Model Curriculum
Grade 8
Life Science (LS)

Topic: Species and Reproduction
This topic focuses on continuation of the species.

Content Statement
Reproduction is necessary for the continuation of every species.

Every organism alive today comes from a long line of ancestors who reproduced successfully every generation. Reproduction is the transfer of genetic information from one generation to the next. It can occur with mixing of genes from two individuals (sexual reproduction). It can occur with the transfer of genes from one individual to the next generation (asexual reproduction). The ability to reproduce defines living things.

Content Elaboration
Prior Concepts Related to Species and Reproduction
Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next.
Grades 6-7: Modern Cell Theory states cells come from pre-existing cells.

Grade 8 Concepts
An individual organism does not live forever. Reproduction is necessary for the continuation of every species. Most organisms reproduce either sexually or asexually. Some organisms are capable of both. In asexual reproduction, all genes come from a single parent, which usually means the offspring are genetically identical to their parent, allowing genetic continuity. Mitosis was investigated in grade 6. The end products of mitotic and meiotic cell divisions are compared as they relate to asexual and sexual reproduction. It is important that both mitosis and meiosis are addressed in preparation for future study of Mendelian genetics and embryology.

In sexual reproduction, a single specialized cell from a female (egg) merges with a specialized cell from a male (sperm). Typically, half of the genes come from each parent. The fertilized cell, carrying genetic information from each parent, multiplies to form the complete organism. The same genetic information is copied in each cell of the new organism. In sexual reproduction, new combinations of traits are produced which may increase or decrease an organism's chances for survival. Investigations and experimentation (3-D or virtual) must be used to compare offspring to parents in sexual and asexual reproduction.

Future Application of Concepts
High School: The details and importance of gamete formation are studied.

Expectations for Learning: Cognitive Demands
This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

Visions into Practice: Classroom Examples

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

Designing Technological/ Engineering Solutions using Science Concepts	Demonstrating Science Knowledge	Interpreting and Communicating Science Concepts	Recalling Accurate Science
Research cloning in the food industry. Select one practice and determine whether or not it is an environmentally healthy practice. Justify your position with scientific evidence. 	Examine offspring in plants that are produced sexually. Note and record variations that appear. Determine how the variations may help an organism to survive if the environment should change (e.g., warmer or cooler temperatures, increase or decrease in precipitation). 	Explain why genetic variation is a survival advantage. 	Describe the features of sexual and asexual reproduction related to the transfer of genetic information from parent to offspring. 

Instructional Strategies and Resources

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- Teachers' Domain: Reproduction is an online activity in which students explore the various ways that organisms reproduce.
- Teachers' Domain: Reproduction and Genetics is a two-session course that explores the cellular processes that organisms use to develop, reproduce and pass traits from one generation to the next.

Common Misconceptions

- Weber State University provides a list for misconceptions in biology. Scroll down to Standard IV to address misconceptions about reproduction.

Diverse Learners

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at this site. Resources based on the Universal Design for Learning principles are available at www.cast.org.

Classroom Portals

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

A Harvard case study on improving the teaching of science in real classrooms is available at http://www.learner.org/resources/series21.html?pop=yes&pid=1050. Nancy, an eighth-grade teacher, encourages students to work and think more on their own in her science class. This encourages true scientific inquiry and investigation at the student level.

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Content Statement
Diversity of species occurs through gradual processes over many generations. Fossil records provide evidence that changes have occurred in number and types of species.

Fossils provide important evidence of how life and environmental conditions have changed.

Changes in environmental conditions can affect how beneficial a trait will be for the survival and reproductive success of an organism or an entire species.

Throughout Earth's history, extinction of a species has occurred when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment. Most species (approximately 99 percent) that have lived on Earth are now extinct.

Note: Population genetics and the ability to use statistical mathematics to predict changes in a gene pool are reserved for grade 10.

