# CURRICULUM

# FOR

# SCIENCE

# GRADE 7

This curriculum is part of the Educational Program of Studies of the Rahway Public Schools.


## ACKNOWLEDGMENTS

**Dr. Susan Dube, Program Supervisor of Science and Technology Education**

The Board acknowledges the following who contributed to the preparation of this curriculum.

**Anjanette Highsmith**

**Dr. Tiffany A. Beer, Director of Curriculum and Instruction**


Subject/Course Title:
**Science**
**Grade 7**

Date of Board Adoption:
**September 21, 2021**

**RAHWAY PUBLIC SCHOOLS CURRICULUM**

**Science Grade 7**

***PACING GUIDE***

| Unit | Title | Pacing |
|---|---|---|
| 1 | Forces and Motion | 5 weeks |
| 2 | Types of Interactions | 5 weeks |
| 3 | Relationships among Forms of Energy | 4 weeks |
| 4 | Stability and Change on Earth | 6 weeks |
| 5 | Human Impact | 5 weeks |
| 6 | Matter and Energy in Organisms and Ecosystems | 5 weeks |
| 7 | Interdependent Relationships in Ecosystems | 5 weeks |
| 8 | Organization for Matter and Energy Flow in Organisms | 3 weeks |

# *ACCOMMODATIONS*

**504 Accommodations:**

- Provide scaffolded vocabulary and vocabulary lists.
- Provide extra visual and verbal cues and prompts.
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages).
- Provide study sheets and teacher outlines prior to assessments.
- Quiet corner or room to calm down and relax when anxious.
- Reduction of distractions.
- Permit answers to be dictated.
- Hands-on activities.
- Use of manipulatives.
- Assign preferential seating.
- No penalty for spelling errors or sloppy handwriting.
- Follow a routine/schedule.
- Provide student with rest breaks.
- Use verbal and visual cues regarding directions and staying on task.
- Assist in maintaining an agenda book.

**IEP Accommodations:**

- Provide scaffolded vocabulary and vocabulary lists.
- Differentiate reading levels of texts (e.g., Newsela).
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide extra visual and verbal cues and prompts.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Provide students with additional information to supplement notes.
- Modify questioning techniques and provide a reduced number of questions or items on tests.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Provide study sheets and teacher outlines prior to assessments.
- Use of manipulatives.
- Have students work with partners or in groups for reading, presentations, assignments, and analyses.
- Assign appropriate roles in collaborative work.
- Assign preferential seating.
- Follow a routine/schedule.

**Gifted and Talented Accommodations:**

- Differentiate reading levels of texts (e.g., Newsela).
- Offer students additional texts with higher lexile levels.
- Provide more challenging and/or more supplemental readings and/or activities to deepen understanding.
- Allow for independent reading, research, and projects.
- Accelerate or compact the curriculum.
- Offer higher-level thinking questions for deeper analysis.
- Offer more rigorous materials/tasks/prompts.
- Increase number and complexity of sources.

**ELL Accommodations:**

- Provide extended time.
- Assign preferential seating.
- Assign a peer buddy who the student can work with.
- Check for understanding frequently.
- Provide language feedback often (such as grammar errors, tenses, subject-verb agreements, etc…).
- Have student repeat directions.
- Make vocabulary words available during classwork and exams.
- Use study guides/checklists to organize information.
- Repeat directions.

| | |
|---|---|
| ● Assign group research and presentations to teach the class.<br>● Assign/allow for leadership roles during collaborative work and in other learning activities. | ● Increase one-on-one conferencing.<br>● Allow student to listen to an audio version of the text.<br>● Give directions in small, distinct steps.<br>● Allow copying from paper/book.<br>● Give student a copy of the class notes.<br>● Provide written and oral instructions.<br>● Differentiate reading levels of texts (e.g., Newsela).<br>● Shorten assignments.<br>● Read directions aloud to student.<br>● Give oral clues or prompts.<br>● Record or type assignments.<br>● Adapt worksheets/packets.<br>● Create alternate assignments.<br>● Have student enter written assignments in criterion, where they can use the planning maps to help get them started and receive feedback after it is submitted.<br>● Allow student to resubmit assignments.<br>● Use small group instruction.<br>● Simplify language.<br>● Provide scaffolded vocabulary and vocabulary lists.<br>● Demonstrate concepts possibly through the use of visuals.<br>● Use manipulatives.<br>● Emphasize critical information by highlighting it for the student.<br>● Use graphic organizers.<br>● Pre-teach or pre-view vocabulary.<br>● Provide student with a list of prompts or sentence starters that they can use when completing a written assignment.<br>● Provide audio versions of the textbooks.<br>● Highlight textbooks/study guides.<br>● Use supplementary materials.<br>● Give assistance in note taking<br>● Use adapted/modified textbooks.<br>● Allow use of computer/word processor.<br>● Allow student to answer orally, give extended time (time-and-a-half).<br>● Allow tests to be given in a separate location (with the ESL teacher).<br>● Allow additional time to complete assignments and/or assessments.<br>● Read question to student to clarify.<br>● Provide a definition or synonym for words on a test that do not impact the validity of the exam.<br>● Modify the format of assessments.<br>● Shorten test length or require only selected test items.<br>● Create alternative assessments.<br>● On an exam other than a spelling test, don't take points off for spelling errors. |

## *UNIT OVERVIEW*

**Content Area:** Physical Science
**Unit Title:** Forces and Motion

**Target Course/Grade Level:** 7th

**Unit Summary:** Students use s*ystem and system models* and *stability and change* to understanding ideas related to why some objects will keep moving and why objects fall to the ground. Students apply Newton's third law of motion to related forces to explain the motion of objects. Students also apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of s*ystem and system models* and *stability and change* provide a framework for understanding the disciplinary core ideas

**Approximate Length of Unit:** 5 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science:**

- **MS-PS2-1**-Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
- **MS-P$2-2**-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-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.

