Unit 3-4 Life Science

Content Area: **Science**
Course(s): **Honors Science 8**
Time Period: **MP3-4**
Length: **MP3-4**
Status: **Published**

Essential Questions

- What are cells made of?
- Why don't offspring always look like their parents?
- What does DNA do?
- How can genetic information be used?
- How do life forms change over time?
- How does your body sense and react to your surroundings?
- How do species change over time and should we intervene?
- How are humans harming Earth, plants, and animals, and what can we do about it?

Big Ideas

- Living things are made of cells.
- Genetic information passes from parent to offspring.
- Living things change over time.
- Structures in living things are related to their functions.

CRLLKS- Career Education

9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

9.2.8.B.4 Evaluate how traditional and nontraditional careers have evolved regionally, nationally, and globally.

9.2.8.B.5 Analyze labor market trends using state and federal labor market information and other resources available online.

9.2.8.B.6 Demonstrate understanding of the necessary preparation and legal requirements to enter the workforce.

Connection:

Instruct students to include a section about career options that go along with their research project topic. Example, if the research topic is high cholesterol and its harmful effects, students should connect careers in

food science and/or in the medical field.

Cross-Curricular Integration

Integration Area: Language Arts

W.6.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

Activity:

Students will use CERs (Claim, Evidence & Reason) to explore Climate Change to show if students are able to convey their thinking and decision making in written form.

- Students will be answering the question, "What are causes of cancer and mutations?"
- Students provide evidence that supports their claim.
- Students will then write a reasoning that explains what their claim is, state knowledge they have on the topic, evidence to prove their topic, and close their reasoning with their claim again.

Integration Area: Math

8.EE.C.7.a Give linear equations in one variable.

Activity:

Students will take notes on a lesson about Punnett Squares which relates to probability, fractions, and percentages. Once Punnett Squares is taught, the students will work in groups to complete a worksheet on different scenarios relating to the possible outcomes of the offspring of varied traits of sexual reproductive parents: homozygous recessive and dominant as well as heterozygous.

Language Arts Companion Standards:

WHST 6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

RST 6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

RST 6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6-8 texts and topics*.

RST 6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of

that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Activity:

Water on Earth: One way in which NJ residents could help control the mosquito population is to eliminate or decrease the amount of standing water around their homes. Using evidence from one or more credible sources, explain why this procedure might be effective to reduce the mosquito population? Be sure to explain how this evidence supports your claim.

Crosscutting Concepts

Structure, Function and Information Proessing-Life Science

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (From Molecules to Organisms MS-LS1-7)
- Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (From Molecules to Organisms MS-LS1-6)

Growth Development and Reproduction of Organisms-Life Science

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems. (Heredity MS-LS3-2)

Structure and Function

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. (Heredity MS-LS3-1)

Natural Selection and Adaption-Life Science

Patterns

- Patterns can be used to identify cause and effect relationships. (Biological Evolution MS-LS4-2)
- Graphs, charts, and images can be used to identify patterns in data. (Biological Evolution MS-LS4-1, MS-LS4-3)

Cause and Effect

- Phenomena may have more than one cause, and some cause and effect relationships in systems can

only be described using probability. (Biological Evolution MS-LS4-4, MS-LS4-5, MS-LS4-6)

<u>Adapt or Die?</u>-Life Science

Patterns

- Patterns can be used to identify cause and effect relationships. (Ecosystems MS-LS2-2) (Biological Evolution MS-LS4-2)
- Graphs, charts, and images can be used to identify patterns in data. (Biological Evolution MS-LS4-1, MS-LS4-3)

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems. (From Molecules to Organisms MS-LS1-8) (Ecosystems MS-LS2-1) (Heredity MS-LS3-2)
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Scale, Proportion, and Quantity

- Phenomena that can be observed at one scale may not be observable at another scale. (From Molecules to Organisms MS-LS1-1)