Content Elaboration
Prior Concepts Related to Species and Reproduction
PreK-2: Living things have physical traits that enable them to live in different environments. Some kinds of individuals that once lived on Earth have completely disappeared, although they may be something like others that are alive today.
Grades 3-5: Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.
Grades 6-7: In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic conditions.

Grade 8 Concepts
The fossil record documents the variation in a species that may have resulted from changes in the environment. The fossil record is contained within the geologic record (ESS grade 8). Combining data from the geologic record and the fossil record, Earth's living history can be interpreted. Data and evidence from the fossil record must be used to develop further the concepts of extinction, biodiversity and the diversity of species.

Diversity can result from sexual reproduction. The sorting and combination of genes results in different genetic combinations, which allow offspring to be similar to, yet different from, their parents and each other. (This statement must be connected to the grade 8 Life Science content statement on reproduction and Mendelian Genetics.) These variations may allow for survival of individuals when the environment changes. Diversity in a species increases the likelihood that some individuals will have characteristics suitable to survive under changed conditions.

Evidence from geologic and fossil records can be used to infer what the environment was like at the time of deposition, The variations that exist in organisms can accumulate over many generations, so organisms can be very different in appearance and behavior from their distant ancestors.

Note 1: Molecular clocks are not appropriate at this grade level.
Note 2: The term "transitional form" should be used to describe parts of the fossil record that are incomplete.

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Visions into Practice: Classroom Examples

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Designing Technological/ Engineering Solutions using Science Concepts	Demonstrating Science Knowledge	Interpreting and Communicating Science Concepts	Recalling Accurate Science
Research a genetically modified organism (e.g., Bt corn) and make a recommendation whether or not it is harmful to the environment. Provide peer-reviewed scientific evidence to support your answer. Evaluate the validity of the scientific claims made by both proponents and opponents of using genetically modified organisms for food. 	Conduct a field study on a specific population of plants or animals in a local area. Examine members of that population and record variations in physical characteristics that can be seen (e.g., height, coloration, number of flowers). Predict which traits are more beneficial for survival in the population's current environment. Predict what variations may result in higher survival rates should the environment change (e.g., became warmer, colder, windy). 	Create a timeline that illustrates the relative ages of fossils of a particular organism in sedimentary rock layers. 	Describe how to determine the relative age of fossils found in sedimentary rock. 
		Graph data that indicates how the biodiversity in a particular biome or continent have changed over time. 	
		Examine organisms that are found in a variety of environments and others that have very specific habitats. Compare and contrast the ability of an organism to survive under different environmental conditions.	
		Explain why variation within a population can be advantageous for a population of organisms. 	

Instructional Strategies and Resources

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- The Annenberg Media series *Essential Science for Teachers: Life Science: Session 5* provides information on how children can learn about the variations of living things and offers classroom footage to illustrate implementation. Conduct an investigation to study adaptations of organisms and how they affect survival in a particular environment. Bottle biology offers a methodology for this investigation.
- The Missouri Botanical Garden helps students explore the world's biomes and their organisms. When students choose a biome or ecosystem, they discover a wide variety of information on plants, animals and their habitats.
- The Annenberg Media series *Essential Science for Teachers: Life Science: Session 6* provides information about how children can learn about the variations of living things that lead to evolution. It focuses on the development of a species.

Common Misconceptions

- Weber State University provides a list for misconceptions in biology. Scroll down to Standard IV to address misconceptions about pattern of inheritance.
- AAAS' Benchmarks 2061 Online, Chapter 15, 5f, *Evolution of Life*, states many students believe that environmental conditions are responsible for changes in traits or that organisms develop new traits because they need them to survive.

Diverse Learners

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Topic: Species and Reproduction

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Content Statement

The characteristics of an organism are a result of inherited traits received from parent(s).

Expression of all traits is determined by genes and environmental factors to varying degrees. Many genes influence more than one trait, and many traits are influenced by more than one gene.

