Commercial Township School District

Content Area: Science

Grade: 4

Unit 1: Weathering and Erosion

Unit Duration: 10 Days

Unit Summary
What do the shapes of landforms and rock formations tell us about the past? In this unit of study, students develop understandings of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation. The crosscutting concepts of patterns and cause and effect are called out as organizing concepts. Students demonstrate grade-appropriate proficiency in planning and carrying out investigations and constructing explanations. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 4-ESS2-1 and 4-ESS1-1.
Objectives
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)

<table>
<tr><th colspan="2">Unit Sequence</th></tr>
<tr><td colspan="2">Part A: How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?</td></tr>
<tr><th>Concepts</th><th>Formative Assessment</th></tr>
<tr><td>• 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</td><td>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 water ✔ Cycles of freezing and thawing of water

✔Cycles of heating and cooling ✔Volume of water flow

Formative assessments may include:

● Pre-assessments ● Labs ● Quizzes ● Project and problem-based learning activities ● Graphic organizers ● Short research projects ● Collaborative learning projects ● Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) ● Exit Tickets</td></tr>
<tr><th>Unit Resources</th><th>District/School Summative Assessments</th></tr>
<tr><td>● Scott Foresman Science: Chapter 9 Lessons 1 & 2 (2-3 days)
● Directed Inquiry p. 260 “How can you observe a mineral wear away?” (1 day)
● Glaciers, Water, and Wind, Oh My! This hands-on activity allows students to explore five earth forces that may cause erosion as they model, observe, and record the effects of erosion on earth surfaces. Stations include demonstrations of chemical, wind, water, ice and heat forces as they affect weathering.
● Bill Nye Video- Erosion : Bill Nye, "The Science Guy", presents a video describing the effects of weathering (wind, water, ice) on landforms. Bryce Canyon is used as an example of the ways in which freezing water, plant roots, and wind weather the earth's surface creating the means for erosion. Students in video simulate effects of weathering</td><td>Summative Assessment 1:

Standards:4-ESS2-1 Type: Lab Overview: Through this hands on activity, students explore different forms of erosion: chemical, water, wind, glacier, and temperature. They will rotate through stations and model each type of erosion on rocks, soils, and minerals. Students will record observations and discuss the effects of erosion on the Earth’s landscape.

● Students use materials such as water, soil, and rocks to model erosion. Rubric:http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474(This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook)</td></tr>
</table>

which can be duplicated in a classroom setting. Nye also emphasizes the passage of time in millions of years as he explains the slower erosive effects of certain types of weathering. 26 min. (1 day) ● Gary's Sand Journal: This book allows students to observe illustrations of magnified sand particles with guided dialogue from an earth scientist who discusses sand origins. This book can be used to introduce students to types of sand, explain how earth processes were responsible for their creation, and discuss the work of earth scientists. After reading this book, students may use it as a resource when examining their own sand samples. They could list properties, discuss sand origins, and illustrate samples in a science journal. ● Weather and Erosion Sorting Activity (1 day): https://drive.google.com/drive/u/0/folders/1ELzxJnsDw2NrWnyfn4N8okIXcYDIHQrB?ogsrc=32 ● Weathering, Erosion & Deposition worksheet chart (1 day) https://drive.google.com/drive/u/0/folders/1ELzxJnsDw2NrWnyfn4N8okIXcYDIHQrB?ogsrc=32 ● Weathering and Erosion Quiz (1 day) https://drive.google.com/drive/u/0/folders/1ELzxJnsDw2NrWnyfn4N8okIXcYDIHQrB?ogsrc=32	Resources: https://www.teachengineering.org/activities/view/cub_earth_lesson5_activity1OR (Decide as a grade level which to use as a summative) Summative Assessment 2: Standards: 4-ESS2-1, 3-5-ETS1-2 Type: Lab Overview: Through this hands on activity, students explore different forms of weathering and erosion by plants, wind, water, and ice. Coastal erosion is also explored. Students keep a science notebook and make observations. They will design a model showing how humans can slow erosion. Rubric: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link brings you to a page with links for an entire weathering unit. The first link is the rubric for a science notebook) Resources: http://www.cpalms.org/Public/PreviewResourceUpload/Preview/13474 (This link has several links for an entire weathering unit. As a grade level, we will decide which lab to complete as a summative assessment)

Unit Sequence	
Part B: What can rock formations tell us about the past?	
Concepts	**Formative Assessments**
• 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.	• 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. Formative assessments may include: ● Pre-assessments ● Labs ● Quizzes ● Project and problem-based learning activities ● Graphic organizers ● Short research projects ● Collaborative learning projects ● Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) ● Exit Tickets

Interdisciplinary Connections
English Language Arts/Literacy To support integration of the language arts standards in this unit, students can read content-specific texts to deepen their understanding of the cause-and-effect relationships within earth systems. As they read, students should take notes, which can be used to help them understand and explain how earth processes affect the world around them. They should ask questions, such as, What types of soil erode faster? Why do some rocks weather more easily or more quickly than others? What patterns of change can be observed using models? As they attempt to answer these questions, students can cite evidence from observations and from texts to support their thinking. In addition, students can conduct short research projects that will help them gather additional evidence to support explanations. Throughout this unit, students should collect and record data in science journals and analyze the data to identify patterns of change. Mathematics To support integration of the Mathematics standards into this unit, students are expected to use mathematics when analyzing quantitative data to identify patterns, explain cause-and-effect relationships, and make predictions. Students need opportunities to measure earth materials using tools, such as balances and graduated cylinders, and to measure distances and heights using rulers or tape measures. Students should also be required to solve problems involving measurement and data.

