HILLSBOROUGH TOWNSHIP SCHOOL DISTRICT

SCIENCE CURRICULUM

GRADE 6

AUGUST 2021

Grade 6 Science
Course Overview

The sixth grade science curriculum utilizes an inquiry-based storyline philosophy to explore students' questions that arise from students' interactions with phenomena. It continues to develop an understanding of the physical, life, and earth sciences and builds on the K–5 ideas and practices. At each step, students make progress on the classroom's questions through science and engineering practices to figure out a piece of a science idea. Each piece they figure out adds to the developing explanation, model, or designed solution. Each step may also generate questions that lead to the next step in the storyline. Together, what students figure out helps explain the unit's phenomena or solve the problems they have identified. A storyline provides a coherent path toward building science ideas and understanding piece by piece, anchored in students' own questions, experiences, and sensemaking.

The sixth grade science curriculum encourages inquiry and sensemaking through a wide variety of learning strategies and resources that develop science and engineering practices, core ideas, and crosscutting concepts. Students utilize laboratory investigations, educational websites, current events, articles, and other multimedia resources including videos, interactive websites, animations, and simulations to make sense of the world around them.

The sixth grade course of study includes six interconnected units: Light & Matter, Thermal Energy, Weather, Climate & Water Cycling, Rock Cycling & Plate Tectonics, Natural Hazards, adn Cells & Systems. In Light & Matter, students explain how light interacts with matter, including how it can be absorbed, transmitted, or reflected by different materials. During the Thermal Energy unit students develop a particle level model of thermal energy transfer within materials and between materials, for solids, liquids, and gases. They apply the science ideas they figure out to design a device that slows thermal energy transfer. While studying Weather, Climate and Water Cycling students investigate the natural movement and distribution of water on the planet. Students figure out that precipitation patterns depend on geographic location (e.g., latitude, proximity to large bodies of water, altitude). Students explain patterns in weather and climate in terms of temperature patterns, humidity, and precipitation and develop the key mechanism in these processes of convection. In Rock Cycling & Plate Tectonics students investigate changes on the Earth's surface, and figure out how geographic location (proximity to plate boundaries) determines the type of landforms near one's communities and the distribution of rocks and fossils. Students develop models for the cycling of matter and movement of plates to explain earthquakes, volcanoes, and changes in the Earth across geological time scales. As student investigate Natural Hazards they apply knowledge from earlier units to investigate how these natural processes can affect and shape human communities. Students investigate how earthquakes, tsunamis, volcanic eruptions, and catastrophic weather can be forecasted and how communities can plan to mitigate the effects of these hazards. In the last unit of the year, students

investigate Cells Systems to determine what is needed at the cellular and systems level for a multicellular organism to survive. Students use evidence to support the idea that living things are made of cells, and explain how the cells' and body system's structure and function contribute to the organism's ability to function.

The sixth grade science curriculum meets the requirements of the New Jersey Student Learning Standards for Science. It also helps to prepare students to meet and exceed the standards assessed by the New Jersey State administered assessments through higher order application of various skills required for complete understanding and sensemaking of science phenomena at the sixth grade developmental level.

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Unit Title	**Time Frame/Pacing**
Light and Matter	21 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
One-Way Mirror: Students explore how a one-way mirror can act as both a mirror and a window at the same time.

Anchoring Question:
Why do we sometimes see different things when looking at the same object?

Supporting Questions:

- Lesson 1: How can something act like a mirror and a window at the same time?
- Lesson 2: What happens if we change the light?
- Lesson 3: What happens when light shines on the one-way mirror?
- Lesson 4: How do similar amounts of light transmit through and reflect off the one-way mirror?
- Lesson 5: How do light and the one-way mirror interact to cause the one-way mirror phenomenon?
- Lesson 6: Why does the music student not see the adults?
- Lesson 7: Why do the music student and the adults see the music student but the music student can't see the adults?
- Lesson 8: Why do we sometimes see different things when looking at the same object?

Enduring Understandings

- Some materials can be reflective and see-through at the same time.
- Whether the material is reflective or see-through is related to where there is a light.
- Light travels in straight lines.
- For us to see an object, light must leave a light source, bounce off the object, and travel in a direct path to enter our eyes.
- When light shines on an object, it is reflected (bounces off), transmitted (passes through), or some combination of these, depending on the object's material.
- A material can have different structures, even at a microscale, that cause different amounts of light to transmit through or reflect off of it.
- Light changes direction (refracts) when it travels between different transparent materials.
- When a light input is directed by sense receptors in our eye, it is turned into a signal that travels along the optic nerve to the brain, which processes it into what we see.
- When there are multiple inputs, the brain responds to the strongest signal.
- Differences in light on either side of an object or material can cause us to see different things when looking at the same object or material.

- The brighter or more prominent an object appears, the more light that reaches our eyes from the object.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Asking Questions and Defining Problems • Ask questions that require sufficient and appropriate empirical evidence to answer. • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument. • Ask questions to determine relationships between independent and dependent variables and relationships in models. • Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.	**MS.PS4.B: Electromagnetic Radiation:** • When light shines on an object, it is reflected, or transmitted through the object, depending on the object's material. • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. **MS.LS1.D: Information Processing:** • Each sense receptor responds to different inputs (electromagnetic), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain.	**Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Models are limited in that they only represent certain aspects of the system under study. **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore

Developing and Using Model • Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. **Constructing Explanations and Designing Solutions** • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.		complex natural structures/systems can be analyzed to determine how they function.

• Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.		

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- 5.NBT.1 Understand the place value system. Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. (Lesson 3)
- 5.NBT.2 Understand the place value system. Explain patterns in the number of zeros of the product when multiplying a number by powers of 10. (Lesson 3)

ELA

- SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly (lesson 1, 3, 6, 8)
- SL.6.1.a Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. (lesson 1, 2, 3, 5)
- SL.6.1.B Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
- SL.6.1.c Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. (Lesson 1)
- RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (lesson 3, 4)
- W.6.1.A Introduce claim(s) and organize the reasons and evidence clearly. (lesson 3)
- SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. (lesson 6, 8)
- RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent

understanding of a topic or issue. (lesson 8 only if extension is used)
- W.6.1 Write arguments to support claims with clear reasons and relevant evidence. (lesson 3)

Computer Science and Design Thinking
- 8.2.8.ED.1 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

Career Readiness, Life Literacies, and Key Skills

By the end of grade 8:
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 9.4.8.CT.3 Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
- 9.4.8.CT.1 Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
- 9.4.8.DC.5 Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Self-Awareness:** Recognize the importance of self-confidence in handling daily tasks and challenges.
- **Self-Management:** Recognize the skills needed to establish and achieve educational and personal goals.
- **Social Awareness**
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the expectations for social interactions.
- **Responsible Decision-Making:** Develop, implement, and model effective problem solving and critical thinking skills.
- **Relationship Skills**
  - Utilize positive communication and social skills to interact effectively with others.
  - Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways.

Learning Targets	Investigations/Resources	Formative Assessment

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Lesson 1: How can something act like a mirror and a window at the same time? Develop a model to identify the important parts of the system and how those parts interact that could cause an object to look different in different light conditions. Ask questions that arise from observations of a phenomenon in which an object appears different depending on the light conditions within the defined system.	Lesson 1: • Introduce the phenomenon. (One-way mirror)	Lesson 1: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Topic: identify the important parts of the system and how those parts interact that could cause an object to look different in different light conditions.
Lesson 2: What happens if we change the light? Ask questions that can be investigated in the classroom and frame a hypothesis about what we will see from both sides of the box model if we change the amount of light on either side. Create model based on evidence to match changes in what we see when we change the light in the box model.	Lesson 2: • Use a one-way mirror to observe its partially reflective and see-through properties. • Think about the role of light in how and what we see. • Conduct an investigation in which light source is changed in both rooms. • Determine how differences in light affect the one-way mirror phenomenon. • Update class model to include arrows to represent the path of light. • Brainstorm and share related phenomena from our lives.	Lesson 2: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Topic: Revise and identify the important parts of the system and how those parts interact that could cause an object to look different in different light conditions.
Lesson 3: What happens when light shines on the one-way mirror? Ask a testable question to determine how an object's material influences the amount of light transmitted and reflected. Use evidence to modify a model to explain how an object's material influences the path of light as it transmits through or reflects off the material.	Lesson 3: • Determine that the one-way mirror mimics a mirror in a bright room and a window in a dark room. • Conduct an investigation to determine why and compare what happens when light shines on the one-way mirror, glass, and a standard mirror. • Make observations and use a light meter to measure the amount of light transmitted	Lesson 3: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Topic: explain and determine how an object's material structure; (Independent variable) influences the amount of light transmitted and reflected (function; dependent variable). ○ Topic: building an explanation toward

	through and reflected off the one-way mirror, glass, and standard mirror. • Develop and plan a question to investigate. • Conduct investigation and record observations and analyze data to determine what happens when light shines on the one-way mirror.	the unit goal of how an object's material (structure) influences the path of light as it transmits through or reflects off the material (function). ○ Update Progress Tracker-modifying a model
Lesson 4: How do similar amounts of light transmit through and reflect off the one-way mirror? Develop a model to describe the unobservable mechanisms that affect how a material's microscale structures change how light reflects off and transmits through the material.	Lesson 4: • Inquire how similar amounts of light transmit through and reflect off the one-way mirror. • Read an article about regular mirrors and one-way mirrors. • We modify models to explain what happens when light shines on the different materials. • Explain how the structures of the one-way mirror interacting with light connect to the one-way mirror phenomenon.	Lesson 4: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Topic: explain how light interacts with different structures (transmitting vs. reflecting)
Lesson 5: How do light and the one-way mirror interact to cause the one-way mirror phenomenon? Revise a model to explain the observable one-way mirror phenomenon caused by unobservable interactions between light, the people and the one-way mirror, which reflects and transmits through the same amount of light.	Lesson 5: • Revisit the anchoring phenomenon and update model to show interactions between light, the people, and the one-way mirror. • Model the reaction that occurs when the light source shines directly on the one-way mirror to people on the other side. • Determine that reflected light from one side will enter the eyes of the individuals on the other side of the one-way mirror. • Wonder why the individuals on the other side still can't see through.	Lesson 5: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Topic: revise model to describe one-way mirror phenomena
Lesson 6: Why does the music student not see the adults? Ask questions to model the path of light as it travels	Lesson 6: • View a video to obtain more information about what happens when light enters the	Lesson 6: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets)

through the lens of the eye, and to explain how the shape and composition of the lens causes the path of light to change directions (refract) before reaching the retina at the back of the eye. Develop a model that describes how the eye responds to different inputs of light and transforms those inputs to signals that travel along the optic nerve to the brain, which processes the signals into what we "see."	eye. Record observations. We model the structure of the eye and how light input is processed by the eye and brain. • Brainstorm experiences from our lives to help us explain what happens when there are two inputs of light and we don't always see the same thing.	○ Topic: describe and explain how light travels through the eye and discuss how the lens and retina are involved ○ Topic: describe and explain how the eye sends signals to optic nerve of the brain to discuss what is 'seen'
Lesson 7: Why do the music student and the adults see the music student but the music student can't see the adults? Construct and revise an explanation using a model to explain why an object appears different depending on the interaction between light and an object's material and how the brain processes signals.	Lesson 7: • Develop a written explanation to answer the question: Why do the adults see the music student? • Develop a written explanation to answer the question: Why does the music student see themself but not the adults? • Self-assess explanations. • Provide peer feedback on explanations. • Revise a final explanation.	Lesson 7: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Topic: revise an explanation from the models that explains why an object appears different depending on light interactions
Lesson 8: Why do we sometimes see different things when looking at the same object? Use a model to describe how differences in light on both sides of a one-way mirror strengthens or weakens the one-way mirror phenomenon due to changing the components and interactions within and between systems. Apply science ideas and evidence from classroom investigations to explain a common, real-world phenomena in which a material designed for light transmission and to look transparent to the eye and brain functions as a one-way mirror due to the relationship the material has to other parts of the system.	Lesson 8: • Investigate the best light conditions for the one-way mirror phenomen. • Determine that the effect is greatest when there is a big difference in light on both sides of the one-way mirror. • Understand that other materials can behave like one-way mirrors when there is a similar difference in light on both sides of the material. • Use models and science ideas to show what we have learned on an assessment and update DQB to reflect on learning.	Lesson 8: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Topic: describe how differences in light on both sides of a one-way mirror can strengthen/weaken the one-way mirror phenomena due to changes within or between systems