Structure and Function

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (From Molecules to Organisms MS-LS1-2) (Heredity MS-LS3-1)

Stability and Change

- Small changes in one part of a system might cause large changes in another part. (Ecosystems MS-LS2-4, MS-LS2-5)

Using Engineering & Technology to Sustain our World-Engineering, Technology and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (Engineering Design MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (Engineering Design MS-ETS1-1)

Disciplinary Core Ideas

Structure, Function & Information Processing-Life Science

LS1.C: Organization for Matter and Energy Flow in Organisms (From Molecules to Organisms)

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)
- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)

Growth, Development and Reproduction of Organisms-Life Science

LS1.B: Growth and Development of Organisms (Heredity)

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS- LS3-2)

LS3.A: Inheritance of Traits (Heredity)

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

LS3.B: Variation of Traits (Heredity)

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

Natural Selection and Adapation-Life Science

LS4.A: Evidence of Common Ancestry and Diversity (Biological Evolution)

- The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)
- Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)
- Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)

LS4.B: Natural Selection (Biological Evolution)

- Natural selection leads to the predominance of certain traits in a population, and the suppression of others.(MS-LS4-4)
- In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring. (MS-LS4-5)

LS4.C: Adaptation (Biological Evolution)

- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)

Adapt or Die?-Life Science; Earth and Space Sciences

ESS1.C: The History of Planet Earth (Earth's Place in the Universe)

- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3)

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Using Engineering & Technology to Sustain Our World-Earth and Space Science; Life Science; Physical Science; Engineering, Technology and Applications of Science Engineering Design

ESS3.C: Human Impacts on Earth Systems (Earth and Human Activity)

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
- Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3, MS-ESS3-4)

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PS4.A: Wave Properties (Waves and Their Applications in Technologies for Information Transfer)

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)
- A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

PS4.B: Electromagnetic Radiation (Waves and Their Applications in Technologies for Information Transfer)

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

PS4.C: Information Technologies and Instrumentation (Waves and Their Applications in Technologies for

Information Transfer)

- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

ETS1.A: Defining and Delimiting an Engineering Problem (Engineering Design)

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3)

ETS1.B: Developing Possible Solutions (Engineering Design)

- A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3)

Diversity

Race and Ethnicity

Objective:

- Students should be able to identify the genetic diversity within the classroom.
- Students should be able to explain how genetic diversity relates to biodiversity.
- Students should be able to gather the information from their survey to find the population of students who carry specific traits.
- Students should be able to graph this information in a pie chart.

Activity:

Students will obtain a list of traits they need to look for within their class. They are to mingle and record the data on the phenotypes of the students.

They must determine if the traits they are recording are acquired or genetic.

They will use a tool to create polls and/or pie chart on their findings.

Science and Engineering Practices

MS. Structure, Function and Information Processing-Life Science

Developing and Using Models

- Develop and use a model to describe phenomena. (From Molecules to Organisms MS-LS1-2)
- Develop a model to describe unobservable mechanisms. (From Molecules to Organisms MS-LS1-7)

Planning and Carrying Out Investigations

- Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (From Molecules to Organisms MS-LS1-1)

Constructing Explanations and Designing Solutions

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (From Molecules to Organisms MS-LS1-6)

Engaging in Argument from Evidence

- Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (From Molecules to Organisms MS-LS1-3)

Obtaining, Evaluating, and Communicating Information

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (From Molecules to Organisms MS-LS1-8)

MS. Growth, Development, and Reproduction of Organisms-Life Science

Developing and Using Models

- Develop and use a model to describe phenomena. (Heredity MS-LS3-1, MS-LS3-2)

Obtaining, Evaluating, and Communicating Information

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (Biological Evolution MS-LS4-5)

MS. Natural Selection and Adaption-Life Science

Analyzing and Interpreting Data

- Analyze and interpret data to determine similarities and differences in findings. (Biological Evolution MS-LS4-1)
- Analyze displays of data to identify linear and nonlinear relationships. (Biological Evollution MS-LS4-3)

