MENDHAM TOWNSHIP SCHOOLS

SCIENCE CURRICULUM

Grade 4

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Grade 4 Unit 1: "Human Machine~ Body, Senses, and the Brain"
Source - NJSLS From Molecules to Organisms: Structures and Processes

Stage 1: Unit Summary

This introductory human body unit takes the perspective that we can think about our bodies as being like a machine. We have parts for moving around, sensors, and a built-in computer. Students explore their senses and consider how the information we process helps us understand and react to our environment. Students will also develop an understanding that eyes are sensory organs that receive information about the world, light enters the eye, which provides information about surroundings, the pupil gets larger to let more light in when it is dark, the brain receives information from the senses, processes the information, and controls the muscles to enable movement. By developing a model, students describe that an object can be seen when light reflected from its surface enters the eye.

Students are also expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

This unit is based on **4-LS1-1, 4-LS1-2, 4-PS4-2.**

Crosscutting Concepts:

Systems and System Models

- A system can be described in terms of its components and their interactions. (4-LS1-1), (4-LS1-2)

Cause and Effect

- Cause and effect relationships are routinely identified. (4-PS4-2)

Evidence Statements: NJSLS Science Unit Standards: 4-LS1-1, 4-LS1-2, 4-PS4-2.

- **Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, sems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.] **(4-LS1-1)**
- **Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.] **(4-LS1-2)**
- **Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.] **(4-PS4-2)**

Engineering Design:

- **3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- **3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- **3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Essential Questions:

1. How do internal and external parts of plants and animals help them to survive, grow, behave, and reproduce?
2. How do animals and humans use their senses to help them understand and react to their environment?
3. What happens when light from an object enters the eye?

Interdisciplinary Connections:

ELA/Literacy -

- W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)
- SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-LS1-2)

Mathematics -

- 4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)

Stage 2- Assessment:

Essential Question 1: How do internal and external parts of plants and animals help them to survive, grow, behave, and reproduce?

Concepts:

- A system can be described in terms of its components and their interactions.
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Formative Assessment:

Students who understand the concepts are able to:

- Be design engineers who use the biomimicry of animals to come up with a new invention! Engineers have used nature as inspiration for many of their inventions. By observing animals, plants and natural processes, we can understand how they do certain things and then try to copy them. (End of the Unit ~ Animal Superpowers).
- Describe a system in terms of its components and their interactions.
- Construct an argument with evidence, data, and/or a model.
- Construct an argument to support the claim that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. (Assessment is limited to macroscopic structures within plant and animal systems.)
- Examples of structures could include:

✔ Thorns	✔ Heart
✔ Stems	✔ Stomach
✔ Roots	✔ Lung
✔ Color petals	✔ Brain
	✔ Skin

Essential Question 2: How do animals receive and process different types of information from their environment in order to respond appropriately?
Concepts:

- A system can be described in terms of its components and its interactions.
- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain.
- Animals are able to use their perceptions and memories to guide their actions.

Formative Assessment:

Students who understand the concepts are able to:

- Describe a system in terms of its components and their interactions.
- Use a model to test interactions concerning the functioning of a natural system.
- Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. The emphasis is on systems of information transfer. (Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.)
- Design a model to demonstrate that different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain and that animals are able to use their perceptions and memories to guide their actions.

Essential Question 3: What happens when light from an object enters the eye?

Concepts:

- Cause-and-effect relationships are routinely identified.
- An object can be seen when light reflected from its surface enters the eyes.

Formative Assessment:

Students who understand the concepts are able to:

- Identify cause-and-effect relationships.
- Develop a model to describe phenomena.
- Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works)

Summative Assessment:

Summative Assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.

