indigenous population.

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.

Explain how DNA evidence can be used to determine evolutionary relationships.

Investigate how the human ability to manipulate genetic material and reproductive processes can be applied to many areas of medicine, biology, and agriculture. Evaluate the risks and benefits of various ethical, social and legal scenarios that arise from this ability.

Discuss examples of how genetic engineering technology can be applied in biology, agriculture and medicine in order to meet human wants and needs.

Explain the basic process of bacterial transformation and how it is applied in genetic engineering.

Explain how developments in technology (e.g., gel electrophoresis) have been used to identify individuals based on DNA as well as to improve the ability to diagnose genetic diseases.