Constructing Explanations and Designing Solutions

- Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (Biological Evolution MS-LS4-2)

Using Mathematics and Computational Thinking

- Use mathematical representations to support scientific conclusions and design solutions. (Biological Evolution MS-LS4-6)

Adapt or Die?-Life Science

Developing and Using Models

- Develop and use a model to describe phenomena. (From Molecules to Organisms MS-LS1-2) (Ecosystems MS-LS2-3) (Heredity MS-LS3-1, MS-LS3-2)
- Develop a model to describe unobservable mechanisms. (From Molecules to Organisms MS-LS1-7)

Analyzing and Interpreting Data

- Analyze and interpret data to provide evidence for phenomena. (Ecosystems MS-LS2-1)
- Analyze displays of data to identify linear and nonlinear relationships. (Biological Evolution MS-LS4-3)
- Analyze and interpret data to determine similarities and differences in findings. (Biological Evolution MS-LS4-1)

Using Mathematics and Computational Thinking

- Use mathematical representations to support scientific conclusions and design solutions. (Biological Evolution MS-LS4-6)

Constructing Explanations

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (From Molecules to Organisms MS-LS1-5, MS-LS1-6) (Ecosystems MS-LS2-2)
- Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (Biological Evolution MS-LS4-2)
- Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (Biological Evolution MS-LS4-4)

Engaging in Argument from Evidence

- Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (From Molecules to Organisms MS-LS1-3)
- Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (From Molecules to Organisms MS-LS1-4)
- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (Ecosystems

MS-LS2-4)
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (Ecosystems MS-LS2-5)

Obtaining, Evaluating, and Communicating Information

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (From Molecules to Organisms MS-LS1-8) (Biological Evolution MS-LS4-5)

<u>Using Engineering & Technology to Sustain Our World</u>-Engineering, Technology and Applications of Science

Asking Questions and Defining Problems

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (Engineering Design MS-ETS1-1)

Developing and Using Models

- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (Engineering Design MS-ETS1-4)

Engaging in Arguments from Evidence

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (Engineering Design MS-ETS1-2)

Science and Society

Robert Hooke

The cell was first discovered and named by Robert Hooke in 1665. He remarked that it looked strangely similar to ‘cellula’ or small rooms which monks inhabited, thus deriving the name.

Theodor Schwann

Schwann demonstrated that animal tissues contained cells, and in 1839 concluded that all tissues are made up of cells: this laid the foundations for the cell theory. Combined with Schleiden’s findings of plant tissue containing cells, they concluded that all living things are made up of cells and that cells are the basic units of life.

Robert Virchow

Concluded that all cells come from pre-existing cells

Antonie Van Leeuwenhoek

The first to observe living bacteria and protista.

Gregor Mendel

Discovered the basic principles of genetics concerning dominant and recessive traits within pea plants. He also proved that traits undergo independent assortment; traits are able to separate from each other.

Rosalind Franklin

Rosalind Franklin was a chemical physicist (1920–1958), who used x-ray diffraction to determine the structure of DNA.

Francis Crick and James Watson

Crick and Watson, together with Maurice Wilkins, won the 1962 Nobel Prize in Medicine for their discovery of the structure of DNA. Watson and Crick created the first accurate 3D model of DNA.

Charles Darwin

English naturalist whose scientific theory of evolution by natural selection became the foundation of modern evolutionary studies. Darwin stated that animals and humans shared a common ancestor.

Tasks

Adapt or Die?

Task 1 – The Fossil Record and Geologic Time Scale - students will examine the evidence we have that all species have changed over Earth's long history and why.

Task 2 – Evidence of Change Over Time - students continue their reconstruction of evolutionary history, by looking at two more kinds of evidence that scientists use to infer lines of evolutionary descent: anatomical structures and embryos of different organisms.