- Individual Lesson Assessments (Mystery Science)
- Unit Assessment (Mystery Science)
- Performance Task (Mystery Science)
- End of Unit Project: Animal Superpowers (TPT)

Stage 3: Learning Plan

Mystery Science "Human Machine ~ Body, Senses, and the Brain" Activities:

- **Anchor Phenomenon~ System Models** - Students create an initial conceptual model to explain how the owl's body parts work together to hunt. Then, the students conduct investigations to help them explain how the owl's body parts function as a system.
- **Lesson 1: Why do your biceps bulge?** - Students build a model of a finger that they then use to construct an explanation for how fingers move. (DCI: LS1.A)
- **Lesson 2: What do people who are blind see?** - Students build a model of an eyeball that they then use to construct an explanation of why some people have blurry vision. (DCI: LS1.A, LS1.D, PS4.B)
- **Lesson 3: How can some animals see in the dark? -** Students conduct an investigation to see how pupils change in response to light. Students build a model of an eye (extending the model they built in Lesson 2) to explain how changes in pupil size changes the image that appears on the retina. (DCI: LS1.A, LS1.D, PS4.B)
- **Lesson 4: How does your brain control your body?** - Students conduct investigations to explore how the brain processes information and responds to that information. Students analyze and interpret data from the investigations to determine how fast their reflexes are. (DCI: LS1.A, LS1.D)
- **Performance Task** - Students select a different animal or plant to research, and then create a system model to explain how the animal or plant senses and responds to its environment. Students create a group model and share their work in a gallery walk.

TPT "Plant and Animal Structure Unit" Activities:

- Plants and Animals Structures Unit Activities(TPT) (click on link for access to activities)

Connection to STEM / Makerspace:

- The students apply their conceptual understanding to a new scenario. Students select a different animal or plant to research, and then create a system model to explain how the animal or plant senses and responds to its environment. Students create a group model and share their work in a gallery walk. (Mystery Science Performance Task)

Integrated accommodations and modifications for students with IEP's 504s, ELLs, and gifted and talented students:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tools (Zoom, Google Meet), experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.

- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

List of Core Instructional and Supplemental Materials:

- Mystery Science online “Human Machine”
- Mystery Science hands-on materials
- Discovery Education
- Brainpop Educational Videos
- Readworks
- Epic
- Fossweb
- “Plants and Animals Structures Unit” on Teachers Pay Teachers Unit

Integration of 21st Century Skills and Life and Career Standard
CRP1, 2, 4, 6, 8, 11

Integration of the Technology Standard
NJSLS.8.1

Grade 4 Unit 2: "Energizing Everything ~ Energy & Motion"
Source - NJSLS From Energy

Stage 1: Unit Summary

This introductory energy unit will encourage students to think about the energy that things need to move. Students will explore how energy makes things go, from powering vehicles to moving one's body. Students will experiment with rubber bands to discover the relationship between how much energy is stored in a material and how much is released. They will investigate the role that hills play in making roller coasters move and the energy transfer that happens when two objects collide. Students will realize that thinking about the world in terms of energy helps them make sense of how and why things speed up and slow down. Hands-on activities focus on engineering, testing hypotheses and using results to develop their ideas.

This unit is based on **4-PS3-1,4-PS3-2, 4-PS3-3, 4-PS3-4 , 4-ESS3-1.**

Crosscutting Concepts:

Cause and Effect

Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3- 1)

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (4- PS4-1)
- Similarities and differences in patterns can be used to sort and classify designed products. (4- PS4-3)

Cause and Effect

- Cause and effect relationships are routinely identified. (4-PS4-2)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4- 3)

Evidence Statements: NJSLS Science Unit Standards: 4-PS3-1,4-PS3-2, 4-PS3-3, 4-PS3-4 , 4-ESS3-1.

- **Use evidence to construct an explanation relating the speed of an object to , the energy of that object.** [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.] **(4-PS3-1)**
- **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [Assessment Boundary: Assessment does not include quantitative measurements of energy.] **(4-PS3-2)**
- **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.] **(4-PS3-3)**
- **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.] **(4-PS3-4)**

- **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.] **(4-ESS3-1)**

Engineering Design:

- **3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- **3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- **3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Essential Questions:

1. What is the relationship between the speed of an object and its energy?
2. In what ways does energy change when objects collide?
3. How does energy move?
4. How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?
5. From what natural resources are energy and fuels derived? In what ways does the human use of natural resources affect the environment?