During reproduction, genetic information (DNA) is transmitted between parent and offspring. In asexual reproduction, the lone parent contributes DNA to the offspring. In sexual reproduction, both parents contribute DNA to the offspring.

Note 1: The focus should be the link between DNA and traits without being explicit about the mechanisms involved.

Note 2: The ways in which bacteria reproduce is beyond the scope of this content statement.

Note 3: The molecular structure of DNA is not appropriate at this grade level.

Content Elaboration

Prior Concepts Related to Species and Reproduction

PreK-2: Offspring tend to look their parents.
Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next.
Grades 6-7: Modern Cell Theory states cells come from pre-existing cells.

Grade 8 Concepts

The traits of one or two parents are passed on to the next generation through reproduction. Traits are determined by instructions encoded in deoxyribonucleic acid (DNA), which forms genes. Genes have different forms called alleles. Introduce the principles of Mendelian genetics by reviewing Mendel's work. Mendel's two laws provide the theoretical base for future study of modern genetics. Mendel's first law, the Law of Segregation, and his second law, the Law of Independent Assortment, should be demonstrated and illustrated in a variety of organisms. The concepts of dominant and recessive genes are appropriate at this grade level. Codominant traits such as roan color in horses and cows may be useful to provide further validation of the theory and to help dispel some misconceptions. Pedigree analysis is appropriate for this grade level when limited to dominant, recessive or codominance of one trait. The Law of Independent Assortment should only be explored in simple cases of dominance and recessive traits. Chi-square and dihybrid crosses are reserved for high school.

Conduct a long-term investigation to analyze and compare characteristics passed on from parent to offspring through sexual and asexual reproduction. Ask questions about the phenotypes that appear in the resulting generations and what they infer about genotypes of the offspring.

Note: Myxobacteria reproduce by spore formation and streptomyces bacteria reproduce by budding.

Note: Incomplete dominance is not suggested for this grade level to help avoid the misconception of "blending of traits." Codominance is encouraged because both traits are expressed in the resulting offspring.

Future Application of Concepts

High School: The details and importance of gamete formation, the structure of DNA and modern genetics are studied.

Expectations for Learning: Cognitive Demands

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Designer dogs are developed to meet human needs. Investigate a number of breeds and explain the benefits and drawbacks of mixing the breeds. Make sure to examine several generations of dogs to determine the stability of the resulting hybrid. 	Design and implement an investigation to predict the genotype and phenotypes of offspring between plants of known heritage (e.g., Wisconsin Fast Plants™) 	Compare the exchange of genetic information during sexual and asexual reproduction. 	Describe how genes, chromosomes and inherited traits are connected. 
		Given the genetic characteristics of the parents, use a Punnett square to predict the genetic outcome of the offspring produced. 	Describe the characteristics and transfer of dominant and recessive traits. 

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- DNA from the Beginning explores aspects of Mendel's genetic experiments with animations. The Law of Segregation, the Law of Independent Assortment and the Law of Dominance are explained.
- The University of Utah's Genetic Learning Center offers *Tour of the Basics*, a tutorial that contains animations to explain heredity and its components. For this content area, focus on *What is Heredity?* and *What is a Trait?* Some areas of this site go beyond the scope of this grade-level content.
- The Canadian Museum of Nature's section called The GEEE! in Genome offers foundational information for heredity. Click on *The Basics* and then *Heredity and Reproduction* for activities to support the understanding of genetics.
- Teachers' Domain: Reproduction and Genetics is a two-session course that explores the cellular processes that organisms use to develop, reproduce and pass traits from one generation to the next.

Common Misconceptions

- Weber State University provides a list for misconceptions in biology. Scroll down to Standard IV to address misconceptions about patterns of inheritance.
- AAAS' Benchmarks 2061 Online, Chapter 15, 5b, *Heredity*, highlights that students think sexual reproduction results in traits being inherited from only one parent (e.g., the mother or same-sex parent). They also may believe that there is a "blending of characteristics" in offspring.

Diverse Learners

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