Task 3 – Natural Selection - Students engage in a simulation of natural selection,

generating data they can use to mathematically calculate the percentages of different traits.

Task 4 – Human Intervention - students explore ways in which humans have intervened in these natural processes through selective breeding and genetic engineering.

Using Engineering & Technology to Sustain Our World

Task 1 – Human Population and Resource Consumption- students explore this phenomenon in more depth by looking not just at evidence that there are impacts, but also why there are these impacts.

Task 2 – Effects of Environmental Change on Biodiversity- students examine

how different populations of organisms are affected by human activity, explaining what is happening in terms of natural selection.

Task 3 – Waves and Energy- students are introduced to types of waves that are able to travel through a medium, like water waves and sound waves.

Task 4 – Wave Interactions- students use the contexts of sound waves and light waves to explore how they behave when confronted with different materials.

Task 5 – Using Waves to Communicate Information- students are introduced to satellite

images that monitor Earth's changing landscape due to human activity and explore digital and analog waves in order to decide which would be better to communicate information.

CSDT Technology Integration

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.

8.1.8.A.2 Create a document (e.g. newsletter, reports, personalized learning plan, business letters or flyers) using one or more digital applications to be critiqued by professionals for usability.

Activity:

Students will create a model of the cell. Within the model, students will need to create a key table, identifying the name of the organelle, the image of that organelle in their model, an accurate description of the function of that organelle, and the types of cells they are found in.

Activity:

Students will create a brochure using a template. The project will gather and make sense of information to describe what stem cells are, what they can do or treat, and what the moral pathways of making the treatment

possible. The end product will be a color, typed, and well-designed informative brochure on one stem cell treatment specific to an ailment. Projects will be graded based on a rubric.

Enduring Understandings

MS. From Molecules to Organisms: Structures and Processes

MS-LS1-1 Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers or types of cells.

MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and the ways parts of cells contribute to the function of a whole cell.

MS-LS1-3 Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

MS. Heredity: Inheritance and Variation of Traits

MS-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial or neutral effects to the structure and function of the organism.

MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring results with identical genetic information and sexual reproduction results in offspring with genetic variation.

MS. Biological Evolution: Unity and Diversity

MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Natural Selection and Adaption

MS. Biological Evolution: Unity and Diversity

MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary

relationships.

MS-LS4-3 Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.

MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

MS-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Adapt or Die?

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MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

MS-LS1-3 Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

MS-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS. Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological

components of an ecosystem affect populations.

MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

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MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

MS-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

MS. Earth's Systems

MS-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Using Engineering & Technology to Sustain our World

MS. Engineering Design

MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

MS. Earth and Human Activity

MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

MS. Biological Evolution: Unity and Diversity

MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

Energy

MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Focus Areas

Introduction to Cells

- Cells are the basic units of structure and function in living things.
- All living things are composed of cells, and all cells come from other cells.
- Some microscopes focus light through lenses to produce a magnified image, and other microscopes use beams of electrons.
- Each kind of cell structure has a different function within a cell.
- In multicellular organisms, cells are organized into tissues, organs, and organ systems.
- Elements are the simplest substances. Compounds form when elements combine.
- Important compounds in living things include carbohydrates, lipids, proteins, nucleic acids, and water.
- Substances move into and out of a cell by of two processes: passive transport or active transport.

Cell Processes and Energy

- Cell division allows organisms to grow, repair damaged structures, and reproduce.
- During the cell cycle, a cell grows, prepares for division, and divides into two new cells, which are called "daughter cells".
- Cellular Respiration is essential in the cycling of matter and flow of energy into and out of an organism.

- Most cells exchange oxygen and carbon dioxide with their surroundings by diffusion across the outer coverings, or membranes of cells.