Interdisciplinary Connections:

ELA/Literacy -

Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1) **RI.4.1**

Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1) **RI.4.3**

Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1) **RI.4.9**

Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1) **W.4.2**

Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-3) **W.4.7**

Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-3) **W.4.8**

Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1) **W.4.9**

Math-

Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4) **4.OA.A.3**

Stage 2- Assessment:

Essential Question 1: What is the relationship between the speed of an object and its energy?

Concepts:

Energy can be transferred in various ways and between objects.

- The faster a given object is moving, the more energy it possesses.

Formative Assessment:

Students who understand the concepts are able to:

- Describe various ways that energy can be transferred between objects.
- Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
- Use evidence to construct an explanation relating the speed of an object to the energy of that object. (Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.)

Essential Question 2: In what ways does energy change when objects collide?

Concepts:

- Energy can be transferred in various ways and between objects.
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- Energy is present whenever there are moving objects, sound, light, or heat.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- When objects collide, the contact forces transfer energy so as to change the objects' motions.

Formative Assessment:

Students who understand the concepts are able to:

- Describe the various ways that energy can be transferred between objects.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
- Ask questions and predict outcomes about the changes in energy that occur when objects collide. Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. (Assessment does not include quantitative measurements of energy.)

Essential Question 3: How does energy move?

Concepts:

- Energy can be transferred in various ways and between objects.
- Energy can be moved from place to place through sound, light, or electric currents.
- Energy is present whenever there is sound, light, or heat.
- Light also transfers energy from place to place.

- Energy can also be transferred from place to place by electric currents; the currents may have been produced to begin with by transforming the energy of motion into electrical energy.

Formative Assessment:

Students who understand the concepts are able to:

- Make observations to produce data that can serve as the basis for evidence for an explanation of a phenomenon or for a test of a design solution.
- Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

Essential Question 4: How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?
Concepts:

- Energy can be transferred in various ways and between objects.
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.
- Possible solutions to a problem are limited by the available materials and resources (constraints).
- The success of a designed solution is determined by considering the desired features of a solution (criteria).
- Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
- Research on a problem should be carried out before beginning to design a solution.
- Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Formative Assessment:

Students who understand the concepts are able to:

- Describe the various ways that energy can be transferred between objects.
- Apply scientific ideas to solve design problems.
- Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.)
- Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound or passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Essential Question 5: From what natural resources are energy and fuels derived? In what ways does the human use of natural resources affect the environment?

Concepts:

- Cause-and-effect relationships are routinely identified and used to explain change.
- Knowledge of relevant scientific concepts and research findings is important in engineering.
- Over time, people's needs and wants change, as do their demands for new and improved technologies.
- Energy and fuels that humans use are derived from natural sources.
- The use of energy and fuels from natural sources affects the environment in multiple ways.
- Some resources are renewable over time, and others are not.

Formative Assessment:

Students who understand the concepts are able to:

- Identify cause-and-effect relationships in order to explain change.
- Obtain and combine information from books and other reliable media to explain phenomena.
- Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
- Examples of renewable energy resources could include:
    - Wind energy
    - Water behind dams
    - Sunlight.
- Examples of nonrenewable energy resources are:
    - Fossil fuels
    - Fissile materials
- Examples of environmental effects could include:
    - Loss of habitat due to dams
    - Loss of habitat due to surface mining
    - Air pollution from burning of fossil fuels

Summative Assessment:

Summative Assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit. (all resources are available on the Mystery Science website)

- Individual Lesson Assessments
- Unit Assessments & Performance Tasks

Stage 3: Learning Plan

Mystery Science "Energizing Everything ~ Energy & Motion" Activities:

- **Anchor Phenomenon~ System Models** - Students create an initial conceptual model to explain how the owl's body parts work together to hunt. Then, the students conduct investigations to help them explain how the owl's body parts function as a system.