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Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate
• Accommodations as per IEP/504/ELL • Utilize and/or encourage use of graphic organizers • Encourage students to use words and/or drawings when representing and recording their investigation setup and observations. • Having different modes for interacting with the readings and/or provide different ways to access the readings (Text to Speech/Speech to Text, read-aloud, etc.) • Provide options for investigations when applicable (giving students a choice to pursue a line of inquiry that is more relevant to them) • Utilize hands-on materials for students to demonstrate their ideas when possible/relevant • Utilize prompting/sentence starters when relevant/as needed • Provide paper copies as needed (when appropriate) • Utilize models/examples when appropriate • Scaffold graphs and/or diagrams/pictures (pre-labeling as needed) • Supplement auditory materials with visual aids/supplement visual materials with auditory aids • Encourage students to use key vocabulary concepts (domain-specific) in written responses • Convey information via pictures, maps, charts, films, diagrams etc. • Emphasize associations for newly taught material which relate to realm of student experiences

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Common Assessment - 6.1 • Summative (Lesson 8)	• Utilize study questions/study sheets ahead of time when applicable • Allow extra time for completion of task • Bolded key words in directions and/or questions (encourage highlighting) • Word banks (when appropriate) • Read aloud words, phrases, questions, and/or directions • Provide access to anchor charts and classroom labels relevant to science concepts • Written explanations may be scribed by teacher and/or speech to text feature on the Chromebooks may be used to assist students with their explanations, when needed • Any other specific modifications listed in a students IEP/504

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Unit Title	**Time Frame/Pacing**
Thermal Energy	38 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Students observe an iced drink in a regular cup warming up faster than an iced drink in a fancy cup.

Anchoring Question:
How can containers keep things from warming up or cooling down?

Supporting Questions:

- Lesson 1: Why does the temperature of the liquid in some cup systems change more than in others?
- Lesson 2: What cup features seem most important for keeping a drink cold?
- Lesson 3: How are the cup features that keep things cold the same or different for keeping things hot?
- Lesson 4: How does a kid affect what happens to the liquid in the cup?
- Lesson 5: Where does the water on the outside of the cold cup system come from?
- Lesson 6: How can we explain the effect of a kid on what happens to the liquid in the cup over time?
- Lesson 7: If matter cannot enter or exit a closed system, how does liquid in the system change temperature?
- Lesson 8: How does a cup's surface affect how light warms up a liquid inside the cup?
- Lesson 9: How does the temperature of a liquid on one side of a cup wall affect the temperature of a liquid on the other side of the wall?
- Lesson 10: What is the difference between a hot and cold liquid?
- Lesson 11: Why do particles move more in hot liquids?
- Lesson 12: How does the motion of particles compare in a sample of matter at a given temperature?
- Lesson 13: How could the motion of particles on one side of a solid wall affect the motion of the particles on the other side of that wall?
- Lesson 14: Does our evidence support that cold is leaving the system or that heat is entering the system?
- Lesson 15: How do certain design features slow down the transfer of energy into a cup?
- Lesson 16: How can we design a cup system to slow energy transfer into the liquids inside it?
- Lesson 17: How can we improve our first design to slow energy transfer into the cup system even more?
- Lesson 18: How can containers keep stuff from warming up or cooling down?

Enduring Understandings

- A system consists of parts that work together (interact) to form the system.
- Some systems have structural features that help maintain the temperature of a substance inside the system.

- Heat can enter a system and/or cold can leave a system, and maybe gases can escape the system too.
- Some systems have structural features that are designed to help maintain the temperature of a substance inside the system.
- Objects that can keep liquids cold are also able to keep liquids hot.
- Liquids and gases are made of particles. Particles in gas have a lot of space between them but those in liquids do not.
- The smallest particle of water is a molecule. Molecules of water in liquid go into gas over time (evaporation).
- An open system has space for matter to enter or exit.
- A closed system is one in which no matter can enter or exit.
- Water droplets often condense on a cold surface when humid air comes in contact with the surface.
- Liquids do not move through solids.
- Matter does not enter or leave a closed system; therefore, the mass of a closed system does not change.
- Liquids, gases, and solids are made of particles of matter.
- Particles in a gas have a lot of space between them, but particles in liquids and solids do not.
- Liquids and gases are made of particles that can move around freely, but solids are made of particles that cannot.
- Light can transfer energy into a system.
- When light that shines on a surface is not reflected or transmitted, it is absorbed.
- Temperature changes in the water can still occur even if light does not transmit through material and even if there's no light.
- When the temperature difference between two neighboring systems is great, more energy transfers between them.
- A particle's speed is related to how much kinetic energy it has.
- The particles in hot liquids and gases have more kinetic energy than the particles in cold liquids and gases.
- Liquids and gases are made of particles that can move around freely.
- Not all particles in a sample of matter have the same kinetic energy.
- Kinetic energy is transferred from one particle to another in a particle collision.
- Temperature is a measure of the average kinetic energy of the particles in a sample of matter.
- The total kinetic energy of a sample of matter is the sum of the kinetic energy of all the particles in that sample. If you add more particles, the total kinetic energy increases but the temperature (the average kinetic energy) might stay the same.
- Particles in a solid vibrate back and forth in place.
- Collisions between particles in a solid, liquid, and/or gas can transfer kinetic energy (KE or motion energy) from one particle to another.
- The more particles in a sample of matter that are in contact with another sample of matter, the greater the amount of particle KE is transferred from the warmer piece of matter to the cooler pieces of matter over time.
- Temperatures change when energy moves from warmer to cooler matter.
- Energy is transferred when higher-energy particles come into contact with lower energy particles.
- Shiny/ light-colored materials (feature) prevent light from being absorbed. Absorption of light by particles (mechanism) transfers energy to the object.
- Porous materials with air pockets (feature) slow down the conduction of energy because there are fewer particles to collide across the air pockets. Conduction of energy from particle collisions (mechanism) transfers energy.
- Materials used on the object walls that reduce the amount of contact between layers help objects perform better on the regular light and temperature test.

- The rate of energy transfer between systems speeds up or slows down depending on the number of particle collisions.
- The rate of energy transfer between matter and light speeds up or slows down depending on how much light is absorbed.
- The amount of matter in a substance affects the rate of energy transfer and how much energy is needed to increase the substance's temperature.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
- MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Developing and Using models • Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena.	**MS-PS1.A: Structure and Properties of Matter** • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. • In a liquid, the molecules are constantly in contact with others. In a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. • The changes of state that occur with variations in temperature can be described and predicted using these models of matter.	**Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Models are limited in that they only represent certain aspects of the system under study. **Energy and Matter** • Matter is conserved because atoms are

• Develop a model to describe unobservable mechanisms. **Planning and Carrying Out Investigations** • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. • Collect data about the performance of a proposed object, tool, process, or system under a range of conditions. **Analyzing and Interpreting Data** • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve	**MS-PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. • Temperature is not a measure of energy; the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. • 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. **MS.PS3.B: Conservation of Energy and Energy Transfer** • When the kinetic energy of an object changes, there is inevitably some other change in energy at the same time. • 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. • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **MS.PS4.B: Electromagnetic Radiation**	conserved in physical and chemical processes. • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. • The transfer of energy can be tracked as energy flows through a natural system. **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success. **Constructing Explanations and Designing Solutions** • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	• When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material. **MS.ETS1.A: Defining and Delimiting an Engineering Problem** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. **MS.ETS1.B: Developing Possible Solutions** • 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.	

○ Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing. **Engaging in Argument from Evidence** • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.		

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- 6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
- 6.SP.A.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
- 6.RP.A.3.c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
- 6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.

ELA

- SL.6.1.c Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under

discussion. (Lesson 1)
- W.6.1 Write arguments to support claims with clear reasons and relevant evidence (Lesson 14)
- W.6.1.a Introduce claim(s) and organize the reasons and evidence clearly (Lesson 7)
- W.6.1.b Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text. (Lesson 11)
- W.6.1.c Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons. (Lesson 11)
- RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (Lesson 3, 4)
- RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics (Lesson 11)
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic (Lesson 10, 14)

Computer Science and Design Thinking
- 8.1.2.DA.3 Identify and describe patterns in data visualizations.
- 8.1.2.DA.4 Make predictions based on data using charts or graphs.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.4 Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
- 8.2.8.ED.5 Explain the need for optimization in a design process.

Career Readiness, Life Literacies, and Key Skills

By the end of grade 8:
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 9.4.8.CT.3 Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
- 9.4.8.CT.1 Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
- 9.4.8.DC.5 Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.

- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Self-Awareness:** Recognize the importance of self-confidence in handling daily tasks and challenges.
- **Self-Management:** Recognize the skills needed to establish and achieve educational and personal goals.
- **Social Awareness**
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the expectations for social interactions.
- **Responsible Decision-Making:** Develop, implement, and model effective problem solving and critical thinking skills.
- **Relationship Skills**
  - Utilize positive communication and social skills to interact effectively with others.
  - Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1: Why does the temperature of the liquid in some cup systems change more than in others? • Develop an initial model to describe a phenomenon in which a substance changes temperature and identify structural parts of the system that slow down or speed up the temperature change. • Ask questions that arise from careful observation and can be investigated in the classroom to test how parts of the cup systems contribute to warming up or maintaining the temperature of the substance inside.	Lesson 1: • Observe iced drinks in two different cups and record observations about what happens to them. • Develop systems models to show what is happening in each cup. • Brainstorm similar phenomena and ask questions about the structure of objects that determine how well an object can maintain its temperature.	Lesson 1: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Explain a new system and identify what parts are important and assign home learning to find a similar system.
Lesson 2: What cup features seem most important for keeping	Lesson 2: • Design and conduct an investigation to	Lesson 2: • Check-Ins (Do Nows, Entrance Tickets,

a drink cold? • Plan and carry out an investigation to gather evidence to answer scientific questions about how parts of the cup system relate to the temperature change of the liquid inside. • Analyze and interpret data and find patterns indicating which parts of the system influence the temperature change of the substance inside the system.	figure out what's important for keeping drinks cold. • Design and conduct an investigation to see how changes in cup design affects the liquid's temperature. • Collect, organize, and analyze data to identify patterns about cup features that aid in keeping the liquid's temperature consistent.	Exit Tickets, Interactive Notebook) ○ Topic: Identify clear patterns about parts of the systems. ○ Progress tracker - student reflects on new learning from lesson.
Lesson 3: How are the cup features that keep things cold the same or different for keeping things hot? • Develop and use a model to explain how the best-performing and worst-performing cup systems affect the temperature change of a substance inside a system. • Plan an investigation to investigate how the lid works to slow the temperature change of a substance inside the system.	Lesson 3: • Organize cups based on how well they keep liquids cold. • Investigate whether these features also keep liquids hot. • Revise explanations to explain how a cup's features help to keep liquids hot and/or cold. • Develop questions about the cup features and design investigations to answer questions and ideas about how the lid works.	Lesson 3: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Explain different starting temperatures of liquid in a cup and how they heat or cool ○ Topic: Review original investigation plans with their corrected plans
Lesson 4: How does a lid affect what happens to the liquid in the cup? • Plan and carry out investigations to determine the effect of a lid on temperature change and mass change in systems that are more open and less open. • Analyze and interpret data by applying concepts of probability to calculate the mathematical mean to compare the temperature change and mass change across conditions (patterns) and use these	Lesson 4: • Develop and conduct investigations to determine how the lid affects temperature change and mass change of a liquid within a cup. • Compare changes in temperature and changes in mass for different cup systems by determining for each cup system. • Create and use liquid and gas particulate models to explain mass loss in open systems.	Lesson 4: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Handout on"Initial model of mass lost in the cup with no lid" ○ Complete handout "Explanations and Predictions of Lids and Covers" ○ Progress tracker - Particles of matter

measures to make claims about the effect of the lid. • Develop a model to describe why mass is lost in some conditions but not others (open systems versus less-open systems), using a particle model of matter for liquids and gases.		
Lesson 5: Where does the water on the outside of the cold cup system come from? • Collect and analyze different forms of data to identify patterns across our data sources that serve as evidence that condensation that forms on the outside surface of a cold cup system comes from the air outside the system. • Construct an argument to support the claim that water forming on the outside surface of a cold cup system comes from the air outside the system and is not leaving the system through the walls.	Lesson 5: • Conduct an investigation to determine where condensation on the outside of a cup of cold water comes. • Determine the mass of a cup of cold water before and after condensation forms on the outside. • Use food colored cold water to observe condensation on the outside of a cup. • Construct an argument using evidence to refute the claim that condensation on the outside of the cup comes from inside the cup system.	Lesson 5: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Handout "Cold Lemonade on a hot day" to show understanding of the water droplet phenomena
Lesson 6: How can we explain the effect of a lid on what happens to the liquid in the cup over time? • Develop and use a particle model of matter for solids, liquids, and gases to show how structural differences in a cup system allow water molecules to leave the system at some points in the system but not others. • Plan an investigation and in the design, identify the controls, the tools needed to gather the data, and how much data are needed to support a claim about how much liquid leaves two different cup systems over	Lesson 6: • Use a model to show why water molecules cannot leave the cup at some points in the cup system but can at other points. • Complete an individual assessment that includes making predictions about whether a cup with a new lid design will keep a drink cooler than a cup with an old lid design, developing a plan for collecting data to see if the amount of liquid changed in either cup over time and developing a model to explain why one cup system would lose more mass than another.	Lesson 6:

30 days.		
Lesson 7: If matter cannot enter or exit a closed system, how does a liquid in the system change? • Develop two models to show relationships among the parts of the mostly closed cup system and how light and heat or cold cause the liquid inside to warm up or cool down.	Lesson 7: • Use what is known about the structures and functions of the closed cup system and their interactions with one another and with other objects and substances outside of the cup system to determine what else might cause a temperature change in the liquid inside. • Develop models to represent student ideas about interactions between energy and the closed cup system. • Use models to explain changes in temperature. • Brainstorm ideas to figure out how energy interacts with the closed cup system.	Lesson 7: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets) ○ Claim: How do you think light/heat causes the temperature in the cup to chnge? ■ Topic: Closed Cup System: Light ■ Topic: Closed Cup System: Heat
Lesson 8: How does a cup's surface affect how light warms up a liquid inside the cup? • Develop and use models to describe how light transmission through, reflection off, and absorption by cup walls causes changes in the temperature of water inside the cup.	Lesson 8: • Conduct an investigation to test the interaction between light and the surface of the cup in warming up the water inside the cups. • Shine light on cups made of varying materials and colors to measure the amount of incoming, reflected, and transmitted light. • Place some cups in complete darkness. Discover that water in all cups warms up but cups in light warm up more.	Lesson 8: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Guided model worksheet (Explaining Temperature Changes in Each Cup) ■ Explaining how light warmed up the liquid differently
Lesson 9: How does the temperature of a liquid on one side of a cup wall affect the temperature of a liquid on the other side of the wall? • Carry out an investigation to measure temperature inside and outside a cup system	Lesson 9: • Determine how to test whether heat or cold is entering or leaving a cup system. • Plan and conduct an investigation with cup and water bath to determine if heat or cold moves between systems.	Lesson 9: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Creating fair test with controlled variables

to test whether heat or cold moves through the wall of the system.	• Determine that a temperature change inside the cup system occurs at the same time as a temperature change outside the cup system. • Conclude that heat or cold moves through the wall of the cup and a greater temperature difference between the cup and water bath systems, the more energy that is transferred between the two systems.	
Lesson 10: What is the difference between a hot and cold liquid? • Develop models based on evidence to explain that matter is made of particles that are in motion, and though the individual particles are not visible to the eye, their collective behavior can be observed as more or less movement depending on the matter's temperature.	Lesson 10: • Explore the differences between hot and cold liquids at the scale of particles. • View a video to observe how candy dissolves in hot, warm, and cold water. • Investigate how water behaves differently at varying temperatures using colored hot, room-temperature, and cold water. Collect qualitative evidence that connects movement in water to temperature. • Read a historical study to support the ideas that liquids are made of particles and there is greater movement in hotter liquids and less movement in colder liquids.	Lesson 10: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Particle movement and relationships in cold/warm/hot water
Lesson 11: Why do particles move more in hot liquids? • Construct an explanation about why food coloring moves more in hot water than in cold water using the idea that at the particle scale, particles in liquids at warmer temperatures have more kinetic energy than particles in liquids at cooler temperatures.	Lesson 11: • Think about discoveries in the Food Coloring Lab at the particle scale and how this relates to energy. • Observe simulation and collect evidence to support that particles move faster in hot liquids and slower in cold liquids. Define kinetic energy as the energy of movement. • Spray perfume and determine that perfume sprayed on one side of the classroom can be smelled on the other side of the classroom. • Determine that particles in gas move freely	Lesson 11: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Construct an explanation about why food coloring moves more quickly (kinetic energy) in hot water than in cold water.

	like particles in liquids. • Apply newly acquired ideas about kinetic energy to explain previous lab observations. • Revisit original iced drink warming up in the regular plastic cup and think about where the kinetic energy came from.	
Lesson 12: How does the motion of particles compare in a sample of matter at a given temperature? • Carry out an investigation to look for patterns in data generated by using an interactive simulation of the particles in a gas (which are too small to be observed) to observe the kinetic energy of individual particles and the transfer of energy when they collide. • Analyze and interpret data to mathematically represent the cause-and-effect relationships between the average kinetic energy of the particles of a gas, the temperature of the gas, and the total kinetic energy of all the particles in the gas.	Lesson 12: • View simulation to determine how individual particles in a sample of gas do not have the same kinetic energy, and how the kinetic energy of each particle is constantly changing due to collisions with other gas particles. • Define temperature as a measure of the average speed of the particles in a sample of matter. Determine that the total energy of that sample is the sum of the kinetic energy of all the particles in the sample combined.	Lesson 12: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Progress Tracker - explain the kinetic energy of the particles in a sample of matter, the temperature of the sample, and the total kinetic energy of all the particles in the sample.
Lesson 13: How could the motion of particles on one side of a solid wall affect the motion of the particles on the other side of that wall? • Carry out investigations using a particle model of matter (with marble manipulatives and computer simulations) to generate evidence that one way the temperature of matter changes over time is that kinetic energy is transferred in collisions between the particles (matter) within and between	Lesson 13: • View a simulation to make observations about particle speeds before and after a collision with other particles. • Use marbles to simulate interactions between particles in a gas, a liquid, and a solid to determine the effects of collisions on particle speeds in different situations. • View a simulation to observe particle interactions in different solids as they come into contact with each other at different	Lesson 13: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Matter changes over time due to kinetic energy of the particles-energy transfer.

solids, liquids, and gases.	temperatures.	
Lesson 14: Does our evidence support that cold is leaving the system or that heat is entering the system? • Develop and use models to track how energy spontaneously transfers out of hotter regions and into colder ones and causes changes in the water's temperature within the cup system. • Construct written arguments supported by empirical evidence and scientific reasoning to support claims describing how energy spontaneously transfers out of hotter regions or objects and into colder ones.	Lesson 14: • Sort evidence collected during previous investigations to determine whether temperature changes are caused by heat or cold moving into or out of the cup system. • Conduct an investigation to collect additional evidence to determine that heat moves into the cup system, to cause a temperature change. • Revise cup system models to apply our new understandings to answer questions from the DQB and explain related phenomena.	Lesson 14: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Energy transfer of hot to cold. ○ Icing Injuries Assessment
Lesson 15: How do certain design features slow down the transfer of energy into a Cup? • Obtain and use information from scientific texts to evaluate the function of certain design features in minimizing energy transfer into a system. • Develop a consensus model for explaining two mechanisms for energy transfer into a system, and design features that minimize energy transfer into a system.	Lesson 15: • Introduce the Cold Cup Design Challenge and observe examples of effective cup designs. • Jigsaw the gaps in knowledge and conduct a gallery walk to share student findings. • Reach consensus about mechanisms for energy transfer in order to help engage in the design challenge.	Lesson 15: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Develop a model explaining energy transfer and identify design features that minimize energy transfer into a system.
Lesson 16: How can we design a cup system to slow energy transfer into the liquid inside it? • Design a solution for a cup system with features (structures) to slow energy transfer into the liquid inside the cup (function). • Carry out investigations to collect data to evaluate the performance of cup systems	Lesson 16: • Review the Cold Cup Challenge and design cups and point out features we have evidence will slow energy transfer. • Build, test, and evaluate first design cups. • Provide and receive feedback to help improve cup designs.	Lesson 16: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Design challenge-design a cup system to slow energy transfer into the liquid inside the cup.

that slow energy transfer given the criteria and constraints of the problem, and to modify design features (structures) based on test results (functions).		
Lesson 17: How can we improve our first design to slow energy transfer into the cup system even more? • Design a solution that is modified based on test results to improve the features to better slow energy transfer by reducing the absorption of light or opportunity for particle collisions. • Carry out investigations to collect data to evaluate the performance of cup systems that slow energy transfer given the criteria and constraints of the problem, and to propose ways to optimize design features based on the test results.	Lesson 17: • Review test results and feedback from first cup design. • Clarify the criteria and constraints. • Redesign, build, test, and evaluate a second cup design. • Observe new data to identify the features of the best performing cups.	Lesson 17: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: from first cup design - identify at least 3 design features they believe will slow energy transfer into the cup system. ○ Students will compare test results from design cycle 1 and 2 to decide which cup design best met the criteria and constraints. They will record their ideas on Part 7: Evaluate your 2nd design.
Lesson 18: How can containers keep stuff from warming up or cooling down? • Develop a model based on patterns in performance that can be used to predict ways to minimize or maximize energy transfer into or out of a variety of systems. • Evaluate a design solution for a disaster blanket that includes several design features to minimize energy transfer that could result in body heat loss.	Lesson 18: • Review and analyze test results from best cup designs. • Provide suggestions based on evidence to design a class Ultimate Cold Cup. • Use a model to explain patterns to minimize or maximize energy transfer. Use a model to predict how energy transfer can be minimized or maximized in relevant daily examples. • Return to the Driving Question Board to apply learning to now answerable questions.	Lesson 18:
Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate		

- Accommodations as per IEP/504/ELL
- Utilize and/or encourage use of graphic organizers
- Encourage students to use words and/or drawings when representing and recording their investigation setup and observations.
- Having different modes for interacting with the readings and/or provide different ways to access the readings (Text to Speech/Speech to Text, read-aloud, etc.)
- Provide options for investigations when applicable (giving students a choice to pursue a line of inquiry that is more relevant to them)
- Utilize hands-on materials for students to demonstrate their ideas when possible/relevant
- Utilize prompting/sentence starters when relevant/as needed
- Provide paper copies as needed (when appropriate)
- Utilize models/examples when appropriate
- Scaffold graphs and/or diagrams/pictures (pre-labeling as needed)
- Supplement auditory materials with visual aids/supplement visual materials with auditory aids
- Encourage students to use key vocabulary concepts (domain-specific) in written responses
- Convey information via pictures, maps, charts, films, diagrams etc.
- Emphasize associations for newly taught material which relate to realm of student experiences
- Use color coding and letter or number coding to assist in identifying parts of the model (accessibility for any student who may be color-blind).
- Make calculators available to students who need the extra support/identified in the IEP.
- When developing new vocabulary, use student-friendly definitions and make connections to cognate words when possible, and show a visual representation of the word (when possible).
- Students may need a direct definition for words like independent variable, dependent variable, controlled variable.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When appropriate**
• Summative Common Assessment (topics from lessons 1-5) (lesson 6) • Summative Assessment in which students apply knowledge to new related phenomenon (lesson 18)	• Utilize study questions/study sheets ahead of time when applicable • Allow extra time for completion of task • Bolded key words in directions and/or questions (encourage highlighting) • Word banks (when appropriate) • Read aloud words, phrases, questions, and/or directions • Provide access to anchor charts and classroom labels relevant to science concepts

	• Written explanations may be scribed by teacher and/or speech to text feature on the Chromebooks may be used to assist students with their explanations, when needed • Any other specific modifications listed in a students IEP/504

Hillsborough Township Public Schools
Grade 6 Science Curriculum

Unit Title	Time Frame/Pacing
Weather, Climate, & Water Cycling	41 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Students observe videos of hailstorms in different locations of the country at different times of the year.