Future Learning
Grade 5 Unit 4: Water on Earth • Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. **Grade 5 Unit 5: Earth Systems** • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.
Prior Learning
Grade 2 Unit 4: The Earth's Land and Water • Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. • Maps show where things are located. One can map the shapes and kinds of land and water in any area. **Grade 2 Unit 5: Changes to Earth's Land** • Wind and water can change the shape of the land.

Modifications
Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted students. Modifications may include: ● *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 tool 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 understandings.* ● *Use project-based science learning to connect science with observable phenomena*

21st Century Themes and Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy Environmental Literacy Health Literacy Creativity & Innovation Communication & Collaboration Media Literacy Critical Thinking & Problem Solving Information Literacy Information, Communication, & Technology Life & Career Skills

Commercial Township School District

Content Area: Science

Grade: 4

Unit 2: Earth Processes

Unit Duration 10 Days

Unit Summary
Is it possible to engineer ways to protect humans from natural Earth? In this unit of study, students 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. The crosscutting concepts of patterns, cause and effect, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, and constructing explanations and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas. **This unit is based on 4-ESS2-2, 4-ESS3-2, 3-5-ETS1-2, and 3-5-ETS1-3.**
Student Learning Objectives
Analyze and interpret data from maps to describe patterns of Earth's features. 4-ESS2-2

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.
Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. 4-ESS3-2 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.
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(3-5-ETS1-3)
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-ETS1-2)

<table>
<tr><th colspan="2">Unit Sequence</th></tr>
<tr><td colspan="2">Part A: What can maps tell us about the features of the world?</td></tr>
<tr><th>Concepts</th><th>Formative Assessment</th></tr>
<tr><td>• 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.</td><td>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
Formative assessments may include:
● Pre-assessments ● Labs ● Quizzes ● Project and problem-based learning activities ● Graphic organizers ● Short research projects ● Collaborative learning projects ● Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) ● Exit Tickets</td></tr>
<tr><th>Unit Resources</th><th>District/School Summative Assessments</th></tr>
<tr><td>● Scott Foresman Science: Chapter 7 Lessons 1 & 2 (2-3 days)
● Directed Inquiry p. 212 "How can you observe a mineral wear away?" (1 day)
● Guided Inquiry p. 226 "Where is the hurricane going? (1day)
● Ranking Hurricanes: Math in Science- p. 228 (1day)</td><td>Summative Assessments: In correlation with the NGSS, students must demonstrate the following as summative assessments:
● Analyze and interpret data from maps to describe patterns of Earth's features (4-ESS2-2.) .</td></tr>
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● DLESE Earth Science Literacy Maps are a tool for teachers and students to find resources that relate to specific Earth science concepts. These maps illustrate connections between concepts and how they build upon one another across grade levels. Clicking on a concept within the maps will show DLESE resources related to the concept, as well as information about related AAAS Project 2061 Benchmarks and National Science Education Standards. ● Earthquakes in the Classroom: Students investigate which building types are structured to withstand earthquake damage. They take on the role of engineers as they design their own earthquake resistant buildings, then test them in a simulated earthquake activity. Students also develop an appreciation for the job of engineers who need to know about earthquakes and their causes in order to design resistant buildings. This lesson is one of several in the "Earthquakes Rock" unit provided by the Teach Engineering site. The unit "URL" listed here is not being reviewed for the Performance Expectation listed. It is offered as a supplemental concept and lesson background aid for teachers. https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_natdis/cub_natdis_lesson03.xml ● Engineering for the Three Little Pigs: This activity helps to demonstrate the importance of rocks, soils, and minerals in engineering and how using the right material for the right job is important. The students build 3 different sand castles composed of varying amounts of sand, water, and glue. The 'buildings' in this lesson are made of sand and glue, sand being a soil and glue being composed of different minerals. They then test them for strength (load bearing), and resistance to weathering. The students will then compare possible solutions and discuss how well each is likely to work while meeting the criteria and constraints of the problem. The students will be the engineers who figure out which materials are best for the buildings they are making, taking into consideration all the properties of materials that are discussed in the lesson.	● Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time (4-ESS1-1) Other summative assessments will include but are not limited to: projects, summative tests, lab skills demonstrations, and vocabulary quizzes.

Unit Sequence	
Part B: In what ways can the impacts of natural Earth processes on humans be reduced?	
Concepts	**Formative Assessment**

● 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. ● At whatever stage, communicating with peers about proposed solutions to a problem 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.	*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. ● 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. Formative assessments may include: ● Pre-assessments ● Labs ● Quizzes ● Project and problem-based learning activities ● Graphic organizers ● Short research projects ● Collaborative learning projects ● Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) ● Exit Tickets
Unit Resources	**District/School Summative Assessments**
	Summative Assessments: In correlation with the NGSS, students must demonstrate the following as summative assessments: ● 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. ● 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. Other summative assessments will include but are not limited to: projects, summative tests, lab skills demonstrations, and vocabulary quizzes.