- **Lesson 1: How is your body similar to a car?** - Students build a model of an amusement park ride called the Twist-o-Matic. They use the model to carry out an investigation to examine the relationship between energy and speed. Students analyze and interpret data from their models, comparing the speed of the ride using a thin versus thick rubber band. (DCI: PS3.B, PS3.A)

- **Lesson 2: What makes roller coasters go so fast?** - Students build a model of a roller coaster and carry out an investigation using marbles. Students analyze and interpret data from the model to explain the connection between height, energy, and speed. Students also start to build an understanding of energy transfer as they observe what happens when additional marbles (additional collisions) are added to the model. (DCI: PS3.B, PS3.A)

- **Lesson 3: Why is the first hill of a roller coaster always the highest? -** Students conduct an investigation using a model roller coaster to determine how energy can be stored in the hills of the coaster. Students analyze and interpret data from the model to understand that marbles must start at the tops of hills so that they will have enough energy to reach the goal at the end of the track. (DCI: PS3.B)

- **Lesson 4: Could you knock down a building using only dominoes?** - Students begin to design a chain reaction machine. They start by figuring out how to connect two components of the chain reaction: the lever and the slide. This is the basis of the machine they will further develop in Lesson 5. (DCI: PS3.A, PS3.C, ETS1.A)

- **Lesson 5: Can you build a chain reaction machine?** Students design a chain reaction machine that displays a message at the end. The chain reaction machines use multiple components that transfer energy from one part to the next. (DCI: PS3.A, PS3.C, ETS1.A)

- **Lesson 6: What if there were no electricity?** Students design flashlights using batteries, lights and tin foil. Students experiment with different ways of constructing their flashlights so that they turn on and off. (DCI: PS3.A, PS3.C, ETS1.A)

- **Lesson 7: How long does it take to travel across the country before cars and planes?** Students build a paper spinner and conduct an investigation to explain how heat makes things move. (DCI: PS3.B, PS3.D)

- **Lesson 8: Where does energy come from?** Students evaluate the advantages and disadvantages of alternative energy sources to power a town. They obtain and evaluate information about the needs of each source of energy and analyze and interpret data about the town's resources. (DCI: PS3.D, ESS3.A)

- **Performance Task** - Students will design a Rube Goldberg machine that utilizes energy transfers and conversions to turn on a flashlight. Students apply what they've learned about storing, releasing, and transferring energy by building their own Rube Goldberg machine to turn on the flashlight they created in Mystery 6. To complete the performance task, students will need the ramps, levers, and various classroom materials from Mystery 4 and 5. They will also need their flashlight (with a switch) from Mystery 6.

Connection to STEM / Makerspace:

- Students will design a Rube Goldberg machine that utilizes energy transfers and conversions to turn on a flashlight. Students apply what they've learned about storing, releasing, and transferring energy by building their own Rube Goldberg machine to turn on the flashlight they created in Mystery 6. To complete the performance task, students will need the ramps, levers, and various classroom materials from Mystery 4 and 5. They will also need their flashlight (with a switch) from Mystery 6. (Mystery Science Performance Task)

Integrated accommodations and modifications for students with IEP's 504s, ELLs, and gifted and talented students:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tools such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
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List of Core Instructional and Supplemental Materials:

- Mystery Science online "Human Machine"
- Mystery Science hands-on materials
- Discovery Education
- Brainpop Educational Videos
- Readworks
- Epic
- Fossweb

Integration of 21st Century Skills and Life and Career Standard
CRP1, 2, 4, 6, 8, 11

Integration of the Technology Standard
NJSLS.8.1

Grade 4 Unit 3: "Birth of Rocks ~ Rock Cycle, Erosion, and Natural Hazards"
Source - NJSLS From Earth's Place in the Universe, Earth's Systems, Earth & Human Activity

Stage 1: Unit Summary

In this unit of study, students develop an understanding of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation. They will apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. This unit takes the perspective that every rock has a story. Students will develop an appreciation for the processes that shape the Earth's surface. After considering where volcanoes form and how they erupt, they turn to investigations of rocks breaking apart and creating potential hazards. Through hands-on investigation, students explore the world of rocks and design ways of protecting humans from their dangers.

This unit is based on **4-ESS2-1, 4-ESS1-1, 4-ESS2-2, 4-ESS3-2.**

Crosscutting Concepts:

Patterns

- Patterns can be used as evidence to support an explanation. (4-ESS1-1), (4-ESS2- 2)

Connections to Nature of Science

- Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes consistent patterns in natural systems. (4- ESS1-1)

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2- 1), (4-ESS3- 2)

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

- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Evidence Statements: NJSLS Science Unit Standards: 4-ESS2-1, 4-ESS1-1, 4-ESS2-2, 4-ESS3-2.