Anchoring Question:
Why does a lot of hail, rain, or snow fall at some times and not others?

Supporting Questions:

- Lesson 1: What causes this kind of precipitation event to occur?
- Lesson 2: What are the conditions like on days when it hails?
- Lesson 3: How does the air higher up compare to the air near the ground?
- Lesson 4: Why is the air near the ground warmer than the air higher up?
- Lesson 5: What happens to the air near the ground when it is warmed up?
- Lesson 6: How can we explain the movement of air in a hail cloud?
- Lesson 7: Where did all that water in the air come from, and how did it get into the air?
- Lesson 8: What happens to water vapor in the air if we cool the air down, and why?
- Lesson 9: Why don't we see clouds everywhere in the air, and what is a cloud made of?
- Lesson 10: Why Do clouds or storms form at some times but not others?
- Lesson 11: Why don't water droplets or ice crystals fall from the clouds all the time?
- Lesson 12: What causes more lift in one cloud versus another?
- Lesson 13: Why do some storms produce (really big) hail and others don't?
- Lesson 14: What causes a large-scale precipitation event like this to occur?
- Lesson 15: What happens with temperature and humidity of air in large storms?
- Lesson 16: How do warm air masses and cold air masses interact along the boundaries between them?
- Lesson 17: Is there a relationship between where the air is rising and where precipitation falls?
- Lesson 18: How can we explain what is happening across this storm (and other large-scale storms)?
- Lesson 19: Are there patterns to how air masses move that can help predict where large storms will form?
- Lesson 20: How do oceans affect whether a place gets a lot or a little precipitation?
- Lesson 21: Why is there less precipitation further inland in the Pacific Northwest than further inland from the Gulf Coast?
- Lesson 22: How can we explain differences in climate in different parts of the world?

Hillsborough Township Public Schools
Grade 6 Science Curriculum

Enduring Understandings
• Some of the water that reaches the ground reached a low enough temperature to freeze, at some point, before it fell. • Cloud movement in the sky, moving air (wind) at Earth's surface, and temperature may be related to why, where, and when different forms of precipitation fall. • Hailstones are made of ice, often in layers. • The days that have hail also have relatively warm air temperatures (mostly in the 50–90°F range, which is above the melting/freezing point of water) and relative humidity in the range of 37–96 percent. • Regardless of the season, the temperature of the air always decreases as you move away from Earth's surface and higher into the atmosphere. • The air temperature at very high altitudes (approx. 40,000 ft) is coldest in winter. • When the temperature of the air increases, the speed of the molecules that make up air increases, and when the temperature of the air decreases, the speed of the molecules that make up air decreases. • Energy from the Sun is absorbed by the ground, which then increases the kinetic energy (and therefore temperature) of the particles in the ground. • Different surfaces heat up differently depending on how much energy from the Sun is absorbed. • As particles in the air come into contact with the ground, energy is transferred to those particles through conduction. • On a sunny day, air temperatures above the ground are cooler than the ground itself. • Changing the temperature of a parcel of air causes changes in the air's density due to changes in the kinetic energy (speed) and spacing of the molecules that make up the air. • Parcels of air that are less dense than the surrounding air rise. Parcels of air that are more dense than the surrounding air sink. • As they rise, parcels of warm, less dense air eventually cool off, transferring thermal energy to the surrounding air. • Air near the surface of the ground is warmed from thermal energy transfer from the ground through conduction. • The warm air near the ground becomes less dense than the surrounding air and rises. • Eventually, the warm air transfers its energy to the surrounding air, becoming just as cold and dense as the air around it, and it stops rising. If that air becomes even cooler than the surrounding air, it sinks. • This type of air movement happens more on sunny days because the air right above the ground gets warmed up more by light from the Sun on those days. • Air is a mixture of different types of substances) in the gas state including water vapor which is measured as humidity. • When individual water molecules on the surface of a liquid gain enough motion energy (kinetic energy), they leave the liquid to become a gas; this process is called evaporation. • Water molecules are attracted to each other. When they are moving fast enough, they can break away from each other and bounce off each other. When they are moving slow enough, they clump and stick together. • Water droplets can grow over time as they run into other water droplets or as more molecules of water vapor condense and stick to them. • When water is below a certain temperature (its condensation/boiling point), the molecules are moving slow enough to remain in liquid form; when water is above that temperature, the molecules are moving fast enough to remain in gas form; they change state when cooled below or heated above that temperature.

- Clouds are made of water droplets and/or ice crystals and molecules of gas (including water vapor).
- We see clouds because the water droplets or crystals in them reflect and scatter or absorb a noticeable amount of light.
- For molecules of water vapor in the air to start the condensation or deposition process, the air has to reach 100% humidity and then be cooled. The water vapor also needs a solid surface to stick to. In the air, these surfaces are cloud condensation nuclei (small, solid particles).
- A greater difference between near-ground and atmospheric temperatures is correlated with larger storm development.
- Higher humidity is correlated with stronger storms.
- Simulations are models that can represent only parts of a system, which limits their use.
- The more mass something has, the greater the force of gravity pulling down on it (which can be measured as its weight on a scale).
- Moving air (wind) pushes (exerts a force on) matter in its path.
- Air moving upward (updrafts) can keep an object suspended or floating in the air when the force from the molecules in that air colliding with that object counterbalances the downward force from gravity. When those forces are no longer balanced, the object that was suspended will start moving upward or downward.
- A barometer can detect changes in the density of the air outside of it.
- When one spot in a fluid heats up, it becomes less dense, which causes it to rise. When it cools down, it becomes more dense and sinks. This leads to circular motion in fluids, called convection.
- The greater the thermal energy input into the fluid, the stronger the lift or convection currents. The more of Earth's surface that is in contact with the air above it, the more thermal energy it can transfer to that air.
- Some winds are the result of this convection. Air at the surface moves toward an area where warmed air rose, filling in the space left behind.
- Some storms are very large (hundreds of miles across) and can last for many days. These large-scale storms can produce different types and amounts of precipitation over different areas.
- Many of the mechanisms we used to explain small-scale precipitation events seem like they could be relevant to explaining large-scale storms too.
- Large-scale storms also may have something to do with large areas of cold air and warm air moving over great distances.
- Air masses are large parcels of air (hundreds of miles wide) with similar characteristics (e.g., temperature, humidity).
- Air masses move horizontally, such as from west to east across the United States.
- Storms and precipitation can develop where two air masses with different characteristics meet; this boundary is called a front.
- When a warm air mass moves toward a cold air mass, the warm air slides over the cold air. When a cold air mass moves toward a warm air mass, the cold air pushes into and below the warm air, pushing it up and over. Both interactions cause predictable changes in weather.
- The maximum amount of water vapor that air at a given temperature can hold is referred to as 100% relative humidity.
- The maximum amount of water vapor that can be in the air changes based on the temperature of the air; warmer air can hold more water vapor than colder air.
- Cooling air at 100% relative humidity will cause water vapor to condense out of the air; the greater the decrease in air temperature, the greater the amount of water vapor that will condense out of it.
- When the air pressure outside decreases, it tends to correspond with the appearance of cloudier skies and in some cases precipitation.
- Large-scale, low-pressure air masses can move and their movement can be predicted.
- The movement and location of warm and cold fronts appear to be connected to this low pressure center.

- Precipitation tends to fall along the line of the cold front and warm front and behind the low pressure center.
- Many storms are due to the path that air masses follow as they are moving, other air masses they interact with along their boundaries (fronts), and how much lift occurs in the air mass or along those fronts.
- We have new questions about whether certain weather patterns are typical for different places in our country and what causes any differences in those from one place to another over longer periods of time.
- There are patterns in the direction that air and precipitation move over a region.
- Patterns in air movement are caused by prevailing winds and the prevailing winds in the northern hemisphere mirror the southern hemisphere.
- These patterns help us predict where air and precipitation come from (colder from the north and warmer from the south).
- Climate is the long-term average of weather in an area, typically averaged over 30 years.
- The ocean is warmer near the equator and cooler near the poles.
- Ocean currents can bring warmer waters toward the poles and cooler waters toward the equator.
- More evaporation occurs over warmer ocean waters.
- The temperature of the ocean affects the humidity of the air moving over it.
- Changes in elevation affect the flow of air over the land.
- As elevation increases, the air flowing over the land is forced upward; as elevation decreases the air flowing over the land can fall back downward.
- Air that is forced upward cools as it rises and tends to lose much of the water vapor in it through condensation and precipitation.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
- MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Developing and Using Models • Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed.	**MS.ESS2.C: The Roles of Water in Earth's Surface Processes** • Global movements of water and its changes in form are propelled by sunlight and gravity.	**Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

- Use and/or develop a model of simple systems with uncertain and less predictable factors.
- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
- Develop and/or use a model to predict and/or describe phenomena.
- Develop a model to describe unobservable mechanisms.

Planning and Carrying Out Investigations

- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
- Collect data about the performance of a proposed object, tool, process, or system under a range of conditions.

Analyzing and Interpreting Data

- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, adn ocean temperatures and currents, are major determinants of local weather patterns.
- Variations in density due to variations in temperature drive a global pattern of interconnected ocean currents.
- Water continually cycles among land, ocean, adn atmosphere via transpiration, condensation and crystallization, and precipitation.

MS.ESS2.D: Weather and Climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, and landform. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- Because these patterns are so complex, weather can only be predicted.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

- Graphs, charts, and images can be used to identify patterns in data.
- Patterns in rates of change and other numerical relationships can provide information about natural systems.
- Patterns can be used to identify cause-and-effect relationships.

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.

Systems and System Models

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems
- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models are limited in that they only represent certain aspects of the system under study.

Matter and Energy

- Matter is conserved because atoms are conserved in physical and chemical processes.

• Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.		• Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. • The transfer of energy can be tracked as energy flows through a natural system.

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- 6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
- 6.SP.B.5 Summarize numerical data sets in relation to their context, such as by:
- 6.SP.B.5.A Reporting the number of observations.
- 6.SP.B.5.B Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.
- 4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.
- 6.NS.C.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

ELA

- SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (lesson 3, 7, 18)

- SL.6.1.C Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. (lesson 1 and 14)
- SL.6.1.D Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. (lesson 18)
- SL.6.3 Delineate a speaker's argument and specific claims, distinguishing claims that are supported by reasons and evidence from claims that are not. (lesson 18)
- SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation. (lesson 18)
- W.6.1 Write arguments to support claims with clear reasons and relevant evidence. (lesson 3 and 12)
- W.6.1.A Introduce claim(s) and organize the reasons and evidence clearly. (lesson 3 and 12)
- W.6.1.B Support claim(s) with clear reasons and relevant evidence, using
- credible sources and demonstrating an understanding of the topic or text. (lesson 3, 6, and 12)
- W.6.1.C Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons. (lesson 12)
- W.6.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (lesson 10, 17)
- W.6.2.A Introduce a topic; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. (lesson 10)
- W.6.2.B Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples. (lesson 10, 17)
- W.6.2.C Use appropriate transitions to clarify the relationships among ideas and concepts. (lesson 10)
- W.6.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic. (lesson 10, 17)
- RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (lesson 6, 9, 13, 20)

Computer Science and Design Thinking

- 8.1.8.DA.5 Test, analyze, and refine computational models.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies, and Key Skills

By the end of grade 8:

- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 9.4.8.CT.3 Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
- 9.4.8.CT.1 Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
- 9.4.8.DC.5 Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.

- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Self-Awareness:** Recognize the importance of self-confidence in handling daily tasks and challenges.
- **Self-Management:** Recognize the skills needed to establish and achieve educational and personal goals.
- **Social Awareness**
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the expectations for social interactions.
- **Responsible Decision-Making:** Develop, implement, and model effective problem solving and critical thinking skills.
- **Relationship Skills**
  - Utilize positive communication and social skills to interact effectively with others.
  - Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1: What causes this type of precipitation to occur: • Develop an initial model to describe changes and mechanisms at both the observable and the particle level that cause hail to fall during a brief time period. • Ask questions that arise from careful observation of phenomena and gaps in our current models to clarify and seek additional information about how changes to the flow of matter and energy in the air above and around a location on Earth's surface and cause short duration	Lesson 1: • View video clips of hail storms in different locations of the United States at different times. • Develop a model to attempt an explanation for differences in hail storms at different locations at different times. • Develop questions about the causes of different kinds of precipitation occurrences for DQB (Driving Question Board). • Brainstorm data sources and investigations that could provide answers to questions about different precipitation events.	Lesson 1: • Teacher observation

precipitation events and longer-duration precipitation events.		
Lesson 2: What are the conditions like on days when it hails? • Analyze and interpret data using graphical displays of large data sets to identify temporal and spatial patterns in the range of weather conditions that lead to the formation of precipitation.	Lesson 2: • Examine photos of hail. • Analyze data from hail storms at different locations and times of years. • Identify patterns and factors that could be responsible for the formation of hail.	Lesson 2: • Progress Tracker ○ Topic:Set up Progress Tracker - explain the conditions in which hail forms
Lesson 3: How does the air higher up compare to the air near the ground? • Analyze and interpret sets of data to identify patterns (similarities across data sets) that provide evidence that air temperature changes based on altitude above Earth's surface independently of geographical location or time of year. • Develop a model to show the relationship between the motion of the molecules that make up air and the energy of those molecules to explain the patterns of change in air temperature at various altitudes.	Lesson 3: • Analyze and interpret temperature data of the atmosphere at various altitudes and locations at different times of the year. • Create a class consensus model to represent the motion of air molecules that make up air at different temperatures.	Lesson 3: • Progress Tracker ○ Topic: Update progress tracker: How does the air higher up compare to the air near the ground?
Lesson 4: Why is the air near the ground warmer than the air higher up? • Plan an investigation collaboratively by identifying variables of interest, tools to gather data, methods for obtaining measurements, and how many sites are necessary to determine if a pattern exists between the temperature of the ground and	Lesson 4: • Plan and conduct an investigation to determine why air above varying ground surfaces are warmer than air higher in the atmosphere. • Measure the temperature of different ground surfaces and the air above them. • Measure the amount of sunlight reaching and reflecting off of ground surfaces.	Lesson 4: • Progress Tracker: ○ Use progress tracker to come to an agreement. Summarize what we can say now about how sunlight affects ground and air temperature. ○ Then draw a three-box progress tracker with the big idea question, "Why is the air near the ground

the temperature of the air right above it. • Collect, analyze, and interpret data using graphical displays (tables of data we obtain from our own investigations) to identify ground and surface air temperature patterns as they relate to incoming and reflected solar radiation. • Develop and use a model to describe phenomena and unobservable mechanisms that track the transfer of energy from the Sun to the ground and then to the air at the surface.	• Analyze data to determine that differing amounts of incoming and reflected sunlight are associated with different ground and surface air temperatures. • Analyze data to determine that ground temperatures are warmer than surface air temperatures.	warmer than the air higher up?" Students will provide evidence from what they have learned so far.
Lesson 5: What happens to the air near the ground when it is warmed up? • Conduct investigations to collect and use observations and data as evidence to determine the effects of thermal energy transfer to the air in contact with Earth's surface. • Develop and use a model to track and describe how transferring thermal energy to and from a fixed amount of air (matter) in a closed system affects its volume and density due to unobservable mechanisms (causes), including changes in the speed and spacing of the molecules that make up that air.	Lesson 5: • Conduct an experiment to observe how transferring thermal energy into and out of an air parcel in a closed system affects the volume and behavior of the air. • Conduct an experiment to observe how density changes in an air parcel in a different closed system lead to floating or sinking in the surrounding air. • Develop models to show how the speed, spacing, and density of air molecules are affected by changes in temperature.	Lesson 5: • Progress Tracker: ○ Update progress tracker: What happens to the air near the ground when it is warmed up?
Lesson 6: How can we explain the movement of air in a hail cloud? • Analyze and interpret data including graphical displays of large data sets to identify cause-and-effect relationships to	Lesson 6: • View photos and video of hail producing clouds to look for patterns in air motion as clouds form. • Construct an explanation supported by evidence for the path of air movement	Lesson 6:

construct an explanation of how the movement of parcels of air via conduction and convection causes the upward and downward movement of air in clouds. • Develop and use a model to describe how thermal energy from the Sun causes movement of parcels of air via conduction to cause the formation of clouds. • Obtain information by reading scientific texts adapted for classroom use and summarize key ideas to determine that the air is a mixture of different types of gases (matter), including water vapor, and that relative humidity is a measure of a small proportion of molecules of water vapor in the air.	below, within, and at the top of hail producing clouds. • Revise initial models and return to DQB based on new knowledge acquisition.	
Lesson 7: Where did all that water in the air come from, and how did it get into the air? • Plan and conduct an investigation using a model to gather data to serve as evidence to support a claim about where water in the air originates. • Develop and use a model to predict and describe changes in particle motion and the movement of water molecules from a liquid into the air (via evaporation) when the thermal energy of the water increases.	Lesson 7: • Plan and carry out an investigation that measures the humidity in the air over different Earth surfaces to discover where the water in the air comes from. • Develop a model to show how water got into air from different places.	Lesson 7: • Distribute Model for How Water Gets into the Air. Orient students to the zoom-in circle where they are to show what is happening at the surface of the ground as well as in the air (look for how the molecular level as thermal energy is added to the bottle system) • Update progress tracker: How Water Gets into the Air?
Lesson 8: What happens to water vapor in the air if we cool the air down, and why? • Carry out an investigation to collect data about the patterns in the appearance and growth of water droplets in humid air that is	Lesson 8: • Conduct an experiment to investigate what happens when air containing water vapor is cooled and observe what happens when water droplets make contact with other water droplets.	Lesson 8: • Exit ticket: Show slide on particle interactions and explain 1. ○ What might have been happening between the water droplets that would make them do this.

cooled down and how water droplets interact to serve as evidence to explain the causes of condensation. • Develop and use a model to describe unobservable mechanisms that explain why the mutual attraction between water molecules and a decrease in their speed causes them to condense when water reaches a low enough temperature (condensation/boiling point).	• Develop a model using magnetic marbles to show how mutual attraction between water molecules and changes in the speed of water molecules cause a change in state of matter in water from gas to liquid when cooled below a certain temperature.	○ Imagine the same thing happening between any two water molecules when they get close to each other. ○ How could you use these ideas to explain why liquid droplets appeared on the side of the bottle and grew larger as you lowered the temperature of the air with water vapor? • Update progress tracker: Particle Interactions
Lesson 9: Why don't we see clouds everywhere in the air, and what is a cloud made of? • Obtain and communicate information by reading scientific texts adapted for classroom use to determine key ideas and cause-and-effect relationships related to what clouds are made of, why we can see them, the role of cloud condensation nuclei, and methods of cloud seeding. • Apply scientific ideas and principles to construct an explanation and represent interactions between energy and matter that lead to the condensation and crystallization of water in the atmosphere and the formation of clouds.	Lesson 9: • Read about the composition of clouds, why we see them, the impact of cloud condensation nuclei, and cloud seeding. • Connect cloud formation to cold gel pack over humid air in 2-L bottles.	Lesson 9: • Construct an explanation for frost formation. • Then distribute a copy of the handout Explaining a Related Phenomenon to each student, explain interaction between energy and matter leading to formation of clouds.
Lesson 10: Why do clouds or storms form at some times but not others? • Modify a model—based on evidence—to build a storm system by changing the input variables, such as temperature and humidity, and measuring changes in the output, the size of storm formation.	Lesson 10: • Develop and use a checklist to test a simulation that produces large and small storms. • Manipulate variables of temperature and humidity to determine effects on storm strength. • Design interfaces for additional features in	Lesson 10: • Making of a Thunderstorm: Explain and discuss how temperature and humidity affect the size of a thunderstorm.

• Evaluate the limitations of the thunderstorm simulation, identifying which aspects of the system are represented in the model and which additional aspects could be added to account for thunderstorm development. • Construct an explanation that includes correlational relationships between temperature and humidity that can be used to predict storm development.	simulations.	
Lesson 11: Why don't water droplets or ice crystals fall from clouds all the time? • Use mathematical thinking and construct an explanation to predict patterns in the relationship between the relative strength of two opposing forces on different objects and the resulting change in motion of those objects. • Develop a model to represent balanced and unbalanced forces on an object suspended by an upward current of air, and use the model to predict and explain whether the object would remain suspended or start moving downward or upward due to the relative strength of the opposing forces.	Lesson 11: • Conduct investigations to lift or suspend different objects with upward blown air. • Record the weight and force registered on different objects when air is blown toward or away from a digital scale. • Develop a model to show how an object is lifted, falls, or remains suspended based on the strength of the two different forces acting on the object. • Use a homemade barometer to measure the air pressure and record cloud cover and precipitation outside.	Lesson 11: • Progress Tracker: Predicting and Explaining the Effects of Opposing Forces.
Lesson 12: What causes more lift in one cloud than others? • Collaboratively plan an investigation to collect data, identifying independent and dependent variables and controls and how the data are recorded, to serve as the basis for evidence that greater temperature differences between the ground and the air higher in the atmosphere cause greater lift	Lesson 12: • We plan and conduct an investigation to see what variables affect the amount of lift produced by transferring thermal energy into a fluid. • We use the results of the investigation to help us notice how differences between air and ground temperatures can cause the amounts to lift and movement or air to vary.	Lesson 12: • Report Results

of air. • Develop a model to represent how varying inputs of thermal energy affect the resulting movement of air (output) to show the relationships among variables that can predict greater lift and movement of air. • Construct an explanation that includes qualitative relationships between variables that predict the movement of a fluid (air), based on the transfer of energy that drives the motion.		
Lesson 13: Why do some storms produce (really big) hail and others don't? • Develop and use a model to describe and explain unobservable mechanisms that drive the cycling of matter and the flow of energy into and through the air to cause some storms to produce large hail while others do not. • Construct an explanation, using a model and previously developed science ideas, to explain what causes hurricanes to form, grow, and produce strong winds and large amounts of rain.	Lesson 13: • Complete close reading about how really big hail forms and add to Lesson 10 checklist. • Develop a final model to explain why some storms produce hail and others do not produce hail. • Return to DQB to answer questions that are now answerable based on information acquired. • Apply knowledge to a new weather phenomenon, a hurricane.	Lesson 13:
Lesson 14: What causes a large-scale precipitation event like this to occur? • Analyze data using maps of national weather conditions and forecasts to identify temporal and spatial relationships (patterns) between precipitation, cloud cover, temperature, and air pressure. • Develop an initial model to explain how	Lesson 14: • View a video and observe maps from a weather report and forecast. • Develop a model to show how a weather event in one part of the country at a given time can be connected to predicted weather in another part of a country 24 hours later. • Develop questions for DQB and brainstorm ideas for determining answers to these	Lesson 14: • Teacher Observation

precipitation that is happening in one part of the country at one point in time could be connected to what is predicted to happen in another part of the country at a later time. Use a previous model to identify mechanisms at the observable and the particle levels to explain the causes of this large-scale weather phenomenon. • Ask questions about possible patterns in and causes for a storm affecting large parts of the country over multiple days or causes shared between this precipitation event and a smaller-scale, shorter-duration precipitation event (a hailstorm).	questions.	
Lesson 15: What happens with temperature and humidity of air in large storms? • Use graphical displays of temperature, humidity, and radar data to identify temporal and spatial patterns as air masses interact in a large storm system. • Use an argument supported by empirical evidence and scientific reasoning based on patterns from data and maps to support an explanation that precipitation forms along the boundary of two air masses with different temperature and humidity characteristics.	Lesson 15: • Use temperature, humidity, and radar data of the storm across eight-hour increments to track the movement of air and precipitation. • Consider how air moves horizontally in large parcels, called air masses, and also notice that precipitation and storms develop where air masses of different characteristics meet.	Lesson 15: • Discuss then do Progress tracker: Why would precipitation occur when two air masses meet"
Lesson 16: How do warm air masses and cold air masses interact along the boundaries between them? • Develop and use models to observe and describe the complex patterns of change that occur when warm and cold air masses	Lesson 16: • Conduct an investigation to explore what happens along a frontal boundary where warm air and cold air meet. • Develop models to describe interactions between warm and cold air masses and use	Lesson 16: • Progress Tracker: ○ Revisit the weather models. Explain why the weather changes along a front