Genetics: The Science of Heredity

- In all of his crosses, Mendel found that only one form of the trait appeared in the F1 generation. However, in the F2 generation, the "lost" form of the trait always reappeared in about one fourth of the plants.
- An organism's traits are controlled by the alleles it inherits from its parents. Some alleles are dominant, while other alleles are recessive.
- In a genetic cross, the combination of alleles that parents can pass to an offspring is based on probability.
- An organism's phenotype is its physical appearance, or visible traits. An organism's genotype is its genetic makeup, or alleles.
- Most traits are the result of complex patterns of inheritance.
- Environmental factors can influence the way genes are expressed.
- The chromosome theory of inheritance states that genes pass from parents to their offspring on chromosomes.
- Meiosis produces sex cells that have half as many chromosomes as body cells.

DNA: The Code of Life

- The order of the nitrogen bases along a gene forms a genetic code that specifies what type of protein will be produced.
- During protein synthesis, the cells use information from a gene on a chromosome to produce a specific protein.
- Mutations can cause a cell to produce an incorrect protein during protein synthesis. As a result, the organism's trait may be different from what it normally would be.
- Cancer begins when mutations disrupt the normal cell cycle, causing cells to divide in an uncontrolled way.

Human Genetics and Genetic Technology

- Some human traits are controlled by single genes with two alleles, and others by single genes with multiple alleles. Still other traits are controlled by many genes that act together.
- The sex chromosomes carry genes that determine whether a person is a male or female. They also carry genes that determine other traits.
- Some genetic disorders are caused by mutations in the DNA of genes. Other disorders are caused by changes in the overall structure or number of chromosomes.
- Today, doctors use tools such as pedigrees, karyotypes, and genetic testing to help trace and diagnose genetic disorders. People with genetic disorders are helped through medical care, education, and job training.
- Selective breeding, cloning, and genetic engineering are three methods for developing organisms with desired traits.
- Genetic information can be used positively to identify individuals and to learn about health and disease, or negatively to discriminate against people.

Change Over Time

- Darwin hypothesized that species change over many generations and become better adapted to new conditions.

- Darwin proposed that, over a long time, natural selection can lead to change. Helpful variations may accumulate in a species, while unfavorable ones may disappear.
- Fossils, patterns of early development, similar body structures, and similarities in DNA and protein structures all provide evidence that organisms have changed over time.
- A new species can form when a group of individuals remain isolated from the rest of its species long enough to evolve different traits that prevent reproduction.
- The Nervous System
- Your nervous system receives information about what is happening both inside and outside your body. It directs how your body responds to this information and helps maintain homeostasis.
- Cells that carry information through your nervous system are called neurons, or nerve cells.
- Each sense receptor responds to different inputs (electromagnetic, mechanical, and chemical).
- The signals are then processed in the brain, resulting in immediate behaviors or memories.

*See Appendix E for Cross Content

Climate Change

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

- Activity: Students will be able to explain the process of photosynthesis and how organisms use energy from light to make sugars from carbon dioxide and water. Students will demonstrate their understanding of photosynthesis by completing a diagram showing the process from light energy absorption to sugar production in plants.

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

- Activity: Students will be able to explain the process of photosynthesis and how organisms use energy from light to make sugars from carbon dioxide and water. Students will demonstrate their understanding of photosynthesis by completing a diagram showing the process from light energy absorption to sugar production in plants.

MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

- Activity: Students will be able to explain the process of photosynthesis and how organisms use energy from light to make sugars from carbon dioxide and water. Students will include human activities in this process as well as how it effects other aspects of the process. For example: deforestation and its effects on the environment. Students will demonstrate their understanding of photosynthesis by completing a diagram showing the process from light energy absorption to sugar production in plants.

MS-ESS2-1: Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process.