Interdisciplinary Connections

English Language Arts To support integration of the CCSS for English Language Arts

In this unit, students should have access to multiple sources of information about Earth's features and earth processes. Students should have opportunities to read, analyze, and interpret information from nonfiction text, charts, graphs, diagrams, timelines, and interactive elements on the Internet. Students use this information, along with data they collect during investigations, to help explain, both orally and in writing, the patterns they observe in the features of the Earth and in the natural hazards that occur on the Earth. As students engage in the engineering design process, they need opportunities to conduct research to build their understanding of how earth processes affect humans and to find examples of ways in which engineers reduce the effect of volcanic eruptions, earthquakes, floods, and tsunamis. Students should take notes as they read and summarize or paraphrase their notes to support their work throughout the engineering design process. In addition, students should provide a list of sources when using this type of information.

Mathematics

Use measurements to determine how far earthquakes and volcanoes tend to occur from continental boundaries. • Analyze data to determine patterns of change that occur in areas where volcanoes erupt, earthquakes occur, and in flood zones. • Reason abstractly and quantitatively to draw diagrams to build scale models. • Analyze timelines, charts, and graphs to determine patterns in Earth's features and patterns of change caused by earth processes. • Reason abstractly and quantitatively when discussing the effects of an earth process on humans. For example, on average, 3,000 lives are lost every year due to tsunamis. When early warning systems are in place, fewer than 1,000 lives are lost annually. • Analyze constraints on materials, time, or cost to in order to determine criteria for design solutions.

Future Learning

Grade 5 Unit 4: Water on the Earth

• Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

Prior Learning

Grade 2 Unit 4: The Earth's Land and Water

- Maps show where things are located. One can map the shapes and kinds of land and water in any area.
- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.

Modifications

Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted students may include:

- *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 tool 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 understandings.*
- *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.*
- *Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*
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21st Century Themes and Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy Environmental Literacy Health Literacy Creativity & Innovation Communication & Collaboration Media Literacy Critical Thinking & Problem Solving Information Literacy Information, Communication, & Technology Life & Career Skills

Commercial Township School District

Content Area:

Grade: 4

Unit: 3: Structure and Function

Unit Duration 10 Days

Unit Summary
How do the internal and external parts of plants and animals support their survival, growth, behavior, and reproduction. In this unit of study, students develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. The crosscutting concepts of systems and system models are called out as organizing concepts for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency in engaging in argument from evidence. Students are also expected to use this practice to demonstrate understanding of the core idea. **This unit is based on 4-LS1-1.**
Student Learning Objectives
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. 4-LS1-1 Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.

Unit Sequence	
Part A: How do internal and external parts of plants and animals help them to survive, grow, behave, and reproduce?	
Concepts	**Formative Assessment**
• A system can be described in terms of its components and their interactions.	*Students who understand the concepts are able to:* • Describe a system 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.	• Assessment is limited to macroscopic structures within plant and animal systems. Examples of structures could include: ✔Thorns ✔Heart ✔Stems ✔Stomach ✔Roots ✔Lung ✔Colored petals ✔Brain ✔Skin Formative assessments may include: ● Pre-assessments ● Labs ● Quizzes ● Project and problem-based learning activities ● Graphic organizers ● Short research projects ● Collaborative learning projects ● Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) ● Exit Tickets
Unit Resources	**District/School Summative Assessments**
• Scott Foresman Science: Chapter 1 Lessons 1 -5 (5-7 days) • Scott Foresman Science: Chapter 2 Lessons 1 -4 (4-5 days) • Scott Foresman Science: Chapter 5 Lessons 1 -4 (4 days) • *Symmetry in Nature: Math in Science- p. 36 (1 day)* • *Animal Mouth Structures In this lesson, students gather evidence to understand features that enable them to meet their needs. In particular, they examine the mouth structures of different animals to help them understand how animals are adapted to obtain food in their environment.*	Summative Assessments: In correlation with the NGSS, students must demonstrate the following as summative assessments: • Construct an argument with evidence, data, and/or a model. • Construct an argument to support the claim that plants have internal and external structures that function to support survival, growth, behavior, and reproduction. Other summative assessments will include but are not limited to: projects, summative tests, lab skills demonstrations, and vocabulary quizzes.

Interdisciplinary Connections
English Language Arts Students use the evidence from their observations of plants and animals to support the claim that all organisms are systems with structures that function in growth, survival, behavior, and/or reproduction. Students need opportunities to observe plants and animals closely, taking notes and drawing pictures, so that they can describe various structures and their functions. **Mathematics** Students describe the symmetry that can be observed in an organism's structures. For example, the leaves of many plants and the bodies of many animals display bilateral symmetry. Students should be encouraged to draw each organism that they observe, pointing out any structures that are symmetrical. Students should also trace lines of symmetry in their drawings to support their thinking. In addition, students can conduct research to determine whether the symmetry serves a function in the growth, reproduction, or survival of the organism.