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**
**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
**9.4.8.CT.2**: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
**9.4.8.IML.1**: Critically curate multiple resources to assess the credibility of sources when searching for information.
**9.4.8.IML.3:** Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping.
**9.4.8.IML.4**: Ask insightful questions to organize different types of data and create meaningful visualizations.
**9.4.8.IML.12**: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
**9.4.8.TL.1**: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
**9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Math:**
**MP.2** Reason abstractly and quantitatively.
**6.NS.C.5** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
**6.EE.A.2** Write, read, and evaluate expressions in which letters stand for numbers.
**7.EE.B.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
**7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
**7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

**NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:**
**RST.6-8.1.** Cite specific textual evidence to support analysis of science and technical texts.
**RST.6-8.2.** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

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

**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).

**NJSLSA.W1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

**NJSLSA.W6.** Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

**NJSLSA.W7.** Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

**WHST.6-8.1.** Write arguments focused on discipline-specific content.

A. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
D. Establish and maintain a formal/academic style, approach, and form.
E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).
- Models can be used to represent the motion of objects in colliding systems and their interactions, such as inputs, processes, and outputs, as well as energy and matter flows within systems.
- The uses of technologies and any 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.
- 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, which are likely to limit possible solutions.
- The change in an object's motion depends on balanced (Newton's first law) and unbalanced forces in a system 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 includes qualitative comparisons of forces, mass, and changes in motion (Newton's second law); frame of reference; and specification of units
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change.
- The greater the mass of the object, the greater the force needed to achieve the same change in motion.

- For any given object, a larger force causes a larger change in motion.
- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

**Unit Essential Questions:**

- How does a sailboat work?
- Who can build the fastest sailboat?

**Knowledge and Skills:**

*Students will know...*

- How to apply Newton's Law of Motion.
- Analyze data
- Develop and test a model to use data to modify model

*Students will be able to...*

- Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects.
- Define a design problem involving the motion of two colliding objects that can be solved through the development of an object, tool, process, or system and that includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
- Evaluate competing design solutions involving the motion of two colliding objects based on jointly developed and agreed-upon design criteria.
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.
- Analyze and interpret data to determine similarities and differences in findings.
- Plan an investigation individually and collaboratively 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.
- Design an investigation and identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
- Make logical and conceptual connections between evidence and explanations.
- Examine the changes over time and forces at different scales to explain the stability and change in designed systems.

## *EVIDENCE OF LEARNING*

**Assessment:**

*What evidence will be collected and deemed acceptable to show that students truly "understand"?*

- **End of Unit Assessment**: Students will work in groups to design a boat based on specified criteria such as space, stability, and aesthetics.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- Students will examine and interact with objects in motion.
- Students will experience different types of collisions to build an understanding of what a collision is.
- Students will observe the result of balanced and unbalanced force through hands-on investigations and simulations.
- Students will be introduced to Newton's Laws of Motion.
- Students will apply Newton's Laws of Motion different scenarios.
- Students will use a spring scale to measure force and to discover the relationship between force and mass.
- Students will calculate net force and direction
- Students will apply Newton's Laws of Motion to construct and test a boat with specified materials and constraints.
- Students will observe boat and collect data to modify boat.

## *RESOURCES*

**Teacher Resources:**

- Science Simulation Library
- Build a Boat Lesson
- Phet Interactive Simulations
- Force and Motion Lesson: https://ngss.nsta.org/Resource.aspx?ResourceID=104
- Seeing Motion: https://learn.concord.org/resources/662/seeing-motion
- FOSS Module Electromagnetic Force Investigation 1: Parts 1 and 3
- FOSSweb.com
- Gizmos
    - Fan Cart Physics
- Readworks.org
- Regional Class Research Vessel (RCRV) | College of Earth, Ocean, and Atmospheric Sciences | Oregon State University
- Quizizz.com
- Edpuzzle.com

**Equipment Needed:**

- Chromebooks
- Projector
- Spring Scales
- Loads (240g)
- Rubber Mats
- Aluminum Foil

- Tape
- Cups
- Straws
- Popsicle Sticks
- Pipe Cleaners
- Cork

## *UNIT OVERVIEW*

**Content Area:** Physical Science

**Unit Title:** Types of Interactions

**Target Course/Grade Level:** 7th

**Unit Summary:** Students use cause and effect, system and system models, and stability and change to understand ideas that explain why some materials are attracted to each other while others are not. Students apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students develop understandings that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are expected to consider the influence of science, engineering, and technology on society and the natural world.

**Approximate Length of Unit:** 5 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science**

- **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.

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**

**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).

**9.4.8.CT.2**: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
**9.4.8.IML.1**: Critically curate multiple resources to assess the credibility of sources when searching for information.
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**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Math:**
**HSN.Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
**HSN.Q.A.2** Define appropriate quantities for the purpose of descriptive modeling.
**HSN.Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
**MP.2** Reason abstractly and quantitatively.
**MP.4** Model with mathematics.
**HSA.SSE.A.1** Interpret expressions that represent a quantity in terms of its context.
**HSA.SSE.B.**3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

**NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:**
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**RST.6-8.2.** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
**RST.6-8.3.** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
**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).
**NJSLSA.W1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
**NJSLSA.W6.** Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
**NJSLSA.W7.** Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

**WHST.6-8.1.** Write arguments focused on discipline-specific content.

A. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
D. Establish and maintain a formal/academic style, approach, and form.
E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- Fields exist between objects that exert forces on each other even though the objects are not in contact.
- The interactions of magnets, electrically charged strips of tape, and electrically charged pith balls are examples of fields that exist between objects exerting forces on each other, even though the objects are not in contact.
- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object or a ball, respectively).
- Cause-and-effect relationships may be used to predict phenomena in natural or designed systems.
- Factors affect the strength of electric and magnetic forces.
- Devices that use electric and magnetic forces could include electromagnets, electric motors, and generators.
- Electric and magnetic (electromagnetic) forces can be attractive or repulsive.
- The size of an electric or magnetic (electromagnetic) force depends on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
- Cause-and-effect relationships may be used to predict the factors that affect the strength of electrical and magnetic forces in natural or designed systems
- Gravitational interactions are always attractive and depend on the masses of interacting objects.
- There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass.
- Evidence supporting the claim that gravitational interactions are attractive and depend on the masses of interacting objects could include data generated from simulations or digital tools and charts displaying mass, strength of interaction, distance from the sun, and orbital periods of objects within the solar system.