interact in the atmosphere. • Use computational thinking to describe how patterns in data support explanations of the changes in weather that occur where warm and cold air masses interact.	patterns to explain changes in precipitation that can occur when air masses collide.	
Lesson 17: Is there a relationship between where the air is rising and where precipitation falls? • Analyze data using maps of air pressure recorded over the country at different points in time and forecasts to identify patterns and the relationship between this and the location of fronts and precipitation. • Construct an explanation that includes the qualitative relationships presented in a weather forecast among (1) the area of lowest air pressure and where it will move to, (2) the locations of the fronts, and (3) where precipitation will fall, using scientific ideas and principles to explain what would be causing these three things to be connected to one another.	Lesson 17: • Analyze national pressure maps from around the time of the original forecast. • Construct an explanation of the patterns we notice among (1) the area of lowest air pressure, (2) the locations of the fronts, and (3) where precipitation would fall. • Apply scientific ideas to explain what is causing these three things to be connected.	Lesson 17: • Progress Tracker: ○ Explain how and why this phenomenon occurs. What is our next step as a class in order to come up with an agreement.
Lesson 18: How can we explain what is happening across this storm (and other large-scale storms)? • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different mechanisms in their explanations of the patterns in how the weather changed during the Jan. 19, 2019 storm. • Apply scientific ideas and related evidence to evaluate whether the new mechanisms (air mass movement, interaction of fronts,	Lesson 18: • Explore video and maps from three parts of a weather report and forecast from a date. • Develop a model to explain how what was happening in one part of the country at one point in time can be connected to what is predicted to happen in another part of the country over a day later.	Lesson 18: • Teacher Observation of group discussions • Discussion and brainstorming of ideas for other types of datasets we need.

and low pressure areas that were used in an explanation of one large-scale storm are also needed to explain how the patterns in the weather will change in the predictions made for three other storms occurring at a different time of year. • Ask questions about typical patterns and causes related to these in how air masses move across the country and how where a place is located affects the amount and type of precipitation that the place receives over more than a few years.		
Lesson 19: Are there patterns to how air masses move that can help predict where large storms will form? • Use visualized precipitation data from a large data set to identify spatial patterns in the direction of air masses movement that influences long-term weather patterns in predictable ways.	Lesson 19: • Observe simulated satellite and ground observation data to answer our questions about patterns in air and storm movement. • View a visualization showing precipitation movement across the United States and annotate a class map. • Determine that air mostly moves in the same pattern across most of the United States, from west to east, bringing colder air from the north and warmer air from the south. • There are some places near the coasts where air and precipitation show a different pattern. • Zoom out to a global view and notice the U.S. pattern is the same as other places in the northern hemisphere and a mirror image of patterns in the southern hemisphere. • Notice precipitation is more common over or near the ocean and wonder how the ocean changes a place's weather.	Lesson 19: • Teacher Observation

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Lesson 20: How do oceans affect whether a place gets a lot or a little precipitation? • Integrate text and media to gather additional information to clarify how ocean currents that circulate cooler and warmer waters to different latitudes affect air mass temperature and humidity. • Use sea surface temperature maps and tabular precipitation data to articulate a spatial pattern connecting offshore ocean temperatures to precipitation on land.	Lesson 20: • Come to agreement about the temperature of air masses and the direction of their movement. • Gather information by observing a visualization of ocean temperatures, a reading about ocean currents, and interpretation of precipitation data for coastal cities. • Determine that the ocean affects the humidity of air masses and update our model to show the predictable formation and movement of different air masses. • Wonder why the moisture from the Atlantic Ocean and Gulf of Mexico can travel so far inland compared to the moisture from the Pacific Ocean.	Lesson 20: • Exit Ticket: Complete an exit ticket about air masses, oceans, and precipitation. • Progress Tracker ○ Update Progress Tracker. Display slide M.
Lesson 21: Why is there less precipitation further inland in the Pacific NorthWest than further inland from the Gulf Coast? • Analyze and interpret data to identify patterns in the data to provide evidence of the relationship between elevation, air temperature, and precipitation.	Lesson 21: • Analyze precipitation, temperature, and elevation data at five locations along two different prevailing wind pathways to explore why there is less precipitation inland in the Pacific Northwest than there is further inland from the Gulf Coast. • Model what happens as an air mass moves from above the ocean to locations over tall mountains and relatively flat landforms. • Develop a list of ideas and data we would need to explain climate patterns in places outside of the United States.	Lesson 21: • Progress Tracker ○ Update progress tracker for precipitation Pacific Northwest vs. Gulf Coast • Teacher Observation of student work related to analyzing graphs.
Lesson 22: How can we explain differences in climate in different parts of the world? • Use graphical displays of global climate	Lesson 22: • Use our key ideas list from Lesson 21 to explain why the rainforests are located where they	Lesson 22:

datasets to identify the relationships between the transfer of energy and the cycling of matter that explain the location and climate of rainforests around the globe.	• Explain why rainforests have different climates. • Revisit the Driving Question Board and discuss all of our questions that we have now answered.	

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

- Accommodations as per IEP/504/ELL
- Utilize and/or encourage use of graphic organizers
- Encourage students to use words and/or drawings when representing and recording their investigation setup and observations.
- Having different modes for interacting with the readings and/or provide different ways to access the readings (Text to Speech/Speech to Text, read-aloud, etc.)
- Provide options for investigations when applicable (giving students a choice to pursue a line of inquiry that is more relevant to them)
- Utilize hands-on materials for students to demonstrate their ideas when possible/relevant
- Utilize prompting/sentence starters when relevant/as needed
- Provide paper copies as needed (when appropriate)
- Utilize models/examples when appropriate
- Scaffold graphs and/or diagrams/pictures (pre-labeling as needed)
- Supplement auditory materials with visual aids/supplement visual materials with auditory aids
- Encourage students to use key vocabulary concepts (domain-specific) in written responses
- Convey information via pictures, maps, charts, films, diagrams etc.
- Emphasize associations for newly taught material which relate to realm of student experiences

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Summative Assessment - Explaining the Movement of Air in a Hailstorm Cloud (Lesson 6) • Summative Assessment - Hurricane Assessment (Lesson 13) • Summative Assessment - Rainforest Climate Assessment (Lesson 22)	• Utilize study questions/study sheets ahead of time when applicable • Allow extra time for completion of task • Bolded keywords in directions and/or questions (encourage highlighting) • Word banks (when appropriate) • Read aloud words, phrases, questions, and/or directions • Provide access to anchor charts and classroom labels relevant to science concepts • Written explanations may be scribed by teacher and/or speech to text feature on the Chromebooks may be used to assist students with their explanations, when needed • Any other specific modifications listed in a students IEP/504

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Unit Title	**Time Frame/Pacing**
Plate Tectonics & Rock Cycling	30 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Mt. Everest earthquake reverses the typical movement of Mt. Everest.

Anchoring Question:
How and why does Earth's surface change?

Supporting Questions:

- Lesson 1: What causes Mt. Everest to move in different ways?
- Lesson 2: How are patterns in earthquakes similar or different in locations around the world?
- Lesson 3: Why do earthquakes happen in specific patterns around the world?
- Lesson 4: What are plates?
- Lesson 5: What is below Earth's plates?
- Lesson 6: How are the plates moving?
- Lesson 7: How much have the plates moved near Mt. Everest?
- Lesson 8: How does plate movement explain movement at Mt. Everest and other places in the world ?
- Lesson 9: Why do volcanoes form in some places?
- Lesson 10: How do the mantle and plates interact to explain earthquakes and landforms at locations on Earth's surface?
- Lesson 11: How could a fossil get to the top of Mt. Everest?
- Lesson 12: How do fossils form?
- Lesson 13: Why is there so little ancient seafloor left on the top of Mt. Everest?
- Lesson 14: How did a marine fossil get to the top of Mt. Everest?

Enduring Understandings

- Mountains can move in one direction normally, but can reverse direction during an earthquake.
- Mountains can get taller.
- There seems to be a pattern between earthquakes and mountain locations.
- Earthquake patterns look like mostly lines or in large clusters of activity.
- In some locations, earthquakes get deeper as you move inland, but in other locations they are shallow.
- When you only look at a short time period, a pattern is not as clear as when you look at data across a longer time period.

- Locations with earthquakes appear "bumpy" on the relief map, which indicates higher elevations, even underwater.
- Earth's surface is not a solid continuous piece of crust; rather, there are pieces called plates and the edges can be observed using earthquake data.
- A network of GPS sensors provide data on the speed and direction of plate movement.
- Plates are either moving toward each other or away from each other, and at different speeds too.
- Earth's plates are made of materials with different heaviness (density).
- On the surface, what we see of plates is different, but below the surface they all are on bedrock that has different depths.
- The deeper into the plates, the higher the temperatures become, indicating a heat source toward the interior of the Earth.
- The crust of the Earth is the "skin" that covers the mantle and the core.
- Different layers of Earth have different temperatures and the core produces this energy.
- The mantle of the Earth is heated by the heat from the core.
- Energy from the Earth's core heats up the mantle and causes molten rock to move around (hotter material rises to the surface and cooler material sinks).
- This circular movement, called convection, within the mantle causes plates to move at the surface.
- When the convection cell rises and pushes out and away, plates at the surface move away from one another. New crust forms when molten rock (magma) seeps through the crust and cools and hardens.
- When parts of the convection cell sink back down into the mantle, plates are pulled together and collide at the surface.
- Plates on Earth have been moving for millions of years.
- When plates of different heaviness collide, volcanoes and trenches form because the heavier plate "sinks" into the mantle under the lighter plate.
- As the sinking crust recycles back into the mantle, it melts and some magma pushes to the surface to form volcanoes and new crust.
- Earthquakes occur at greater depths as one plate is sinking below another.
- A combination of energy from the mantle transferred to the crust causes plates to move in different ways.
- The main movements are colliding or spreading away from one another.
- When plates of similar density collide, they can push up mountains; when plates of different densities collide, one will sink and melt into the mantle, causing volcanoes to form at the surface. It is this interaction of movement in the mantle and plates that shape different places on Earth's surface.
- Fossils of tropical sea creatures have been found at the top of mountains.
- There are layers of rock, and younger rock layers are mostly on top of old layers.
- The relative age of a fossil can be determined by examining the surrounding rock layers.
- Fossils arise from ancient plants and animals buried and preserved under many layers of rock.
- Wind and water (rain, ice) break down rock into smaller particles, which physically changes Earth's surface over a long period of time.
- Weathering and erosion happen in many different ways and are driven by atmospheric and biological forces.
- Over time, ice, glaciers, and wind have contributed to the breakdown of the ancient seafloor on mountain tops.
- Mountains grow and shrink at big scales over long periods of time. Sometimes they are actively getting bigger or uplifted, but at other times they are shrinking through weathering and erosion.
- Fossil records and rock layers help scientists know what places were like a long time ago (such as an ancient sea) and what they became today (such as the tallest mountain in the world).

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NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
- MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
- MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- MS-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Developing and Using Models • Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. **Asking Questions And Defining Problems** • Ask questions that require sufficient and appropriate empirical evidence to answer. • Ask questions that arise from careful observation of phenomena, models, or	**MS.ESS1.C: The History of Planet Earth** • The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. • Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches. **MS.ESS2.A: Earth's Materials & 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 the matter that cycles produce 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	**Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. • Graphs, charts, and images can be used to identify patterns in data. • Patterns in rates of change and other numerical relationships can provide information about natural systems. • Patterns can be used to identify cause-and-effect relationships. **Stability & Change** • Stability might be disturbed either by sudden events or gradual changes that accumulate over time. • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. • Small changes in one part of a system

unexpected results, to clarify and/or seek additional information.
- Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
- Ask questions to determine relationships between independent and dependent variables and relationships in models.
- Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.
- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Use Mathematics and computational thinking
- Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends.
- Use mathematical representations to describe and/or support scientific conclusions and design solutions.
- Create algorithms (a series of ordered steps) to solve a problem.
- Apply mathematical concepts and/or processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems.
- Use digital tools and/or mathematical concepts and arguments to test and compare

second to billions of years. These interactions have shaped Earth's history and will determine its future.