Future Learning
Grade 7 Unit 4: Structure and Function ● All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). ● Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. ● In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. Con
Prior Learning
Grade 1 Unit 3: Mimicking Organisms to Solve Problems ● All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. ● Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

Modifications
Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted students may include: ● *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 tool 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 understandings.* ● *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.* ● *Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*

21st Century Themes and Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy Environmental Literacy Health Literacy Creativity & Innovation Communication & Collaboration Media Literacy Critical Thinking & Problem Solving Information Literacy Information, Communication, & Technology Life & Career Skills Stage 2-Assessment Evidence

Commercial Township School District

Content Area:

Grade: 4

Unit: 4 How Organisms Process Information

Unit Duration: 10 days

Unit Summary
How do animals use their perceptions and memories to make decisions? 4-LS1-2 and 4-PS4-2. In this unit of study, students are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. The crosscutting concepts of cause and effect, systems and system models, and structure and function are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in developing and using models. Students are expected to use these practices to demonstrate understanding of the core ideas.
Student Learning Objectives
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. 4-LS1-2 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.
Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. 4-LS4-2 Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.

Unit Sequence	
Part A: How do animals receive and process different types of information from their environment in order to respond appropriately?	
Concepts	**Formative Assessment**
● 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.	*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. ● 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.
Unit Resources	**District/School Summative Assessments**

• Pinhole Cameras and Eyes: In this activity, students make a pinhole camera and see images formed on an internal screen. They then use a lens to see how this affects the images. Students investigate variables in its construction, and explore how it models the human eye's ability to receive and process information. • The Life of Environments This unit is designed to address the concept that organisms sense the environment in order to live. It is a far-ranging and comprehensive unit that is designed to address multiple NGSS performance expectations (4-LS1-2, 4LS1-2, 4-PS3-2, 4-PS4-2) in seven explorative sections, with an additional summative assessment step. •	Summative Assessment: Standards: 4-LS1-1 Type: Exam Overview: Students will synthesize information gathered throughout the unit by completing the end of unit exam. Students will be asked to prove animals have internal and external structures that function to support survival, growth, behavior, and reproduction. Rubric: Resources: Student science notebooks

Unit Sequence	
Part B: What happens when light from an object enters the eye?	
Concepts	**Formative Assessment**
• Cause-and-effect relationships are routinely identified. • An object can be seen when light reflected from its surface enters the eyes	*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).*
Unit Resources	**District/School Summative Assessments**
• Pinhole Cameras and Eyes	Summative Assessment : Standards: 4-LS1-2 Type: Lab Overview:In this activity, students make a pinhole camera and see images formed on an internal screen. They then use a lens to see how this affects the images. Students investigate variables in its construction, and explore how it models the human eye's ability to receive and process information. Students will draw models of how light enters the human eye and relate this to the pinhole cameras. Resources: http://ngss.nsta.org/Resource.aspx?ResourceID=88

Interdisciplinary Connections

English Language Arts

Students should use text and online media resources when appropriate to help them understand how animals receive and process information they receive from the environment, and to develop a conceptual understanding of what happens when light reflects off objects and enters the eye. They should also use visual displays to enhance their observations and explanations of the concepts in this unit of study.

Mathematics

Students should model with mathematics as they draw points, lines, line segments, and angles to describe how light behaves when coming into contact with lenses, mirrors, and other objects. Students will also use points, lines, and angles when drawing pictures and diagrams that show how light reflects off objects and into the pinhole viewer or into the human eye.

Future Learning

Grade 7 Unit 4: Structure and Function

- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.

Grade 7 Unit 5: Body Systems

- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.
- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

Grade 8 Unit 7: Electromagnetic Radiation

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

Prior Learning

Grade 1 Unit 4: Light and Sound

• Objects can be seen if light is available to illuminate them or if they give off their own light.
• Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam.

Modifications

Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted 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 tool 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 understandings.*
- *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.*
- *Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*

21st Century Themes and Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy Environmental Literacy Health Literacy Creativity & Innovation Communication & Collaboration Media Literacy Critical Thinking & Problem Solving Information Literacy Information, Communication, & Technology Life & Career Skills Stage 2- Assessment Evidence

Commercial Township School District

Content Area:

Grade: 4

Unit: 5 Transfer of Energy

Unit Duration 15 days

Unit Summary
Where do we get the energy we need for modern life? 4-PS3-2 and 4-ESS3-1. In this unit of study, fourth-grade students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents. Students also obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. The crosscutting concepts of cause and effect, energy and matter, and the interdependence of science, engineering, and technology, and influence of science, engineering, and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade appropriate proficiency in planning and carrying out investigations and obtaining, evaluating, and communicating information. Students are also expected to use these practices to demonstrate understanding of the core ideas.
Student Learning Objectives
Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. 4-PS3-2 Assessment does not include quantitative measurements of energy.
Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4-ESS3-1

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.

<table>
<tr><th colspan="2">Unit Sequence</th></tr>
<tr><td colspan="2">Part A: How does energy move?</td></tr>
<tr><th>Concepts</th><th>Formative Assessment</th></tr>
<tr><td>

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 are moving objects, 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.

</td><td>
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.