**Unit Essential Questions:**

- Can you apply a force on something without touching it?
- How does a Maglev train work?
- If I were able to eliminate air resistance and dropped a feather and a hammer at the same time, which would land first?

**Knowledge and Skills:**

*Students will know...*

- That fields exist between objects exerting forces on each other even though they are not in contact.
- The factors that affect strength and electric magnetic forces
- Gravitational interactions are attractive and depend on the masses of interacting objects.

*Students will be able to...*

- Conduct an investigation and evaluate an experimental design to produce data that can serve as the basis for evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
- Identify the cause-and-effect relationships between fields that exist between objects and the behavior of the objects.
- Ask questions about data to determine the effect of the strength of electric and magnetic forces that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
- Perform investigations using devices that use electromagnetic forces.
- Collect and analyze data that could include the effect of the number of turns of wire on the strength of an electromagnet or the effect of increasing the number or strength of magnets on the speed of an electric motor.
- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
- Use models to represent the gravitational interactions between two masses.

## *EVIDENCE OF LEARNING*

**Assessment:**

*What evidence will be collected and deemed acceptable to show that students truly "understand"?*

- **End of Unit Assessment**: Students will design, build, and test an electromagnet. Following construction of the electromagnet, students will test variables to design and build a more effective electromagnet.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- Students will investigate magnetic and electric forces to determine the nature of the force (repulsive, attractive, or both), and factors that affect the strength of the forces.
- Students will investigate magnetic and electric forces to determine the nature of the force (repulsive, attractive, or both), and factors that affect the strength of the forces.

- Students will construct and present oral and written arguments using evidence to support the claim that gravitational interactions are always attractive and depend on the masses of interacting objects.
- Students will use magnets to determine their properties.
- Locate a magnet hidden inside a mystery box.
- Test forces between magnets at various distances
- Build and test an electromagnet
- Test variables to improve design to determine which electromagnet is the most effective.
- Apply properties of electromagnetism to explain how a motor and generator transfers energy
- Utilize simulations to reinforce concepts

## *RESOURCES*

**Teacher Resources:**

- Electromagnetic Power: https://ngss.nsta.org/Resource.aspx?ResourceID=105
- Inspector Detector Challenge: https://ngss.nsta.org/Resource.aspx?ResourceID=246
- Science Simulation Library
- Phet Interactive Simulations
- Mosa Mack Science
  - Gravity
- Gizmos
  - Forces and Fan Cart
  - Magnetism
- Quizizz.com
- Edpuzzle.com
- Fossweb.com
- FOSS-Electromagnetic Force: Investigation 2 Parts 1-3 and Investigation 3 Parts 2 and 3

**Equipment Needed:**

- Chromebook
- Projector
- Magnets
  - Doughnut Shaped
  - Bar Magnets
- Iron filings
- D Cell batteries
- D Cell battery holders
- Generator
- Motors
- Rivets
- Switches

- 24 insulated gauge wire
- 20 insulated gauge wire
- Empty cardboard boxes with lids
- Ping Pong Balls
- Tape
- String

## *UNIT OVERVIEW*

**Content Area:** Physical Science

**Unit Title:** Relationships among Forms of Energy

**Target Course/Grade Level:** 7th

**Unit Summary:** In this unit, students use the practices of analyzing and interpreting data, developing and using models, and engaging in arguments from evidence to make sense of relationships between energy and forces. Students develop their understanding of important qualitative ideas about the conservation of energy. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions.

**Approximate Length of Unit:** 4 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science:**

- **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-PS3-5-** 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

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**

**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).

**9.4.8.CT.2**: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.

**9.4.8.IML.1**: Critically curate multiple resources to assess the credibility of sources when searching for information.

**9.4.8.IML.3:** Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping.

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**9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Math:**
**MP.2** Reason abstractly and quantitatively.
**6.RP.A.1** Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.
**6.RP.A.2** Understand the concept of a unit rate a/b associated with a ratio a:b with $b \neq 0$, and use rate language in the context of a ratio relationship.
**7.RP.A.2** Recognize and represent proportional relationships between quantities.
**8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.
**8.EE.A.2** Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
**8.F.A.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

**NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:**
**RST.6-8.1.** Cite specific textual evidence to support analysis of science and technical texts.
**RST.6-8.2.** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
**RST.6-8.3.** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
**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).
**NJSLSA.W1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
**NJSLSA.W6.** Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
**NJSLSA.W7.** Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
**WHST.6-8.1.** Write arguments focused on discipline-specific content.
A. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.

B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
D. Establish and maintain a formal/academic style, approach, and form.
E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- Kinetic energy is related to the mass of an object and to the speed of an object.
- Kinetic energy has a relationship to mass separate from its relationship to speed.
- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of the object's speed.
- Proportional relationships among different types of quantities provide information about the magnitude of properties and processes.
- When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- A system of objects may contain stored (potential) energy, depending on the objects' relative positions.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the objects.
- Models that could include representations, diagrams, pictures, and written descriptions of systems can be used to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems.
- When the kinetic energy of an object changes, energy is transferred to or from the object.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- Kinetic energy may take different forms (e.g., energy in fields, thermal energy, energy of motion).