- **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.] **(4-ESS2-1)**
- **Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.] **(4-ESS1-1)**
- **Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.] **(4-ESS2-2)**
- **Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.] **(4-ESS3-2)**

Engineering Design:

- **3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- **3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- **3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Essential Questions:

1. How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?
2. What can rock formations tell us about the past?
3. What can maps tell us about the features of the world?
4. In what ways can the impacts of natural Earth processes on humans be reduced

Interdisciplinary Connections:

ELA/Literacy -

Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2) **RI.4.1**

Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2) **RI.4.7**

Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2) **RI.4.9**

Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1) **W.4.7**

Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS2-1)**,**(4-ESS1-1)**W.4.8**

Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1) **W.4.9**

Math -

Reason abstractly and quantitatively. (4-ESS2-1), (4-ESS1-1) **MP.2**

Model with mathematics. (4-ESS2-1), (4-ESS1-1) **MP.4**

Use appropriate tools strategically. (4-ESS2-1) **MP.5**

Know the relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1), (4-ESS1-1) **4.MD.A.1**

Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing

measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1) **4.MD.A.2**

Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2) **4.OA.A.1**

Stage 2- Assessment:

Essential Question 1: How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?

Concepts:

- Cause-and-effect relationships are routinely identified, tested, and used to explain change.
- Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
- Rainfall helps to shape the land and affects the types of living things found in a region.
- Living things affect the physical characteristics of their regions.

Formative Assessment:

Students who understand the concepts are able to:

- Identify, test, and use cause-and-effect relationships in order to explain change.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
- Make observations and/or measurements to produce evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (Note: Assessment is limited to a single form of weathering or erosion.) Examples of variables to test could include:
    - ✔ Angle of slope in the downhill movement of water
    - ✔ Amount of vegetation
    - ✔ Speed of the wind
    - ✔ Relative rate of deposition
    - ✔ Cycles of freezing and thawing of water
    - ✔ Cycles of heating and cooling
    - ✔ Volume of water flow

Essential Question 2: What can rock formations tell us about the past?
Concepts:

- Science assumes consistent patterns in natural systems.
- Patterns can be used as evidence to support an explanation.
- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.
- The presence and location of certain fossil types indicate the order in which rock layers were formed.

Formative Assessment:

Students who understand the concepts are able to:

- Support explanations using patterns as evidence.
- Identify the evidence that supports particular points in an explanation.
- Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (Note: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.) Examples of evidence from patterns could include
    - ✔ Rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time.
    - ✔ A canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.

Essential Question 3: What can maps tell us about the features of the world?

Concepts:

- Patterns can be used as evidence to support an explanation.
- Maps can help locate the different land and water features of Earth.
- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns.
- Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans.
- Major mountain chains form inside continents or near their edges.

Formative Assessment:

Students who understand the concepts are able to:

- Support an explanation using patterns as evidence.
- Analyze and interpret data to make sense of phenomena using logical reasoning.
- Analyze and interpret data from maps to describe patterns of Earth's features. Maps can include:
    - ✔ Topographic maps of Earth's land
    - ✔ Topographic maps of Earth's ocean floor
    - ✔ Locations of mountains
    - ✔ Locations of continental boundaries
    - ✔ Locations of volcanoes and earthquakes

Essential Question 4: In what ways can the impacts of natural Earth processes on humans be reduced?

Concepts:

- Cause-and-effect relationships are routinely identified, tested, and used to explain change.

- Engineers improve existing technologies or develop new ones to increase benefits, decrease known risks, and meet societal demands.
- A variety of hazards result from natural processes (e.g., earthquakes, floods, tsunamis, volcanic eruptions).
- Humans cannot eliminate the hazards, but they can take steps to reduce their impacts.
- Research on a problem should be carried out before beginning to design a solution.
- Testing a solution involves investigating how well it performs under a range of likely conditions.