</td></tr>
<tr><th>Unit Resources</th><th>District/School Summative Assessments</th></tr>
<tr><td></td><td>
Summative Assessments:

In correlation with the NGSS, students must demonstrate the following as summative assessments:

Use evidence to construct an explanation relating the speed of an object to the energy of that object (4- PS3-1.)
Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. (4-PS3-2.)
Ask questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3- 3).
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another 4- PS3-4).
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-ETS1-1.)
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-ETS1-2.)
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. (3-5-ETS1-3.)

</td></tr>
</table>

	Other summative assessments will include but are not limited to: projects, summative tests, lab skills demonstrations, and vocabulary quizzes.

Unit Sequence	
Part B: From what natural resources are energy and fuels derived? In what ways does the human use of natural resources affect the environment?	
Concepts	**Formative Assessment**
● 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.	*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 o Loss of habitat due to surface mining ✔Air pollution from burning of fossil fuels.
Unit Resources	**District/School Summative Assessments**
● Scott Foresman Science: Chapter 13 Lessons 1 - 2 (2 days) ● Scott Foresman Science: Chapter 14 Lessons 1 & 3 (2 days) ● Switch Energy Project: The Educator Portal provides free access to a documentary, energy labs, videos, and study guides. ● Wind Generator: Windmills have been used for hundreds of years to collect energy from the wind in order to pump water, grind grain, and more recently generate electricity. There are many possible designs for the blades of a wind generator and engineers are always trying new ones. Design and test your own wind generator, then try to improve it by running a small electric motor connected to a voltage sensor. ● Thermal Energy Transfer: Explore the three methods of thermal energy transfer: conduction, convection, and radiation, in this interactive from WGBH, through animations and real-life examples in Earth and space science, physical science, life science, and technology.	

Interdisciplinary Connections

English Language Arts

Students will conduct research to build their understanding of energy, transfer of energy, and natural sources of energy. Students will recall relevant information from in-class investigations and experiences and gather relevant information from print and digital sources. They should take notes and categorize information and provide a list of sources. Students also draw evidence from literary and information texts in order to analyze and reflect on their findings. Students can also read, take notes, and construct responses using text and digital resources such as Scholastic News, Nat Geo Kids, Study Jams (Scholastic), Reading A–Z.com, NREL.com, switchenergyproject.com, and NOVA Labs by PBS.

Mathematics

Students reason abstractly and quantitatively as they gather and analyze data during investigations and while conducting research about transfer of energy and energy sources. Students model with mathematics as they represent and/or solve word problems. As students research the environmental effects of obtaining fossil fuels, they might be asked to represent a verbal statement of multiplicative comparison as a multiplication equation. For example, students might find information about a spill that was 5 million gallons of oil and was 40 times larger that a previous oil spill in the same location. They can be asked to represent this mathematically using an equation to determine the number of gallons of oils that were spilled in the previous event.

Future Learning

Grade 5 Unit 5: Earth Systems

- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.

Grade 7 Unit 7: Organization for Matter and Energy in Organisms

- 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.(secondary)
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary)

Grade 7 Unit 8: Earth Systems

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.
- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

Grade 8 Unit 3: Stability and Change on Earth

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

Grade 8 Unit 4: Human Impact

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- 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.
- 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 the 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.

Prior Learning

There are no disciplinary core ideas that are considered prior learning for the concepts in this unit of study.

Modifications

Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted 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 tool 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 understandings.*
- *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.*
- *Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*

21st Century Themes and Skills

Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy Environmental Literacy Health Literacy Creativity & Innovation Communication & Collaboration Media Literacy Critical Thinking & Problem Solving Information Literacy Information, Communication, & Technology Life & Career Skills Stage 2- Assessment Evidence

Commercial Township School District

Content Area:

Grade: 4

Unit: 6 Force and Motion

Unit Duration: 15 Days

Unit Summary
What is the relationship between the speed of an object and the energy of that object? 4-PS3-1 and 4-PS3-3. In this unit of study, students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object, and are expected to develop an understanding that energy can be transferred from object to object through collisions. The crosscutting concept of energy and matter is called out as an organizing concept. Students are expected to demonstrate grade-appropriate proficiency in asking questions, defining problems, and constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.
Student Learning Objectives
Use evidence to construct an explanation relating the speed of an object to the energy of that object. 4-PS3-1 Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.
Ask questions and predict outcomes about the changes in energy that occur when objects collide. 4- PS3-3 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.

Unit Sequence	
Part A: What is the relationship between the speed of an object and its energy?	
Concepts	**Formative Assessment**
• Energy can be transferred in various ways and between objects. • The faster a given object is moving, the more energy it possesses.	*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.)
Unit Resources	**District/School Summative Assessments**
• Scott Foresman Science: Chapter 15 Lessons 1 -3 (3 days) • Chapter 15 Directed Inquiry- page 437 (1 day) • Chapter 15 Guided Inquiry- page 450 (1 day) • Spool Racers: This resource includes three parts: a video clip from the TV show, Zoom, to introduce the activity, an essay with background information about energy, and a set of printable instructions. Students use a spool, a toothpick, a washer, a rubber band, and a pencil to build a racer. They conduct tests with the racer by varying the number of twists in the rubber band or changing other design features. These websites provide additional ideas for modifying the basic rubber band	Summative Assessment: Standards: 4-PS3-4, 4-PS3-1 Type: Lab Overview: Students use a spool, a toothpick, a washer, a rubber band, and a pencil to build a racer. They conduct tests with the racer by varying the number of twists in the rubber band or changing other design features. Students relate the speed of the object to the stored energy in the object. Resources: https://nj.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsplcar/potential-and-kinetic-energy-spool-racer/#.WXCv4tTyu70

