### Unit Big Ideas/Understandings:
- What is the universe, and what goes on in the stars?
- What are the predictable patterns caused by Earth’s movement in the solar system?
- How do people reconstruct and date events in Earth’s planetary history?

### Unit Essential Questions:
- What is the universe, and what is Earth’s place in it?

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<thead>
<tr>
<th>Content</th>
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<tbody>
<tr>
<td>Demonstrate and predict the sequence of events in the lunar cycle</td>
<td>MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.</td>
<td>Patterns</td>
</tr>
<tr>
<td>Describe the physical properties of the planets and their locations. Describe the movements of the sun, the planets, and the Galilean moons.</td>
<td>MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.</td>
<td>Scale, Proportion, and Quantity</td>
</tr>
<tr>
<td>Model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun causing changes in season.</td>
<td>MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.</td>
<td>Systems and System Models</td>
</tr>
<tr>
<td></td>
<td>MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth’s 4.6-billion-year-old history.</td>
<td></td>
</tr>
</tbody>
</table>
## Middle School Science

### 8th Grade Earth Science

#### Unit Big Ideas/Understandings
- How do Earth’s major systems interact?
- Why the continents move, and what causes earthquakes and volcanoes?
- How do properties and movements of water shape Earth’s surface?
- What regulates weather and climate?

### Unit 2: Earth's Systems

#### Unit Essential Questions
- How and why is the Earth constantly changing?

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Describe the historical developments that support the plate tectonic theory.</td>
<td>MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.</td>
</tr>
<tr>
<td>Relate plate tectonics to the formation of crustal features.</td>
<td>MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.</td>
</tr>
<tr>
<td>Describe and illustrate the structural layers of the Earth.</td>
<td>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.</td>
</tr>
<tr>
<td>Analyze the effects of weathering, erosion, and deposition on the environments in our region.</td>
<td>MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.</td>
</tr>
<tr>
<td>Classify rocks as metamorphic, igneous, or sedimentary by the process of their formation.</td>
<td>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.</td>
</tr>
<tr>
<td></td>
<td>MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.</td>
</tr>
</tbody>
</table>

#### Crosscutting Concepts

- **Systems and System Models**
  - Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

- **Energy and Matter**
  - Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
Middle School Science

8th Grade Earth Science

Unit Big Ideas/Understanding
- How do humans depend on Earth’s resources?
- How do natural hazards affect individuals and societies?
- How do humans change the planet?
- How do people model and predict the effects of human activities on Earth’s climate?

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| Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. | MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. 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-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. | Patterns
- Graphs, charts, and images can be used to identify patterns in data. Cause and Effect
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
- Cause and effect relationships may be used to predict phenomena in natural or designed systems |

Unit Essential Questions
- How do the Earth’s surface process and human activities affect each other?
# Middle School Science

## 8th Grade Earth Science

### Unit Big Ideas/Understandings
- The goal for middle school students is to define problems more precisely, to conduct a more thorough process of choosing the best solution, and to optimize the final design.

## Unit 4: Engineering Design

### Unit Essential Questions
- How can you ask a question, develop and create a model, analyze and interpret the data, to solve a real-world problem?

### Content
- Defining the problem involves thinking more deeply than is expected to address the goals a design is intended to reach. Students are expected to consider the end user as well as the broader society and the environment.
- The focus on developing a two stage process of evaluating the different ideas proposed to determine which solutions are the most promising.
- Improving designs involves an iterative process in which students test the best design, analyze the results, and modify the design accordingly. Students may go through this cycle many more times in order to reach the optimal result.

### Standards
- **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-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- **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.

### Crosscutting Concepts
- **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.
  - 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.
<table>
<thead>
<tr>
<th>Unit Big Ideas/Understandings</th>
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</table>
| • How do the structures of organisms enable life’s functions?  
• How do organisms grow and develop?  
• How do organisms obtain and use the matter and energy they need to live and grow? | • How do organisms live, grow, respond to their environment and reproduce? |

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| All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).  
Within cells, special structures are responsible for particular functions  
Construct a scientific explanation based on evidence that radiant energy from the Sun is converted into chemical energy through the process of photosynthesis. | MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.  
MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.  
MS-LS1-3. Use argument 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. | Systems and System Models  
• Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.  
Energy and Matter  
• Matter is conserved because atoms are conserved in physical and chemical processes.  
• Within a natural system, the transfer of energy drives the motion and/or cycling of matter. |
## Unit Big Ideas/Understandings
- How do organisms interact with the living and nonliving environments to obtain matter and energy?
- How do matter and energy move through an ecosystem?
- What happens to ecosystems when the environment changes?
- How do organisms interact in groups to benefit individuals?

## Unit Essential Questions
- How do organisms interact with their environment?

## Content Standards

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<tbody>
<tr>
<td>Describe biotic and abiotic parts of an ecosystem in which organisms interact.</td>
<td>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.</td>
</tr>
<tr>
<td>Investigate how organisms and populations in an ecosystem depend on and my compete for biotic and abiotic factors</td>
<td>MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.</td>
</tr>
<tr>
<td>Diagram the flow of energy through living systems, including food chains and food webs.</td>
<td>MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.</td>
</tr>
<tr>
<td>Describe food webs within marine, freshwater, and terrestrial ecosystems.</td>
<td>MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.</td>
</tr>
<tr>
<td>Describe how biodiversity contributes to the sustainability of an ecosystem</td>
<td>MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</td>
</tr>
</tbody>
</table>