Formative Assessments:

Students who understand the concepts are able to:

- Identify and test cause-and-effect relationships in order to explain change.
- Generate multiple solutions to a problem and compare them based on how well they meet the criteria and constraints of the design solution.
- Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans (Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.) Examples of solutions could include:
  - ✔ Designing an earthquake-resistant building
  - ✔ Improving monitoring of volcanic activity.
- Generate multiple possible solutions to a problem and compare them based on how well each is likely to meet the criteria and constraints of the problem.

Summative Assessment:

Summative Assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit. (all resources are available on the Mystery Science website)

- Individual Lesson Assessments
- Unit Assessment
- Performance Task

Stage 3: Learning Plan

<u>Mystery Science "Birth of Rocks ~ Rock Cycle, Erosion, and Natural Hazards" Activities:</u>

- **Anchor Phenomenon~ Fossils and Constructing Explanations** - Students generate observations and questions about the phenomenon and create an initial explanation to explain what killed the prehistoric animals, how their bones ended up underground, and what changes happened to the land that uncovered their fossils.

- **Lesson 1: Could a volcano pop up where you live?** - Students analyze and interpret data from recent volcanic eruptions. They use their findings as evidence for an argument that volcanoes are (or are not) likely to erupt in their backyard. (DCI: ESS1.C, ESS2.B)

- **Lesson 2: Why volcanoes explode?** - Students conduct an investigation to construct an explanation for why some volcanoes explode and why some do not. Students model thick and thin lava to conduct their investigations. (DCI: ESS2.B)

- **Lesson 3: Will a mountain last forever? -** Students conduct an investigation by modeling how rocks erode over time. Students construct an explanation for why rocks erode. (ESS2.A)

- **Lesson 4: How could you survive a landslide?** - Students design solutions to protect their "homes" from rock slides. Students argue for the merits of their design. (ESS3.B)

- **Performance Task -** Students will use their knowledge of how rocks form and how the earth changes over time to help geologists solve a puzzle. They analyze maps and photos from four locations to figure out which rocks were found in each place. Then, they support their claims with evidence. If you have time to extend the performance task, there is an optional writing extension in the last step.

Connection to STEM / Makerspace:

- Students will create earthquake resistant buildings. Students will use shake tables to model how their earthquake resistant designs respond to vigorous shaking. (Mystery Science Performance Task)

Integrated accommodations and modifications for students with IEP's 504s, ELLs, and gifted and talented students:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tools such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

List of Core Instructional and Supplemental Materials:

- Mystery Science online "Human Machine"
- Mystery Science hands-on materials
- Discovery Education
- Brainpop Educational Videos
- Readworks
- Epic
- Fossweb

Integration of 21st Century Skills and Life and Career Standard

CRP1, 2, 4, 6, 8, 11

Integration of the Technology Standard

NJSLS.8.1

Grade 4 Unit 4: "Waves of Sound ~ Sound, Waves, & Communication"
Source - NJSLS From Waves and Their Applications in Technologies for Information Transfer

Stage 1: Unit Summary

In this unit of study, students use a model of waves to describe patterns of waves in terms of amplitude and wavelength and to show that waves can cause objects to move. This unit helps students develop the idea that sound is an actual thing, a wave of vibrations traveling through the air. Equipped with this understanding, students can begin to make sense of how sound and music work.

This unit is based on 4- **PS4-1 and 4- PS4-3**.

Crosscutting Concepts:

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (4- PS4-1)
  Similarities and differences in patterns can be used to sort and classify designed products. (4- PS4-3)

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4- 3)

Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence

- Science findings are based on recognizing patterns. (4-PS4-1)

Evidence Statements: NJSLS Science Unit Standards: 4-PS4-1 and 4-PS4-3.

- **Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.] **(4-PS4-1)**
- **Generate and compare multiple solutions that use patterns to transfer information.** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.] **(4-PS4-3)**

Engineering Design:

• **3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

• **3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

• **3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify
aspects of a model or prototype that can be improved.

Essential Questions:

1. How can we use waves to gather and transmit information?
2. Which team can design a way to use patterns to communicate with someone across the room?