racer design: http://www.scienceworld.ca/resources/activities/popcan-porsche and http://pbskids.org/designsquad/build/rubber-band-car/. ● Force and Motion: This video segment from IdahoPTV's D4K defines gravity, force, friction and inertia through examples from amusement park rides. Examples and explanations of Sir Isaac Newton's Three Laws of Motion are also included. ● Advanced High-Powered Rockets: Students select a flight mission (what they want the rocket to do) and design and construct a high-power paper rocket that will achieve the mission. They construct their rocket, predict its performance, fly the rocket, and file a post-flight mission report. Missions include achieving high altitude records, landing on a "planetary" target, carrying payloads, testing a rocket recovery system, and more.	

Unit Sequence	
Part B: In what ways does energy change when objects collide?	
Concepts	**Formative Assessment**
● 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.	*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).
Unit Resources	**District/School Summative Assessments**
● Scott Foresman Science: Chapter 15 Lessons 1 -3 (3 days) ● Chapter 15 Directed Inquiry- page 437 (1 day) ● Chapter 15 Guided Inquiry- page 450 (1 day) ● Spool Racers: This resource includes three parts: a video clip from the TV show, Zoom, to introduce the activity, an essay with background information about energy, and a set of printable instructions. Students use a spool, a toothpick, a washer, a rubber band, and a pencil to build a racer. They conduct tests with the racer by varying the number of	

twists in the rubber band or changing other design features. These websites provide additional ideas for modifying the basic rubber band racer design: http://www.scienceworld.ca/resources/activities/popcan-porsche and http://pbskids.org/designsquad/build/rubber-band-car/. ● Force and Motion: This video segment from IdahoPTV's D4K defines gravity, force, friction and inertia through examples from amusement park rides. Examples and explanations of Sir Isaac Newton's Three Laws of Motion are also included. ● Advanced High-Powered Rockets: Students select a flight mission (what they want the rocket to do) and design and construct a high-power paper rocket that will achieve the mission. They construct their rocket, predict its performance, fly the rocket, and file a post-flight mission report. Missions include achieving high altitude records, landing on a "planetary" target, carrying payloads, testing a rocket recovery system, and more.	

Interdisciplinary Connections
English Language Arts Students will conduct a short research project to build their understanding of the transfer of energy (motion, heat, and sound) in force and motion systems. They will need access to a variety of texts and should use information from their class experiences and from print and digital sources to write informative/explanatory texts. As students gather information, they should take notes and categorize information. In their writing, students should detail what they observed as they investigated simple force and motion systems, describe procedures they followed as they conducted investigations, and use information from their observations and research to explain the patterns of change that occur when objects move and collide. As students participate in discussions and write explanations, they should refer specifically to text, when appropriate. **Mathematics: This unit does not have any interdisciplinary connections to mathematics**

Future Learning
Grade 6 Unit 4: Forces and Motion ● 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). ● 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.

- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

Grade 6 Unit 5: Types of Interactions

- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the

Grade 4 Model Science Unit 6: Force and Motion

- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

Grade 8 Unit 5: Relationships among Forms of Energy

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Prior Learning

Kindergarten Unit 1: Pushes and Pulls

- When objects touch or collide, they push on one another and can change motion.

Grade 3 Unit 2: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual used at this level.)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Modifications

Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted 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 tool 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 understandings.*
- *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.*
- *Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*

21st Century Themes and Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy, Civic Literacy, Environmental Literacy, Health Literacy, Creativity & Innovation, Communication & Collaboration, Media Literacy, Critical Thinking & Problem Solving, Information Literacy Information, Communication & Technology, Life & Career Skills

Commercial Township School District

Content Area:

Grade: 4

Unit: 7 Using Engineering Design with Force and Motion Systems

Unit Duration: 15 Days

Unit Summary
How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another? **4-PS3-4, 3-5-ETS1-1, 3-5-ETS1-2, and 3-5-ETS1-3** In this unit of study, students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents or from objects through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of energy and matter and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, planning and carrying out investigations, constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate their understanding of the core ideas.
Student Learning Objectives
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. 4-PS3-4 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.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.
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-ETS1-1
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-ETS1-2)
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. (3-5-ETS1-3)

Unit Sequence

Part A: How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?