MS.ESS2.B: Plate Tectonics and Large-Scale System Interactions
- Maps of ancient land and water patterns based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.

MS.ESS2.C: The Roles of Water in Earth's Surface Processes
- Water's movements - both on land - cause weathering and erosion, which change the land's surface features.

might cause large changes in another part.
- Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms.

Scale, Proportion & Quantity
- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
- Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
- Phenomena that can be observed at one scale may not be observable at another scale.
- The observed function of natural and designed systems may change with scale.
- Scientific relationships can be represented through the use of algebraic expressions and equations

Systems & System Models
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems
- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models are limited in that they only represent certain aspects of the system under study.

proposed solutions to an engineering design problem. **Analyzing and Interpreting Data** • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success. **Obtain, Evaluate and Communicate Information** • Critically read scientific texts adapted for classroom use to determine the central ideas		**Energy & Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. • The transfer of energy can be tracked as energy flows through a natural system. **Cause & Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **Structure & Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore

and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. • Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. • Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. **Constructing Explanations and Designing Solutions** • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.		complex natural structures/systems can be analyzed to determine how they function.

• Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.		

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

ELA

- RL.6.1 Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. (lesson 5, 12)
- SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (lesson 10)
- SL.6.1.A Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. (lesson 10)
- SL.6.1.B Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed. (lesson 10)
- SL.6.1.C Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. (lesson 10)
- SL.6.1.D Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. (lesson 10)
- W.6.1 Write arguments to support claims with clear reasons and relevant evidence. (lesson 10)
- W.6.1.A Introduce claim(s) and organize the reasons and evidence clearly. (lesson 10)

- W.6.1.B Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text. (lesson 10)
- W.6.1.C Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons. (lesson 10)
- W.6.1.D Establish and maintain a formal style. (lesson 10)
- W.6.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (lesson 8)
- W.6.2.A Introduce a topic; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. (lesson 8)
- W.6.2.B Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples. (lesson 8)
- W.6.2.C Use appropriate transitions to clarify the relationships among ideas and concepts. (lesson 8)
- W.6.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic. (lesson 8)
- RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. (lesson 11)
- RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (lesson 1, 3, 4, 9, 13)
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (lesson 3, 4, 9, 13)

Computer Science and Design Thinking

- 8.2.8.ED.1 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model.

Career Readiness, Life Literacies, and Key Skills

By the end of grade 8:

- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 9.4.8.CT.3 Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
- 9.4.8.CT.1 Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
- 9.4.8.DC.5 Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations.

- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Self-Awareness:** Recognize the importance of self-confidence in handling daily tasks and challenges.
- **Self-Management:** Recognize the skills needed to establish and achieve educational and personal goals.
- **Social Awareness**
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the expectations for social interactions.
- **Responsible Decision-Making:** Develop, implement, and model effective problem solving and critical thinking skills.
- **Relationship Skills**
  - Utilize positive communication and social skills to interact effectively with others.
  - Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1: What causes Mt. Everest to move in different ways? • Develop a model to describe how Mt. Everest regularly moves and grows each year, compared to how Mt. Everest moved suddenly during an earthquake. • Ask questions that arise from careful observations of a mountain shifting position during an earthquake and after looking at patterns from earthquake data at different scales.	Lesson 1: • Explore media sources of the Mt. Everest earthquake. • Make observations about how the typical movement of Mt. Everest was reversed by an earthquake. • Analyze earthquake data and observe connections between earthquakes and mountain ranges. • Create a model to explain the growth, movement, and changes in mountains. • Develop a list of related phenomena. • Brainstorm questions, data, and information that will help explain how earthquakes and mountains are connected.	Lesson 1: • Initial Class Consensus Model • Class develops a unit question

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Lesson 2: How are patterns in earthquakes similar or different in locations around the world? • Use digital tools to examine a large data set at different spatial and temporal scales to compare global earthquake activity to local activity. • Analyze graphical displays of earthquake and topographic data in specific locations to compare local patterns to global ones, and to identify relationships between earthquake locations and topographic features.	Lesson 2: • Collect evidence from different locations about world earthquake activity. • Identify patterns in earthquake activity.	Lesson 2: • Teacher observation of group discussions • Update progress tracker by answering question, "How are Patterns in earthquakes similar or different in locations around the world?"
Lesson 3: Why do earthquakes happen in specific patterns around the world? • Integrate quantitative scientific information in written text with data in an earthquake visualization to clarify patterns in earthquake data in order to locate plates and the direction of their movement. • Analyze and interpret GPS data to provide evidence for the patterns in speed and direction of different plate movements, showing that all plates are moving at different rates and directions, and this movement happens very slowly over millions of years.	Lesson 3: • Read articles to learn more about earthquakes and information that helped lead to the discovery of moving plates.	Lesson 3: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Reflect on what we have figured out and how this helps us explain why earthquakes occur where they do. • Update Progress Tracker: Patterns to the earthquake data.
Lesson 4: What are plates? • Develop a model to represent the structure, composition, and temperature patterns found in Earth's crustal plates. • Develop a model to represent the patterns of earthquake activity at different plate	Lesson 4: • Obtain information from a variety of sources (photographs, text, rock samples) to create representations of plates. • Understand that plates are made of thick layers of bedrock made of varying rock composition, density, and depth.	Lesson 4: • Teacher observations of student's initial models of plates.

boundaries to provide evidence for plate movement and/or depth.	• Obtain information on bedrock, ultra-deep mines, and depths of earthquakes.	
Lesson 5: What is below Earth's plates? • Critically read scientific text to obtain scientific information about the systems and subsystems of the Earth to describe what is below the surface (crust). • Develop or revise a model to represent what is below the surface of the Earth that results in energy flowing and matter cycling in Earth's system that could influence the movement of the plates.	Lesson 5: • Gather information from an article about Earth's structure and layers. • Understand how heat is transferred through the Earth's layers.	Lesson 5: • Consensus discussion and revisit DQB teacher observations
Lesson 6: How are the plates moving? • Develop a model to describe how energy from the Earth's core flows through the mantle (a large, complex system with subsystems), resulting in the collision or spreading apart of the crust's plates, forming mountains in some places and mid-ocean ridges in others. • Apply mathematical concepts, such as rates, and the direction of movement of Earth's plates that are the result of a transfer of energy from Earth's interior to the crust, to explain what causes plates to move great distances, collide, and spread apart.	Lesson 6: • Observe a demonstration on convection to notice changes before and after heat is added. • Revise Earth models to consider how the flow of energy and cycling of matter cause movement within the mantle and at Earth's surface.	Lesson 6: • Teacher observations and comments on work for Parts 1-4 How are the plates moving? document
Lesson 7: How much have the plates moved near Mt. Everest? • Apply mathematical concepts to measure and calculate how far two points on Earth's plates moved over certain amounts of time	Lesson 7: • Use previously gathered data and evidence to determine the distances between two points on plate boundaries of the Eurasian and Indian plates.	Lesson 7: • Student responses to these making sense questions ○ What was in the gap that is created when the plates are moved to represent

ranging from a few years to millions of years.	• Create a time series model for the two plate boundary points at different periods of time.	the past? ○ What happens to this gap as the plates continue to move in the future? ○ What new questions does this make you have? ○ What about 10 million years ago? What would this have looked like?
Lesson 8: How does plate movement explain movement at Mt. Everest and other places in the world? • Develop a model based on evidence to explain the gradual and sudden movements at Mt. Everest due to plate motion and convection in the mantle. • Construct an explanation using models to explain how Earth's surface is changed suddenly and over long periods of time due to plate movement and motion in the mantle.	Lesson 8: • Create a checklist and model to explain different types of movement at Mt. Everest. • Evaluate other previously studied locations to see if the Mt. Everest model can also be used to explain these locations. • Determine that a different model is needed to show two plates moving apart, which is different from Mt. Everest's two plates moving together. • Revise checklists to include what happens where plates spread apart and create model.	Lesson 8: • Teacher Observation on consensus discussion to explain Mt. Everest • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Mt. Everest and rapid and slow changes to Earth's surface.
Lesson 9: Why do volcanoes form in some places? • Integrate qualitative and quantitative scientific information in written text with that contained in media and visual displays to clarify claims about how the Earth's plates and mantle interact to form volcanoes. • Use graphical, cross-section displays of large earthquake data sets to identify spatial relationships and patterns in data to support the formation of volcanoes along boundaries where one plate sinks below another.	Lesson 9: • Use a variety of sources to gather information and data to understand why volcanoes form in some locations. • View video, observe animations, use text, and interpret data to figure out what causes volcanoes to form. • Determine if volcano formation connects to what has been learned about plates and plate movement. • Consensus discussion and revisit DQB teacher observations	Lesson 9: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Compare the Himalayas to the Andres

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Lesson 10: How do the mantle and plates interact to explain earthquakes and landforms at locations on Earth's surface? • Develop and revise a model to describe unobservable movements within Earth's interior that shift the Earth's plates in different ways over long periods of time and large distances, shaping what we see on the surface today. • Apply scientific ideas and evidence to construct an explanation of the interaction of systems on Earth that account for earthquake activity and landform features at real-world places on a plate boundary. • Construct an explanation using models to predict and describe how the different plate movements account for patterns in mountain locations, formation of volcanoes, and earthquake activity on the Earth's surface.	Lesson 10: • Update the Gotta-Have-It Checklist and review the models that explain the different types of movement. • Identify similarities and differences across movements. • Explain the interactions between the mantle and the plates that explain earthquake patterns and landforms. • Assessment to predict and explain patterns found in other places on Earth and add to DBQ.	Lesson 10: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Construct an Explanation: Another Place on Earth's Surface: interaction between the motion of plates and convection in the mantle.
Lesson 11: How could a fossil get to the top of Mt. Everest? • Ask questions to refine a model of how Mt. Everest is changing over time using evidence of fossils from sea creatures found at the top of the mountain.	Lesson 11: • Read a geologist interview transcript about fossils located on Mt. Everest. • Determine that these fossils are the remains of tropical sea organisms lived 400 million years ago. • Use fossil information to update model to explain how and why these fossils could end up at the top of Mt. Everest. • Add to DQB (Driving Question Board).	Lesson 11: • Teacher Observation on revisiting conscious models and DQB questions
Lesson 12: How do fossils form?	Lesson 12: • Analyze worldwide fossil evidence, view a	Lesson 12: • Progress Tracker: update progress tracker

• Use evidence to explain how information from rock layers is used to figure out the relative age and location of fossils from Earth's geologic history. • Analyze and interpret data regarding rock layers and fossil patterns to describe how the Earth's surface has changed through past plate motions.	video and read text about fossils. • Utilize evidence from rock layers to determine the relative ages of fossils. • Predict whether certain areas may have once been under water. • Explain how older rock layers and buried fossils can be found at higher elevations based on mountain uplift knowledge.	with Mt. Everest and sea creature fossil question
Lesson 13: Why is there so little ancient seafloor left on the top of Mt. Everest? • Critically read scientific texts adapted for classroom use to obtain information about the causes of rock to break down and move around at Earth's surface, changing the shape of the land over time. • Apply scientific reasoning to show why weathering and erosion data can help explain how water and wind can shape the land over long periods of time.	Lesson 13: • Look back at Mt. Everest fossil record and determine that only a small portion of the seafloor is present. • Analyze pictures of other locations where landscapes have changed to understand how land can move and make predictions. • Explore stations that give us clues as to what is happening, explore changes and watch time-lapse videos. • Update progress tracker with new ideas about the disappearing seafloor layer.	Lesson 13: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Formation of Horse Bend (weathering and erosion)
Lesson 14: How did a marine fossil get to the top of Mt. Everest? • Use mathematical representations of uplift and erosion rates on Mt. Everest to develop an idea that forces from below and forces from above shape what we see on Mt. Everest and all of Earth's crust. • Develop a time-series model to show the relationships between uplift and erosion over time that would cause a marine fossil record to be on the top of Mt. Everest. • Apply scientific ideas about the growth and shrinking of mountain ranges to explain the	Lesson 14: • Consider cycles of growth and decline in mountains and build a Gotta-Have-It checklist for what to include in the time-series model. • Use the time-series model to explain how a marine fossil was formed, how it ended up on Mt. Everest, and how it was exposed for climbers to find. • Use the ideas on an embedded assessment task and add to DQB.	Lesson 14: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topic: Future of Mt. Everest-making predictions

lifecycle of a mountain range over long periods of time.		