- Activity: Develop a model that describes the cycling of Earth's materials and the flow of energy that drives the process, with a focus on photosynthesis. Create a detailed diagram or 3D model that illustrates the cycling of Earth's materials in photosynthesis and the flow of energy through these

cycles.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

- Activity: Service day(s): students will first research how to help save their selected species of endangered/threatened organisms in New Jersey. With that knowledge, students will survey the school property and their town to look for areas that their species would prefer the most. The students will take note to revisit once their plan is in place on how to help them. Students can video record their findings and show people at home how to find common locations where their chosen species resides and can most often be found. Students will also research how to create or improve the environment to encourage natural food sources. Students will build these environments or show how to create an environment that attracts these threatened/endangered species to Milltown. It is encouraged that the students set up these structures in their backyards or on school property depending on feasibility and permission. Students will scout out the environment to see where these environmental components can be placed on school grounds, if acceptable.

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

- Activity: Service day(s): students will first research how to help save their selected species of endangered/threatened organisms in New Jersey. With that knowledge, students will survey the school property and their town to look for areas that their species would prefer the most. The students will take note to revisit once their plan is in place on how to help them. Students can video record their findings and show people at home how to find common locations where their chosen species resides and can most often be found. Students will also research how to create or improve the environment to encourage natural food sources. Students will build these environments or show how to create an environment that attracts these threatened/endangered species to Milltown. It is encouraged that the students set up these structures in their backyards or on school property depending on feasibility and permission. Students will scout out the environment to see where these environmental components can be placed on school grounds, if acceptable. Students will show real numbers in their data.

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

- Activity: Service day(s): students will first research how to help save their selected species of endangered/threatened organisms in New Jersey. With that knowledge, students will survey the school property and their town to look for areas that their species would prefer the most. The students will take note to revisit once their plan is in place on how to help them. Students can video record their findings and show people at home how to find common locations where their chosen species resides and can most often be found. Students will also research how to create or improve the environment to encourage natural food sources. Students will build these environments or show how to create an environment that attracts these threatened/endangered species to Milltown. It is encouraged that the students set up these structures in their backyards or on school property depending on feasibility and permission. Students will scout out the environment to see where these environmental components can be placed on school grounds, if acceptable. Students will use real numbers, integers, and rational numbers in their data.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

- Activity: Service day(s): students will first research how to help save their selected species of endangered/threatened organisms in New Jersey. With that knowledge, students will survey the school property and their town to look for areas that their species would prefer the most. The students will take note to revisit once their plan is in place on how to help them. Students can video record their findings and show people at home how to find common locations where their chosen species resides and can most often be found. Students will also research how to create or improve the environment to encourage natural food sources. Students will build these environments or show how to create an environment that attracts these threatened/endangered species to Milltown. It is encouraged that the students set up these structures in their backyards or on school property depending on feasibility and permission. Students will scout out the environment to see where these environmental components can be placed on school grounds, if acceptable.

MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved.

- Activity: Service day(s): students will first research how to help save their selected species of endangered/threatened organisms in New Jersey. With that knowledge, students will survey the school property and their town to look for areas that their species would prefer the most. The students will take note to revisit once their plan is in place on how to help them. Students can video record their findings and show people at home how to find common locations where their chosen species resides and can most often be found. Students will also research how to create or improve the environment to encourage natural food sources. Students will build these environments or show how to create an environment that attracts these threatened/endangered species to Milltown. It is encouraged that the students set up these structures in their backyards or on school property depending on feasibility and permission. Students will scout out the environment to see where these environmental components can be placed on school grounds, if acceptable. Students will include in their data the relative populations of their researched organism. Students can design the habitat that would help the population numbers of their organisms the best.

Resources

Scientific Inquiry

MS-LS1-1 Plant, Animal, Bacteria Lab
MS-LS1-2 Cell Organelle Project - Inner Life of a Cell Multiple Project Choice, 2D Cell Project, 3D Cell Project
MS-LS3-1 Strawberry DNA Lab
MS-LS4-5 Technologies that Influence Inheritance of Traits
MS-LS4-1 Investigating Natural Selection
MS-LS4-3 Comparative Embryology