**Unit Essential Questions:**

- Is it better to have an aluminum (baseball/softball) bat or a wooden bat?
- What would give you a better chance of winning a bowling match, using a basketball that you can roll really fast, or a bowling ball that you can only roll slowly?
- Who can design the best roller coaster?

**Knowledge and Skills:**

*Students will know...*

- How to describe the relationship between kinetic energy and mass and kinetic energy and speed.
- That the change of distance of interacting objects in a system impacts the different amounts of potential energy stored in an object.

*Students will be able to...*

- Construct and interpret graphical displays of data to identify linear and nonlinear relationships of kinetic energy to the mass of an object and to the speed of an object.
- Develop a model to describe what happens to the amount of potential energy stored in the system when the arrangement of objects interacting at a distance changes
- Use models to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. Models could include representations, diagrams, pictures, and written descriptions.
- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Conduct an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. Do not include calculations of energy.

## *EVIDENCE OF LEARNING*

**Assessment:**

*What evidence will be collected and deemed acceptable to show that students truly "understand"?*

- **End of Unit Assessment**: Students will be assessed on their ability to design a roller coaster that maximizes potential and kinetic energy.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- Students will be introduced to kinetic and potential energy
- Students construct graphical displays of data that describe the relationships between kinetic energy and mass of an object and speed of an object.
- Students investigate the potential energy stored in a variety of systems.
- Using data from the graphical displays of data and models that students developed earlier in this unit of study, as well as textual evidence, students will construct, use, and present oral and written arguments to support claims that when kinetic energy changes, energy is transferred to or from the object

- Explore the relationship between kinetic energy and mass and kinetic energy and speed
- Utilize PhET interactive simulations to reinforce kinetic and potential energy
- Complete Mosa Mack investigation: Kinetic Energy which includes designing a roller coaster

## *RESOURCES*

**Teacher Resources:**

- Soccer Kick it: https://pbskids.org/retired/dragonfly/
- It's All Downhill: Forces and Sports: https://streaming.discoveryeducation.com/teacherCenter/lessonPlans/pdfs/9-12_Physics_ItsAllDownhillForcesAndSports.pdf
- Energy Skate Park Simulation: https://phet.colorado.edu/en/simulation/energy-skate-park-basics
- Energy Different Kinds: https://learningcenter.nsta.org/search/
- Mosa Mack Science
    - Kinetic Energy
- FOSSweb.com
- Phet Interactive Simulations
- It's All Downhill: Forces and Sports Lesson Plan
- Quizizz.com
- Edpuzzle.com

**Equipment Needed:**

- Chromebook
- Projector
- Marbles (small and large)
- Foam Pipe

## *UNIT OVERVIEW*

**Content Area:** Earth and Space

**Unit Title:** Stability and Change on Earth

**Target Course/Grade Level:** 7th

**Unit Summary:** Students construct an understanding of the ways that human activities affect Earth's systems. Students use practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts on the development of these resources. Students also understand that the distribution of these resources is uneven due to past and current geosciences processes or removal by humans.

**Approximate Length of Unit:** 6 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science:**

- **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-ESS3-4-**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 climate change over the past century.

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**

**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).

**9.4.8.CT.2**: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
**9.4.8.IML.1**: Critically curate multiple resources to assess the credibility of sources when searching for information.
**9.4.8.IML.3:** Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping.
**9.4.8.IML.4**: Ask insightful questions to organize different types of data and create meaningful visualizations.
**9.4.8.IML.12**: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
**9.4.8.TL.1**: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
**9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Math:**
**MP.2** Reason abstractly and quantitatively.
**6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
**7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

**NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:**
**RST.6-8.1.** Cite specific textual evidence to support analysis of science and technical texts.
**RST.6-8.2.** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
**RST.6-8.3.** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
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**NJSLSA.W1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
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B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
D. Establish and maintain a formal/academic style, approach, and form.
E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources.
- All human activities draw on Earth's land, ocean, atmosphere, and biosphere resources and have both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.
- Minerals, fresh water, and biosphere resources are distributed unevenly around the planet as a result of past geologic processes.
- Cause-and-effect relationships may be used to explain how uneven distributions of Earth's mineral, energy, and groundwater resources have resulted from past and current geosciences processes.
- Resources that are unevenly distributed as a result of past processes include but are not limited to petroleum, metal ores, and soil.
- Mineral, fresh water, ocean, biosphere, and atmosphere resources are limited, and many are not renewable or replaceable over human lifetimes.
- The distribution of some of Earth's land, ocean, atmosphere, and biosphere resources are changing significantly due to removal by humans.
- Natural hazards can be the result of interior processes, surface processes, or severe weather events.
- Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable.
- 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.
- Data on natural hazards can be used to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- Data on natural hazards can include the locations, magnitudes, and frequencies of the natural hazards.
- Graphs, charts, and images can be used to identify patterns of natural hazards in a region.
- Graphs, charts, and images can be used to understand patterns of geologic forces that can help forecast the locations and likelihoods of future events.
- Technologies that can be used to mitigate the effects of natural hazards can be global or local.
- Technologies used to mitigate the effects of natural hazards vary from region to region and over time.
- 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.

- Increases in human population and per-capita consumption of natural resources impact Earth's systems.
- 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.
- Cause and effect relationships may be used to predict how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- The consequences of increases in human populations and consumption of natural resources are described by science.
- Science does not make the decisions for the actions society takes.
- Scientific knowledge can describe the consequences of human population and per-capita consumption of natural resources impact Earth's systems but does not necessarily prescribe the decisions that society takes.
- Stability in Earth's surface temperature might be disturbed either by sudden events or gradual changes that accumulate over time.
- Human activities and natural processes are examples of factors that have caused the rise in global temperatures over the past century.
- Human activities play a major role in causing the rise in global temperatures.
- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming).
- Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior, and on applying that knowledge wisely in decisions and activities.
- Evidence that some factors have caused the rise in global temperature over the last century can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.