Concepts	**Formative Assessment**
● Science affects everyday life. ● Most scientists and engineers work in teams. ● Engineers improve existing technologies or develop new ones. ● People's needs and wants change over time, as do their demands for new and improved technologies. ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. ● 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 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.	*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.
Unit Resources	**District/School Summative Assessments**
● The Sound of Science: Students are given a scenario/problem that needs to be solved: Their school is on a field trip to the city to listen to a rock band concert. After arriving at the concert, the students find out that the band's instruments were damaged during travel. The band needs help to design and build a stringed instrument with the available materials, satisfying the following criteria and constraints: 1) Produce	Summative Assessment Standards: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3, 4-PS3-4 Type: Lab Overview: Students will complete a "Design Challenge". Design and build a simple device that converts energy from one form to another (motion energy to electric

three different pitched sounds. 2) Include at least one string. 3) Use only available materials. 4) Be no longer than 30 cm / 1 foot. The challenge is divided into 4 activities. Each activity is designed to build on students' understanding of the characteristics and properties of sound. By using what they learn about sound from these activities, students are then encouraged to apply what they know about sound to complete the engineering design challenge. ● Energy Makes Things Happen: The Boy Who Harnessed the Wind: This article from Science and Children provides ideas for using the trade book, The Boy Who Harnessed the Wind, as a foundation for a lesson on generators. This beautiful book is the inspiring true story of a teenager in Malawi who built a generator from found materials to create much-needed electricity. The lesson allows students to explore the concept of energy transfer using crank generators. Students then design improvements to the crank mechanism on the generator. The lesson may be extended by having students build their own generators.	energy OR stored energy to cause motion or produce light or sound.). Students will research objects with "stored energy" such as stretched rubber bands, batteries, wind up toys, etc. Students work in small groups to build their device. Students will create a poster to display the energy transfer Resources: Lab Materials

Interdisciplinary Connections
English Language Arts Students conduct research that builds their understanding of energy transfers. They will gather relevant information from their investigations and from multiple print or digital sources, take notes, and categorize their findings. They should use this information to construct explanations and support their thinking. **Mathematics** Students can: ● Solve multistep word problems, using the four operations. ● Represent these problems using equations with a letter standing for the unknown quantity. ● Assess the reasonableness of answers using mental computation and estimating strategies, including rounding. For example, "The class has 144 rubber bands with which to make rubber band cars. If each car uses 6 rubber bands, how many cars can be made? If there are 28 students in the class, how many rubber bands can each car have (if every car has the same number of rubber bands)?" Students can also analyze constraints on materials, time, or cost to determine what implications the constraints have for design solutions. For example, if a design calls for 20 screws and screws are sold in boxes of 150, how many copies of the design can be made?

Future Learning
Grade 5 Unit 3: Energy and Matter in Ecosystems ● The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). ● Plants acquire their material for growth chiefly from air and water.

Grade 8 Unit 5: Relationships among Forms of Energy

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Grade 8 Unit 6: Thermal Energy

- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

Prior Learning

Kindergarten Unit 1: Pushes and Pulls

- Pushes and pulls can have different strengths and directions.
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.
- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (secondary)

Grade 3 Unit 2: Force and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual understandings used at this level.)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.

Modifications

Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted 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 tool 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 understandings.*
- *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.*
- *Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*

21st Century Themes and Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy, Civic Literacy, Environmental Literacy, Health Literacy, Creativity & Innovation, Communication & Collaboration, Media Literacy, Critical Thinking & Problem Solving Information, Literacy Information, Communication & Technology, Life & Career Skills

Commercial Township School District

Content Area:

Grade: 4

Unit: 8 Waves and Information

Unit Duration: 20 Days

Unit Summary
How can we use waves to gather and transmit information? 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. The crosscutting concepts of patterns; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, and constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate their understanding of the core ideas.
Student Learning Objectives
Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. 4-PS4-1 Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.
Generate and compare multiple solutions that use patterns to transfer information. 4-PS4-3 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.
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-EST-1-2)
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. (3-5-ETS1-3)

Unit Sequence	
Part A: If a beach ball lands in the surf, beyond the breakers, what will happen to it?	
Concepts	**Formative Assessment**

• 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)	*Students who understand the concepts are able to:* • 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).
Unit Resources	**District/School Summative Assessments**
● What Are Waves?- https://betterlesson.com/lesson/628342/what-are-waves- This is a great introductory lesson on waves. It includes videos, explanations, and great hands on activities. WavesUnit https://learning-in-action.williams.edu/opportunities/elementary-outreach - This site has an entire unit on waves. Pop Bottle Waves and Hair Dryer Ripples- https://betterlesson.com/lesson/636706/pop-bottle-waves-hair-dryer-ripples- In this opening lesson, we explore what waves are all about as we observe, draw, and think about how waves are shaped and how they move and what creates them. ● How Do Waves Move Objects? https://betterlesson.com/lesson/637060/how-do-waves-move-objects - Better Lesson- Using what they have observed about water waves & questioning, students continue to develop the vocabulary and begin to understand how waves transfer energy. ● Catch a Wave https://betterlesson.com/lesson/636938/catching-the-wave - Lab- (Follow up to the "Pop Bottle Waves and Hair Dryer Ripples" Lab above). Students use their videos from Pop Bottle Waves & Hair Dryer Ripples to catch a wave, draw it, define its shape and find out what amplitude means.	Summative Assessments: In correlation with the NGSS, students must demonstrate the following as summative assessments: • Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. (4-PS4-1) • Students will model the properties of waves by disturbing the surface of water in a variety of pans and buckets. Students will record observations in science notebooks as they strike the water with different sized objects and different force. Students will develop a model using drawings, diagrams or 3D objects (slinky, jump rope, etc.) to show the basic properties of waves. Other summative assessments will include but are not limited to: projects, summative tests, lab skills demonstrations, and vocabulary quizzes. Modifications