Interdisciplinary Connections:
ELA / Literacy -

Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3) **RI.4.1**

Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3) **RI.4.9**

Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1) **SL.4.**5

Mathematics -

Model with mathematics. (4-PS4-2),(3-5-ETS1-2),(3-5-ETS1-3) **MP.4**

Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2) **4.G.A.1**

Stage 2- Assessment:

Essential Question 1: How can we use waves to gather and transmit information?

Concepts:

- Science findings are based on recognizing patterns.
- Similarities and differences in patterns can be used to sort and classify natural phenomena.
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface.
- When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks)

Formative Assessments:

Students who understand the concepts can:

- Sort and classify natural phenomena using similarities and differences in patterns.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle.
- Develop a model (e.g., diagram, analogy, or physical model) of waves to describe patterns in terms of amplitude and wavelength, and that waves can cause objects to move. (Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength).

Essential Question 2: Which team can design a way to use patterns to communicate with someone across the room?

Concepts:

- Similarities and differences in patterns can be used to sort and classify designed products.
- Knowledge of relevant scientific concepts and research findings is important in engineering.
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.
- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—that is, convert it from digitized form to voice and vice versa.

- Different solutions need to be tested in order to determine which of them best solve the problem, given the criteria and the constraints.
- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.

Formative Assessments:

Students who understand the concepts can:

- Sort and classify designed products using similarities and differences in patterns.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Generate and compare multiple solutions that use patterns to transfer information. Examples of solutions could include:
  - ✔ Drums sending coded information through sound waves;
  - ✔ Using a grid of ones and zeroes representing black and white to send
  - ✔ information about a picture;
  - ✔ Using Morse code to send text.

Summative Assessment:

Summative Assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit. (all resources are available on the Mystery Science website)

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Stage 3- Learning Plan:

<u>Mystery Science "Waves of Sound ~ Sound, Waves, & Communication" Activities:</u>

- **Anchor Phenomenon -** In the Unit Starter, students are introduced to the unit anchoring phenomenon, a music video by composer Nigel Stanford, that showcases a series of devices that make sound waves visible. In the activity, they create an initial conceptual model to explain how each device works.

- **Lesson 1: How far can a whisper travel?** - Students document their understanding of how vibrations travel using a model of their paper cup telephones. Students then design their own series of investigations to figure out how to make their telephone work better in different circumstances. Students construct an explanation of how the telephone works. Students extend the lesson by developing a way to send a message using a pattern of sounds. (DCI: PS4-A)

- **Lesson 2: What would happen if you screamed in outer space?** - Students conduct investigations with balloons to experience the vibrations caused by the sound of their voices. Students construct an explanation that sound is a vibration. Students then develop a model to explain how sound travels through a medium and how it can cause distant objects to move. (DCI: PS4-A)

- **Lesson 3: Why are some sounds high and some sounds low? -** Students analyze and interpret data from oscilloscopes to determine how wavelengths differ between high and low pitch sounds. Students make claims and argue from evidence about which wavelength patterns were generated from different pitches. Students then use a

rope to model waves created by different pitches and begin to explore the relationship between wavelength and frequency. (DCI: PS4-A)

- **Performance Task "Sound Waves & Engineering"** - In this performance task, students apply what they've learned about sound and sound waves by building their own Sound Wave Watcher that uses the vibrations of sound to make visible patterns.

Connections to STEM / Makerspace:

- **Performance Task "Sound Waves & Engineering"** - In this performance task, students apply what they've learned about sound and sound waves by building their own Sound Wave Watcher that uses the vibrations of sound to make visible patterns. (Mystery Science Performance Task)

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Pacing Guide

Units	NJSLS	Marking Period	Duration in Weeks
Unit 1 - “Human Machine”	4-LS1-1; 4-PS4-2; 4-LS1-2	1	10 Weeks
Unit 2 - “Energizing Everything”	4-PS3-1, 3; 4-ESS3-1; 4-PS3-2,4; 3-5-ETS1-1,2	2	10 Weeks
Unit 3 - “Birth of Rocks”	4-ESS2-1,2; 4-ESS1-1; 4-ESS3-2; 3-5-ETS1-2,3	3	10 Weeks
Unit 4 -“Waves of Sound”	4-PS4-1,3; 3-5-EST-1-2	4	10 Weeks