**Unit Essential Questions:**

- Why aren't minerals and groundwater distributed evenly across the world?
- How can we predict and prepare for natural disasters?
- How might we treat resources if we thought about the Earth as a spaceship on an extended survey of the solar system? (How would astronauts manage their resources?)
- How can basic chemistry be used to explain the mechanisms that control the global temperature the atmosphere?

**Knowledge and Skills:**

*Students will know...*

- How to construct a scientific explanation using evidence to describe the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- How to analyze and interpret data and technology to predict catastrophic events

*Students will be able to...*

- Construct a scientific explanation based on valid and reliable evidence of how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geosciences processes.
- Obtain evidence from sources, which must include the student's own experiments.
- Construct a scientific explanation based on the assumption that theories and laws that describe the current geosciences process operates today as they did in the past and will continue to do so in the future.
- Analyze and interpret data on natural hazards to determine similarities and differences and to distinguish between correlation and causation.
- 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.
- Ask questions to identify and clarify a variety of evidence for an argument about the factors that have caused the rise in global temperatures over the past century.
- Ask questions to clarify human activities and natural processes that are major factors in the current rise in Earth's mean surface temperature

## *EVIDENCE OF LEARNING*

**Assessment:**

*What evidence will be collected and deemed acceptable to show that students truly "understand"?*

- **End of Unit Assessment**: Students will be able to analyze and interpret data to construct an argument of how human impact is affecting natural resources and changes in global temperature.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- Students will discuss negative and positive human impact on the Earth. Students will describe how human activities have positive as well as negative impacts on land, ocean, atmosphere, and biosphere resources.
- Examine the causes of the uneven distribution of Earth's resources and create an informative writing piece with evidence to support their findings.
- Students will perform investigations to gather data showing how natural processes can lead to the uneven distributions of Earth's mineral, energy, and groundwater resources. Analyze data by observing maps that indicate past and present distribution of different resources; students will use mathematical equations (inequalities) to demonstrate the uneven distributions
- Students will learn that some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable.

- Students will look at how technology can be used to predict natural hazards to reduce their impacts. Last, students will examine evidence of natural processes and human activities that have caused global climate change.
- Students will learn that some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Students will also look at how technology can be used to predict natural hazards to reduce their impacts.
- Students will examine evidence of natural processes and human activities that have caused global climate change.

## *RESOURCES*

**Teacher Resources:**

- Mosa Mack Science
  - Climate Change and Ecological Footprint
  - Renewable Resources
- National Oceanic and Atmospheric Administration
- National Geographic Classroom Resources
- USGS-Science for Changing Worlds
- Quizizz.com
- Edpuzzle.com

**Equipment Needed:**

- Chromebooks
- Projector
- Lab equipment

## *UNIT OVERVIEW*

**Content Area:** Earth and Space

**Unit Title:** Human Impact

**Target Course/Grade Level:** 7th

**Unit Summary:** In this unit of study, students analyze and interpret data and design solutions to build on their understanding of the ways that human activities affect Earth's systems. The emphasis of this unit is the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of these uses. The crosscutting concepts of cause and effect and the influence of science, engineering, and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas,

Building on Stability and Change on Earth, students define a problem by precisely specifying criteria and constraints for solutions as well as potential impacts on society and the natural environment; systematically evaluate alternative solutions; analyze data from tests of different solutions; combining the best ideas into an improved solution; and develop and iteratively test and improve their model to reach an optimal solution

**Approximate Length of Unit:** 5 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science:**

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

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**

**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
**9.4.8.CT.2**: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
**9.4.8.IML.1**: Critically curate multiple resources to assess the credibility of sources when searching for information.
**9.4.8.IML.3:** Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping.
**9.4.8.IML.4**: Ask insightful questions to organize different types of data and create meaningful visualizations.
**9.4.8.IML.12**: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
**9.4.8.TL.1**: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
**9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Math:**
**6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
**7.EE.B.**4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
**6.RP.A.**1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
**7.RP.A.2** Recognize and represent proportional relationships between quantities.
**MP.2** Reason abstractly and quantitatively.
**7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

**NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:**

**RST.6-8.1.** Cite specific textual evidence to support analysis of science and technical texts.
**RST.6-8.2.** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

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

**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).

**NJSLSA.W1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

**NJSLSA.W6.** Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

**NJSLSA.W7.** Conduct short as well as more sustained research projects, utilizing an inquiry-based research

process, based on focused questions, demonstrating understanding of the subject under investigation.

**WHST.6-8.1.** Write arguments focused on discipline-specific content.

A. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.

B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.

D. Establish and maintain a formal/academic style, approach, and form.

E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species.
- Changes to Earth's environments can have different impacts (negative and positive) for different living things.
- 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.
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
- The uses of technologies and any 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. Thus technology use varies from region to region and over time.

**Unit Essential Questions:**

- How do we monitor the health of the environment (our life support system)?
- Is it possible to predict and protect ourselves from natural hazards?

**Knowledge and Skills:**

*Students will know...*

- How human activity have impacted the Earth's environment and how to monitor the health of the environment.

*Students will be able to...*

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

## *EVIDENCE OF LEARNING*

**Assessment:**

*What evidence will be collected and deemed acceptable to show that students truly "understand"?*

- **End of Unit Assessment**: Students will conduct a short research project to examine factors such as societal and individual needs, cost effectiveness, available materials and natural resources, current scientific knowledge, and current advancements in science and technology.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- Students will identify human impact on the environment that has resulted from human consumption of natural resources.
- Students will define the criteria and constraints of the design problem whose solution will help to monitor and minimize the human impact on the environment.