● Properties of Waves https://betterlesson.com/lesson/630477/properties-of-waves - In this direct instruction lesson, students draw sketches in their science notebooks in order to make sense of wave properties. ● Morse Code https://betterlesson.com/lesson/644804/morse-code - Students learn that waves can be used to transfer information from one place to another. ● Mini Lesson- A Big Splash! https://betterlesson.com/lesson/637618/mini-lesson-a-big-splash - This lesson can possibly be used to assist in the Summative Assessment. Students drop several different sized objects into a bucket of water and observe what happens by measuring how long the wave continues after the displacement	

Unit Sequence	
Part B: Which team can design a way to use patterns to communicate with someone across the room?	
Concepts	**Formative Assessment**
● 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. ● 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.	*Students who understand the concepts are able to:* ● 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. ● Plan and conduct an investigation collaboratively to produce data that can serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

• Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.	• 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.
Unit Resources	**District/School Summative Assessments**
● What Are Waves?- https://betterlesson.com/lesson/628342/what-are-waves- This is a great introductory lesson on waves. It includes videos, explanations, and great hands on activities. WavesUnit https://learning-in-action.williams.edu/opportunities/elementary-outreach - This site has an entire unit on waves. Pop Bottle Waves and Hair Dryer Ripples- https://betterlesson.com/lesson/636706/pop-bottle-waves-hair-dryer-ripples- In this opening lesson, we explore what waves are all about as we observe, draw, and think about how waves are shaped and how they move and what creates them. ● How Do Waves Move Objects? https://betterlesson.com/lesson/637060/how-do-waves-move-objects - Better Lesson- Using what they have observed about water waves & questioning, students continue to develop the vocabulary and begin to understand how waves transfer energy. ● Catch a Wave https://betterlesson.com/lesson/636938/catching-the-wave - Lab- (Follow up to the "Pop Bottle Waves and Hair Dryer Ripples" Lab above). Students use their videos from Pop Bottle Waves & Hair Dryer Ripples to catch a wave, draw it, define its shape and find out what amplitude means. ● Properties of Waves https://betterlesson.com/lesson/630477/properties-of-waves - In this direct instruction lesson, students draw sketches in their science notebooks in order to make sense of wave properties. ● Morse Code https://betterlesson.com/lesson/644804/morse-code	

- Students learn that waves can be used to transfer information from one place to another. ● Mini Lesson- A Big Splash! https://betterlesson.com/lesson/637618/mini-lesson-a-big-splash - This lesson can possibly be used to assist in the Summative Assessment. Students drop several different sized objects into a bucket of water and observe what happens by measuring how long the wave continues after the displacement	

Interdisciplinary Connections
English Language Arts/Literacy To support integration of English language arts into this unit, students conduct short research projects, using both print and digital sources, to build their understanding of wave properties and of the use of waves to communicate over a distance. Students should take notes, categorize information collected, and document a list of the sources used. Using the information they collect during research, as well as information from their experiences with waves, sound, and light, students integrate the information and use it to design a device or process that can be used to communicate over a distance using patterns. As students create presentations that detail how their design solutions can be used to communicate, they should use details and examples from both their research and experiences to explain how patterns are used in their design to communicate over a distance. They can include audio or video recordings and visual displays to enhance their presentations. **Mathematics** To support the integration of the CCSS for mathematics into this unit of study, students should have opportunities to draw points, lines, line segments, rays, angles, and perpendicular and parallel lines, and identify these in two-dimensional drawings as they identify rays and angles in drawings of the ways in which waves move. Students should also have opportunities to use the four operations to solve problems. Students can analyze constraints on materials, time, or cost to draw implications for design solutions. For example, if a design calls for 20 screws and screws are sold in boxes of 150, how many copies of the design could be made? As students represent and solve word problems, such as these, they reason abstractly and quantitatively and model with mathematics. As students create models of waves and engage in engineering design, they have opportunities to use tools strategically while measuring, drawing, and building.

Future Learning
In middle school, students will know that: • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. • A sound wave needs a medium through which it is transmitted. • Digitized signals (sent as wave impulses) are a more reliable way to encode and transmit information. • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. • Models of all kinds are important for testing solutions. • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process— that is, some of those characteristics may be incorporated into the new design. • 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.
Prior Learning
By the end of Grade 1, students know that: • People also use a variety of devices to communicate (send and receive information) over long distances. By the end of Grade 2, students know that: • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution it is important to clearly

understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs. By the end of Grade 3, students know that: • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Modifications
Modifications for not only special education students but for English Language learners, students at risk for school failure and gifted 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 tool 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 understandings.* ● *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.* ● *Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*

21st Century Themes and Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy, Civic Literacy, Environmental Literacy, Health Literacy, Creativity & Innovation, Communication & Collaboration, Media Literacy, Critical Thinking & Problem Solving Information, Literacy Information, Communication & Technology, Life & Career Skills