## Crosscutting Concepts
- **Patterns**
  - Patterns can be used to identify cause and effect relationships.
- **Cause and Effect**
  - Cause and effect relationships may be used to predict phenomena in natural or designed systems.
- **Energy and Matter**
  - The transfer of energy can be tracked as energy flows through a natural system.
- **Stability and Change**
  - Small changes in one part of a system might cause large changes in another part.
# Unit 3: Heredity: Inheritance and Variation of Traits

## Unit Big Ideas/Understandings
- **How are the characteristics of one generation related to the previous generation?**
- **Why do individuals of the same species vary in how they look, function, and behave?**

## Unit Essential Questions
- **How are characteristics of one generation passed to the next?**
- **How can individuals of the same species and even siblings have different characteristics?**

## Content

Recognize that inherited traits of individuals are governed in the genetic material found in genes within the chromosomes in the nucleus. Using Punnett Squares describe the cause and effect relationship of gene transmission from the parents to offspring and the resulting genetic variations. Compare and contrast sexual and asexual reproduction, including uniform and diverse offspring. Describe the advantages and disadvantages of each type of reproduction. Explain how genetic information is altered through mutations.

## Standards

**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 with identical genetic information and sexual reproduction results in offspring with genetic variation.

## Crosscutting Concepts

**Cause and Effect**
- Cause and effect relationships may be used to predict phenomena in natural systems.

**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 structures/systems can be analyzed to determine how they function.
# Middle School Science

## 7th Grade Earth Science

### Unit Big Ideas/Understandings
- What evidence shows that different species are related?
- How does genetic variation among organisms affect survival?
- How does the environment influence populations of organisms of multiple generations?
- What is biodiversity, and how do humans affect it?

### Unit Essential Questions
- How can there be so many similarities among organisms yet so many different kinds of plants & animals?

## Content

- Identify some changes in genetic traits that have occurred over several generations through natural selection and selective breeding such as the Galapagos Medium Ground Finch or domestic animals.

- Describe how biodiversity contributes to the sustainability of an ecosystem.

## Standards

- **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-LS4-5.** Gather and synthesize information about 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.

## Crosscutting Concepts

- **Patterns**
  - Patterns can be used to identify cause and effect relationships.
  - Graphs, charts, and images can be used to identify patterns in data.

- **Cause and Effect**
  - Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
## Unit Big Ideas/Understandings
- How do particles combine to form the variety of matter?
- How do substances combine to make new substances?
- How does one characterize and explain these reactions and make predictions about them?

## Unit Essential Questions
- How can one explain the structure, properties, and interactions of matter?
## Middle School Science

### 6th Grade Physical Science

### Unit Big Ideas/Understandings
- *How can one predict an object's continued motion, change in motion, or stability?*
- *What underlying forces explain the variety of interactions observed?*
- *Why are some physical systems more stable than others?*

### Unit Essential Questions
- *How can one explain and predict interactions between objects and within systems of objects?*

### Content

- Investigate and describe applications of Newton’s 1st Law of Motion.
- Investigate and describe applications of Newton’s 2nd Law of Motion.
- Investigate and describe applications of Newton’s 3rd Law of Motion.
- Identify and describe the changes in position, direction, and speed of an object when acted upon by unbalanced forces.

### Standards

- **MS-PS2-1.** Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.
- **MS-PS2-2.** Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.
- **MS-PS2-3.** Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
- **MS-PS2-4.** Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
- **MS-PS2-5.** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

### Crosscutting Concepts

- **Cause and Effect**
  - Cause and effect relationships may be used to predict phenomena in natural or designed systems.

- **Systems and System Models**
  - Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.

- **Stability and Change**
  - Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.
## Middle School Science

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<thead>
<tr>
<th>Unit Big Ideas/Understandings</th>
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<tbody>
<tr>
<td>• What is energy and the conservation of energy?</td>
<td>• How is energy transferred and conserved?</td>
</tr>
<tr>
<td>• How is energy transferred between objects or systems?</td>
<td></td>
</tr>
<tr>
<td>• How are forces related to energy?</td>
<td></td>
</tr>
<tr>
<td>• How do food and fuel provide energy?</td>
<td></td>
</tr>
</tbody>
</table>

### Content

- Demonstrate the transformation of energy from one form of energy to another.
- Measure and graph changes in motion.
- Interpret an object’s motion from a graph.
- Describe the characteristics that affect an object’s motion.
- Investigate how simple machines can be used to change the amount of force to move an object.
- Using data determine factors that affect the strength of electric and magnetic forces

### Standards

- **MS-PS3-1.** Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- **MS-PS3-2.** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- **MS-PS3-3.** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- **MS-PS3-4.** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
- **MS-PS3-5.** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

### Crosscutting Concepts

- **Scale, Proportion, and Quantity**
  - Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
- **Systems and System Models**
  - Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.
- **Energy and Matter**
  - Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion).
  - The transfer of energy can be tracked as energy flows through a designed or natural system.

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Pittsford Middle School
### Unit Big Ideas/Understandings
- What are characteristic properties and behaviors of waves?
- How are instruments that transmit and detect waves used to expand human senses?
- How can one explain the varied effects that involve light?

### Unit Essential Questions
- How are waves used to transfer energy and information?

### Content
- Describe how matter and energy interact when waves are generated.
- Distinguish between the three main types of mechanical waves.
- Identify the properties of waves.
- Compare the properties of waves that affect what we hear.
- Explain how sound waves travel.
- Compare and explain how an object’s material and light’s frequency affect the way light is reflected, absorbed or transmitted?
- Model how the frequency of light affects the color of an object.

### Standards
- 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.

### Crosscutting Concepts
- **Patterns**: Graphs and charts can be used to identify patterns in data.
- **Structure and Function**: Structures can be designed to serve functions by taking into account properties of different materials, and how materials can be shaped and used.
- Structures can be designed to serve particular functions.