## *RESOURCES*

**Teacher Resources:**

- National Oceanic and Atmospheric Administration
- National Geographic Classroom Resources
- USGS-Science for Changing Worlds
- Mosa Mack Science
  - Renewable Resources
- Quizizz.com
- Edpuzzle.com

**Equipment Needed:**

- Chromebooks
- Projector

## *UNIT OVERVIEW*

**Content Area:** Life Science

**Unit Title:** Matter and Energy in Organisms and Ecosystems

**Target Course/Grade Level:** 7th

**Unit Summary:** Students analyze and interpret data, develop models, construct arguments, and demonstrate a deeper understanding of the cycling of matter, the flow of energy, and resources in ecosystems. They are able to study patterns of interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on populations. They also understand that the limits of resources influence the growth of organisms and populations, which may result in competition for those limited resources. The crosscutting concepts of matter and energy, systems and system models, patterns, and cause and effect provide a framework for understanding the disciplinary core ideas. Students demonstrate grade-appropriate proficiency in analyzing and interpreting data, developing models, and constructing arguments. Students are also expected to use these practices to demonstrate understanding of the core ideas

**Approximate Length of Unit:** 5 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science:**
**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-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. **[**

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**
**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).

**9.4.8.CT.2**: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
**9.4.8.IML.1**: Critically curate multiple resources to assess the credibility of sources when searching for information.
**9.4.8.IML.3:** Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping.
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**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Mathematics:**
**6.EE.C.9** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.
**6.SP.B.5** Summarize numerical data sets in relation to their context.

**NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:**
**RST.6-8.1.** Cite specific textual evidence to support analysis of science and technical texts.
**RST.6-8.2.** Determine the 6.SP.B.5central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
**RST.6-8.3.** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
**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).
**NJSLSA.W1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
**NJSLSA.W6.** Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
**NJSLSA.W7.** Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
**WHST.6-8.1.** Write arguments focused on discipline-specific content.
A. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.

B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
D. Establish and maintain a formal/academic style, approach, and form.
E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- Organisms and populations of organisms are dependent on their environmental interactions with other living things.
- Organisms and populations of organisms are dependent on their environmental interactions with nonliving factors.
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with others for limited resources.
- Access to food, water, oxygen, or other resources constrain organisms' growth and reproduction.
- Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms.
- Mutually beneficial interactions may become so interdependent that each organism requires the other for survival.
- The patterns of interactions of organisms with their environment, both its living and nonliving components, are shared.
- Interactions within ecosystems have patterns that can be used to identify cause-and-effect relationships.
- Patterns of interactions among organisms across multiple ecosystems can be predicted.
- Patterns of interactions can be used to make predictions about the relationships among and between organisms and abiotic components of ecosystems.
- Food webs are models that demonstrate how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.
- Transfers of matter into and out of the physical environment occur at every level.
- Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments.
- Decomposers recycle nutrients from dead plant or animal matter back to the water in aquatic environments.
- The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
- The transfer of energy can be tracked as energy flows through an ecosystem.
- Science assumes that objects and events in ecosystems occur in consistent patterns that are understandable through measurement and observation.

**Unit Essential Questions:**

- What are the effects of resource availability on organisms and populations of organisms in an ecosystem?

- What predictions can you make about patterns of interactions among organisms across multiple ecosystems?
- How does matter and energy flow among the living and nonliving parts of an ecosystem?

**Knowledge and Skills:**
*Students will know...*

- Food webs are models that demonstrate how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.
- Transfers of matter into and out of the physical environment occur at every level.
- Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments.
- Decomposers recycle nutrients from dead plant or animal matter back to the water in aquatic environments.
- The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
- The transfer of energy can be tracked as energy flows through an ecosystem.
- Science assumes that objects and events in ecosystems occur in consistent patterns that are understandable through measurement and observation.

*Students will be able to...*

- Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- Use cause-and-effect relationships to predict the effect of resource availability on organisms and populations in natural systems.
- Construct an explanation about interactions within ecosystems.
- Include qualitative or quantitative relationships between variables as part of explanations about interactions within ecosystems.
- Make predictions about the impact within and across ecosystems of competitive, predatory, or mutually beneficial relationships as abiotic (e.g., floods, habitat loss) or biotic (e.g., predation) components change.
- Develop a model to describe the cycling of matter among living and nonliving parts of an ecosystem.
- Develop a model to describe the flow of energy among living and nonliving parts of ecosystem. Track the transfer of energy as energy flows through an ecosystem.
- Observe and measure patterns of objects and events in ecosystems.

## *EVIDENCE OF LEARNING*

**Assessment:**
*What evidence will be collected and deemed acceptable to show that students truly "understand"?*

- **End of Unit Assessment**:
    - Students will construct an argument to support or refute an explanation for the changes to populations in an ecosystem caused by disruptions to a physical or

biological component of that ecosystem. Empirical evidence and scientific reasoning must support the argument.
    - Construct a convincing argument that supports or refutes claims for solutions about the natural and designed worlds.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- Students will sort cards to classify individual, population, community, ecosystem, biotic and abiotic.
- Students will examine how characteristic animal behaviors and specialized plant structures affect the successful reproduction of animals and plants
    - Students may observe examples of plant structures that affect probability of reproduction (i.e., bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract pollen-transferring insects)
        - Students can view plant structures using microscopes
        - Students can explore the number of butterflies on brightly colored plants versus the number of butterflies on other types of plants, record the data, and analyze data to make claims backed up with evidence and scientific reasoning
        - Using video clips, students can observe animal behaviors that affect the probability of successful animal reproduction (i.e., nest building to protect young from the cold, herding of animals to protect them from predators, and vocalizations to attract mates for breeding)
- Students will use evidence to support a claim related to the role of pollinators in plant reproduction
- Students will examine the environmental and genetic factors that influence the growth of organisms such as the effects of food, light, space, and water on plant growth
- Create a food web to model the flow of energy and the recycling of energy in an ecosystem.
- Identify the different levels of a food web including decomposers.
- Collect data to analyze what happens to a food web when there are changes in the resources in an ecosystem.

## *RESOURCES*

**Teacher Resources:**

- Mosa Mack Science
    - Food Webs
    - Interaction of Organisms
- Gizmos
    - Food Chains
    - Prairie Ecosystems

    - Forest Ecosystems
- FOSSweb.com
- Quizizz.com
- Edpuzzle.com
- Florida Everglades: The River of Grass
- Modeling Marine Food Webs and Human Impact
- Habitable Planet Population Simulator: https://ngss.nsta.org/Resource.aspx?ResourceID=298
- Modeling Marine Food Webs and Human Impact: https://ngss.nsta.org/Resource.aspx?ResourceID=516
- Interactive Interdependence Reading Resource: https://ngss.nsta.org/Resource.aspx?ResourceID=21

**Equipment Needed:**

- Chromebooks, computers
- Sorting out life cards
- Projector

## *UNIT OVERVIEW*

**Content Area:** Life Science

**Unit Title:** Interdependent Relationships in Ecosystems

**Target Course/Grade Level:** 7th

**Unit Summary:** Students build on their understanding of the transfer of matter and energy as they study patterns of interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on a population. They construct explanations for the interactions in ecosystems and the scientific, economic, political, and social justifications used in making decisions about maintaining biodiversity in ecosystems. The crosscutting concept of stability and change provide a framework for understanding the disciplinary core ideas.

This unit includes a two-stage engineering design process. Students first evaluate different engineering ideas that have been proposed using a systematic method, such as a tradeoff matrix, to determine which solutions are most promising. They then test different solutions and combine the best ideas into a new solution that may be better than any of the preliminary ideas.

**Approximate Length of Unit:** 5 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science:**
**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.
**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-ETS1-3-**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.

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**
**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
**9.4.8.CT.2**: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
**9.4.8.IML.1**: Critically curate multiple resources to assess the credibility of sources when searching for information.
**9.4.8.IML.3:** Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping.
**9.4.8.IML.4**: Ask insightful questions to organize different types of data and create meaningful visualizations.
**9.4.8.IML.12**: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
**9.4.8.TL.1**: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
**9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Mathematics:**
**MP.2** Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-3)
**MP.4** Model with mathematics. (MS-LS2-5)
**7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-3)
**6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5)

**NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:**
**RST.6-8.1.** Cite specific textual evidence to support analysis of science and technical texts.
**RST.6-8.2.** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
**RST.6-8.3.** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
**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).
**NJSLSA.W1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
**NJSLSA.W6.** Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

**NJSLSA.W7.** Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

**WHST.6-8.1.** Write arguments focused on discipline-specific content.

A. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.

B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.

D. Establish and maintain a formal/academic style, approach, and form.

E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- Ecosystems are dynamic in nature.
- The characteristics of ecosystems can vary over time.
- Disruptions to any physical or biological component of an ecosystem can lead to shifts in all the ecosystem's populations.
- Small changes in one part of an ecosystem might cause large changes in another part.
- Patterns in data about ecosystems can be recognized and used to make warranted inferences about changes in populations.
- Evaluating empirical evidence can be used to support arguments about changes to ecosystems.
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems.
- The completeness, or integrity, of an ecosystem's biodiversity is often used as a measure of its health.
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines.
- Changes in biodiversity can influence ecosystem services that humans rely on.
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- A solution needs to be tested and then modified on the basis of the test results, in order to improve it.
- Models of all kinds are important for testing solutions.
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.
- Small changes in one part of a system might cause large changes in another part. Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

**Unit Essential Questions:**

- How can a single change to an ecosystem disrupt the whole system?

- What limits the number and variety of living things in an ecosystem?

**Knowledge and Skills:**

*Students will know...*

- How changes in biodiversity of populations can impact ecosystems and how to use evidence to evaluate competing design solutions.

*Students will be able to...*

- Construct an argument to support or refute an explanation for the changes to populations in an ecosystem caused by disruptions to a physical or biological component of that ecosystem. Empirical evidence and scientific reasoning must support the argument.
- Use scientific rules for obtaining and evaluating empirical evidence.
- Recognize patterns in data and make warranted inferences about changes in populations.
- Evaluate empirical evidence supporting arguments about changes to ecosystems
- Construct a convincing argument that supports or refutes claims for solutions about the natural and designed world(s).
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.
- Create design criteria for design solutions for maintaining biodiversity and ecosystem services.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

## *EVIDENCE OF LEARNING*

**Assessment:**

*What evidence will be collected and deemed acceptable to show that students truly "understand"?*

**End of Unit Assessment**:

- The students will have to complete a Hyperdoc or choice board to apply what they learned about ecosystems to solve a problem based on a scenario.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- **Problem Based Learning Scenario: (Can also be used as an end of unit assessment)** You are a cargo inspection agent working in Guam to prevent the introduction of non-native species to your island. People coming into your territory often do not understand why you must spend so much time checking their cargo. Working in small groups, develop a public service announcement and media campaign to explain to the public how devastating the introduction of non-native species can be to an island ecosystem. Research how the region has been affected by invasive species. Connect with experts in the field to further your understandings. Use video clips, podcasts, and other authentic

media to help explain the impact. Focus your message on how non-native species can become invasive and affect the biodiversity of the island.

- Students will distinguish among facts reasoned judgment based on research findings, and speculation while reading text about maintaining biodiversity and ecosystem services. Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion.
- After determining that ecosystems are dynamic in nature, students may construct an argument to support an explanation for how shifts (large and/or small) in populations are caused by change to physical or biological components in ecosystems (e.g., gas explosions, tornados, mining, oil spills, clear cutting, hurricanes, volcanoes, etc.).
- Students will study the variety of species found in terrestrial and oceanic ecosystems and use the data they gather to make decisions about the health of the ecosystem. Students may compare, through observations and data analysis, the biodiversity before and after events affecting a specific area—for examples, the Pinelands, that were lost due to the creation of the reservoir; the underground coal fires in Centralia, PA, that caused people to abandon the town; the volcanic eruption in Mt. St. Helen's, WA; the nuclear reactor meltdown in Chernobyl, Ukraine.
- Students should recognize patterns in data about changes to components in ecosystems and make inferences about how these changes contribute to changes in the biodiversity of populations.
- Students should investigate and design investigations to test their ideas and develop possible solutions to problems caused when changes in the biodiversity of an ecosystem affect resources (food, energy, and medicine) as well as ecosystem services (water purification, nutrient recycling, soil erosion prevention) available to humans. Students can then construct arguments using evidence to support recognized patterns of change in factors such as global temperatures and their effect on populations and the environment.
- Students will take the evidence they have collected and their understanding of how changes in the biodiversity of populations can impact ecosystem services and use that evidence and understanding to evaluate competing design solutions.
- Read an article from Readwork.org to understand how populations are affected by invasive species.
- Study ecosystems to learn about
    - ecosystem services
    - factors that impact ecosystems such as climate change, changes in populations, health of ecosystem, weather conditions, and human impact
- Collect and analyze data, draw conclusions and make predictions and inferences to develop and test solutions to problems that arise when there is a change in the biodiversity of an ecosystem.

## *RESOURCES*

**Teacher Resources:**

- The Flow of Matter and Energy in Ecosystems Scipack: https://ngss.nsta.org/Resource.aspx?ResourceID=173

- Readworks.org
- FOSSweb.com
- Gizmos
    - Coral Reefs Biotic Factors
    - Coral Reefs Abiotic Factors
- Quizizz.com
- Edpuzzle.com
- National Invasive Species Information Center (NISIC)

**Equipment Needed:**

- Chromebooks, computers
- Sorting out life cards
- Projector

## *UNIT OVERVIEW*

**Content Area:** Life Science

**Unit Title:** Organization for Matter and Energy Flow in Organisms

**Target Course/Grade Level:** 7th

**Unit Summary:** Students provide a mechanistic account for how cells provide a structure for the plant process of photosynthesis in the movement of matter and energy needed for the cell. Students use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems. They construct scientific explanations for the cycling of matter in organisms and the interactions of organisms to obtain matter and energy from an ecosystem to survive and grow. They understand that sustaining life requires substantial energy and matter inputs, and that the structure and functions of organisms contribute to the capture, transformation, transport, release, and elimination of matter and energy.

**Approximate Length of Unit:** 5 weeks

## *LEARNING TARGETS*

**NJ Student Learning Standards:**
**Science:**

- **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

**Interdisciplinary Connections and Standards:**
**Career Readiness, Life Literacies, and Key Skills:**

**9.4.8.CI.1:** Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

**9.4.8.CT.1**: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).

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**9.4.8.GCA.2:** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
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**9.4.8.IML.12**: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
**9.4.8.TL.1**: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
**9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
**9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
**9.4.8.TL.4**: Synthesize and publish information about a local or global issue or event.

**Math:**
**6.EE.C.9** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation.

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B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.

D. Establish and maintain a formal/academic style, approach, and form.
E. Provide a concluding statement or section that follows from and supports the argument presented.

**Unit Understandings:**

*Students will understand that…*

- Photosynthesis has a role in the cycling of matter and flow of energy into and out of organisms.
- The flow of energy and cycling of matter can be traced.
- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon based organic molecules and release oxygen.
- 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.
- Sugars produced by plants can be used immediately or stored for growth or later use.
- Within a natural system, the transfer of energy drives the motion and/or cycling of matter.
- Food is rearranged through chemical reactions, forming new molecules that support growth.
- Food is rearranged through chemical reactions, forming new molecules that release energy as this matter moves through an organism.
- Molecules are broken apart and put back together to form new substances, and in this process, energy is released.
- Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy.

**Unit Essential Questions:**

- What is the role of photosynthesis in the cycling of matter and flow of energy into and out of an organism?
- How is food rearranged through chemical reactions to form new molecules that support growth and/or release energy as this matter moves through an organism?

**Knowledge and Skills:**

*Students will know...*

- How to use data to explain plant growth and gas exchange and how to develop scientific explanation to support observations.

*Students will be able to...*

- Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based on valid and reliable evidence obtained from sources (including the students' own experiments).
- Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based on 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.
- Develop and use a model to describe how food is rearranged through chemical reactions.

## *EVIDENCE OF LEARNING*

**Assessment:**
*What evidence will be collected and deemed acceptable to show that students truly "understand"?*
**End of Unit Assessment**:

- Students will use data collected during their investigations and observations of simulations to construct an explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

**Learning Activities:**
*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*

- Germinate seeds to observe plant growth
- Read *The Molecules of Air. Plants, and Soil*
- Investigate weight loss and weight gain of matter including plants
- Conduct investigations to provide evidence that plants exchange gas, perform photosynthesis and cellular respiration
- Using the data collected during their investigations and observations of simulations, students construct an explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- Measure changes in soil and biomass

## *RESOURCES*

**Teacher Resources:**

- Michigan State University Unit: Plant Growth and Gas Exchange Microsoft Word - Carbon_2012PlantUnitTeachersGuide_Final.doc (msu.edu)
- YouTube video, *The Power of Ten*
- Mosa Mack Science
    - Photosynthesis
- Science Simulation Library
- Quizizz.com
- Edpuzzle.com

**Equipment Needed:**

- Overhead projector
- Digital Scale
- Graduated Cylinders
- Soil