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

- Accommodations as per IEP/504/ELL
- Utilize and/or encourage use of graphic organizers
- Encourage students to use words and/or drawings when representing and recording their investigation setup and observations.
- Having different modes for interacting with the readings and/or provide different ways to access the readings (Text to Speech/Speech to Text, read-aloud, etc.)
- Provide options for investigations when applicable (giving students a choice to pursue a line of inquiry that is more relevant to them)
- Utilize hands-on materials for students to demonstrate their ideas when possible/relevant
- Utilize prompting/sentence starters when relevant/as needed
- Provide paper copies as needed (when appropriate)
- Utilize models/examples when appropriate
- Scaffold graphs and/or diagrams/pictures (pre-labeling as needed)
- Supplement auditory materials with visual aids/supplement visual materials with auditory aids
- Encourage students to use key vocabulary concepts (domain-specific) in written responses
- Convey information via pictures, maps, charts, films, diagrams etc.
- Emphasize associations for newly taught material which relate to realm of student experiences

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Explaining Earth Changes Assessment (Lesson 14)	• Utilize study questions/study sheets ahead of time when applicable • Allow extra time for completion of task • Bolded key words in directions and/or questions (encourage highlighting) • Word banks (when appropriate) • Read aloud words, phrases, questions, and/or directions • Provide access to anchor charts and classroom labels relevant to science concepts • Written explanations may be scribed by teacher and/or speech to text feature on the Chromebooks may be used to assist students with their explanations, when needed • Any other specific modifications listed in a students IEP/504

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Unit Title	**Time Frame/Pacing**
Natural Hazards	20 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Tsunami that occurred in 2011 affecting communities in Japan and Indonesia.

Anchoring Question:
How can communities prepare for natural hazards?

Supporting Questions:

- Lesson 1: What happens to a community when a tsunami occurs?
- Lesson 2: Where do tsunamis happen?
- Lesson 3: What causes a tsunami to form and move?
- Lesson 4: How can we forecast where and when tsunamis will happen and how much damage they will cause?
- Lesson 5: How can we reduce damage from a tsunami wave?
- Lesson 6: How are tsunamis detected and warning signals sent?
- Lesson 7: What are ways we can communicate with people before and during a tsunami?
- Lesson 8: How can we model the systems put into place to protect communities?
- Lesson 9: How can we effectively prepare our communities for a natural hazard?

Enduring Understandings

- Tsunamis are a large wave that results from movement of the ocean floor.
- Proposed solutions include a system of detection sensors, warning plans, and design solutions to reduce damage.
- Tsunamis are caused by earthquakes, volcanic eruptions, and landslides.
- Not all earthquakes cause tsunamis; stronger, shallow earthquakes tend to cause tsunamis.
- Almost all tsunamis occur along plate boundaries where the plates are colliding.
- Data about where hazards have occurred in the past help to determine where the hazard might happen in the future.
- Waves move out in all directions from a disturbance in a ripple or circular manner.
- As waves move and interact with other waves or land, they transfer energy and switch directions. Over time as this continues to happen, they get smaller and smaller.
- When a wave approaches shore, it gets taller until it reaches the shore and collapses on the land flowing up onto the shore.
- The bigger the wave is when it reaches shore, the further onto the land the water will flow.

- Tsunamis happen suddenly and can travel at high speeds over great distances; depending on where the tsunami forms, communities have more or less time to respond.
- Places with more people, or that are closer to the water, or at low elevations have greater risk for a tsunami to cause damage.
- Engineers account for relevant scientific principles and potential impacts on people and the natural environment.
- Solutions can be evaluated using a systematic process to account for both the science of the hazard and the needs of the people at risk.
- Groups of people can be affected by hazards in different ways depending on their access to 1) early warning information, 2) resources to help protect themselves and property, and 3) ability to evacuate when necessary.
- Groups particularly at-risk during a hazard are older people, children, people who speak a different language, or those who are sick or need assistance.
- Effective plans account for the people living in a place and the resources communities have to respond.
- Communication strategies include educating the community before a natural hazard happens and then also alerting people when the hazard is happening.
- A variety of communication strategies (e.g., signs and symbols, warning sounds, multiple languages) are necessary to ensure that all people at risk understand how to respond quickly and safely in the event of a hazard.
- Engineers can design a system for responding to hazards that includes technologies to detect, warn people, and reduce damage.
- Each part of a hazard mitigation system is dependent on another part of the system; subsystems work together actively to meet the criteria of the overall system.
- Engineers engage in a generalized process to define problems, develop solutions, and optimize those solutions.
- All communities are impacted by natural hazards, and these hazards often require different ways to detect, warn people, and reduce damage.
- Knowledge about hazards (the causes of the hazard, locations at risk, how to design solutions, and how to respond when it happens) can empower us and others to design safer communities and save lives.
- Effective communication and response plans account for the people living in a place and the resources communities have to respond.
- Communication strategies include educating the community before a natural hazard happens and then also alerting people when the hazard is happening.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts

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Analyzing and Interpreting Data • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success. **Using Mathematics and Computational Thinking** • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. • Use mathematical representations to describe and/or support scientific conclusions and design solutions.	**MS.ESS3.B: Natural Hazards** • Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. **MS.ETS1.A: Defining and Delimiting Engineering Problems** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specifications of constraints include consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. **MS.ETS1.B: Developing Possible Solutions:** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Models are limited in that they only represent certain aspects of the system under study. **Stability and Change** • Stability might be disturbed either by sudden events or gradual changes that accumulate over time. • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. • Small changes in one part of a system might cause large changes in another part.

• Create algorithms (a series of ordered steps) to solve a problem. • Apply mathematical concepts and/or processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems. • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. **Constructing Explanations and Designing Solutions** • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement		• Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms.

a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing. **Obtaining, Evaluating and Communicating Information** • Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. • Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. • Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.		
Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking		

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Math

- 6.SP.B.5.B Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. (lesson 2)
- 7.RP.A.2 Recognize and represent proportional relationships between quantities.

ELA

- SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. (lesson 2)
- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (lesson 1, 5, 6, 7)
- RST.6-8.4 Determine the meaning of symbols, key terms, and other domain specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (lesson 5, 6, 7)
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (lesson 5, 6, 7)
- RST.6-8.10 By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently. (lesson 6)
- CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly
- and accurately through the effective selection, organization, and analysis of content.
- CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- CCRA.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

Computer Science and Design Thinking

- 8.2.8.ED.1 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model.

Career Readiness, Life Literacies, and Key Skills

By the end of grade 8:

- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 9.4.8.CT.3 Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.

- 9.4.8.CT.1 Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
- 9.4.8.DC.5 Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Self-Awareness:** Recognize the importance of self-confidence in handling daily tasks and challenges.
- **Self-Management:** Recognize the skills needed to establish and achieve educational and personal goals.
- **Social Awareness**
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Recognize and identify the thoughts, feelings, and perspectives of others.
  - Demonstrate an awareness of the expectations for social interactions.
- **Responsible Decision-Making:** Develop, implement, and model effective problem solving and critical thinking skills.
- **Relationship Skills**
  - Utilize positive communication and social skills to interact effectively with others.
  - Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways.

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1: What happens to a community when a tsunami occurs? • Ask questions that arise from careful observations of a sudden natural event that causes damage to communities. • Apply scientific ideas to design an object, tool, or process that detects a tsunami when it starts and warns people or reduces damage to communities.	Lesson 1: • Gather information on 2011 tsunami by watching video and reading articles. • Generate a list of engineering ideas to help detect tsunamis and reduce the effects of tsunamis. • Identify ideas that might be more successful or more challenging. • Brainstorm similar hazards. Ask questions and create a list of information that can better help us understand how to prepare for	Lesson 1: • Teacher observation of initial ideas and navigation: topics: detect tsunami, warning people about a tsunami, and reduce damage of tsunami.

	natural hazards.	
Lesson 2: Where do tsunamis happen? • Use graphical displays of large data sets to identify spatial and temporal patterns in historical tsunami occurrence. • Use maps to analyze large data sets to identify cause and effect relationships between related geologic forces and resulting tsunamis. • Obtain scientific information from text to connect cause and effect relationships to predict communities at risk for future tsunamis occurrence.	Lesson 2: • Determine patterns in locations of tsunamis and relate to causes of tsunamis. • Use maps to analyze data in order to determine that only specific types of earthquakes cause tsunamis. • Predict possible future locations of tsunamis.	Lesson 2: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topics: Why do certain earthquakes cause tsunamis and others don't. • Progress Tracker: update new ideas and how they can be applied to protect communities.
Lesson 3: What causes a tsunami to form and move? • Analyze and interpret video data from different wave models to identify how changes in the profile of the shore and ocean floor cause changes in the height of a wave. • Evaluate different wave models, identifying limitations and benefits in what each shows for explaining how tsunamis form, move, and what happens when tsunamis reach the shore.	Lesson 3: • Use wave models to understand the causes of tsunamis driven by earthquakes. Identify limitations of models. • Determine data that would help predict, warn, and protect communities from the effects of tsunamis.	Lesson 3: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topics: Analyze first wave model to identify how changes (patterns) in the profile of the shore and ocean floor cause changes in the height of a wave (amplitude).
Lesson 4: How can we forecast where and when tsunamis will happen and how much damage they will cause? • Apply scientific ideas to construct an explanation 1) for how sudden changes in the ocean floor during an earthquake form a tsunami, and 2) to forecast which	Lesson 4: • Return to DQB (Driving Question Board) to answer now answerable questions. • Explain the geologic changes that lead to tsunamis using newly acquired knowledge and evidence. • Use knowledge of tsunami causes and	Lesson 4: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topics: How geologic forces lead to the formation of a tsunami (Explaining and Forecasting Tsunami Risk).

communities are most at risk for damage.	locations to identify ways to protect communities from the effects of a tsunami.	
Lesson 5: How can we reduce damage from a tsunami wave? • Evaluate competing design solutions to reduce damage from a tsunami using a systematic process with defined criteria and constraints.	Lesson 5: • Return to Japan coastal communities affected by 2011 tsunami to analyze current and possible solutions. • Define the problem, identify criteria and constraints, and evaluate possible solutions.	Lesson 5: • Check-Ins (Do Nows, Entrance Tickets, Exit Tickets, Interactive Notebook) ○ Topics: Is keeping water from getting to the community the only criteria we need to consider?
Lesson 6: How are tsunamis detected and warning signals sent? • Critically read scientific text to understand how a system designed to detect tsunamis follows specific criteria and constraints.	Lesson 6: • Gather information through reading to learn how seismometers, surface buoys, tsunameter, and satellites are used to detect tsunamis. • Gather information to identify the specific criteria necessary for sending tsunami warnings. • Determine that tsunamis happen suddenly but can travel quickly over large distances, affecting which communities have more or less time to respond.	Lesson 6: • Progress Tracker: update tracker with following question, "How are tsunamis detected and warning signals sent?"
Lesson 7: What are ways we can communicate with people before and during a tsunami? • Integrate stories and accounts of tsunami response with audio-visual tsunami warning and preparedness systems to determine the criteria and constraints of communication and education plan solutions for communities. • Evaluate communication solutions using a systematic process and agreed-upon criteria and constraints to determine how well the design solution communicates with	Lesson 7: • Listen to a tsunami warning signal and use survivor accounts from Japanese tsunami victims to understand how they responded in the time between the warning and the tsunami. • Determine stakeholders and develop criteria and constraints for creating tsunami communication. • Use stakeholder needs to evaluate different options for communicating tsunami warnings. • Determine that there are a variety of	Lesson 7: • Update progress tracker to reflect new ideas ○ Topic: Choose around 3 criteria to detect tsunami, warn people about a tsunami, and reduce damage of tsunami.

stakeholders.	communication methods with different stakeholders before and during a tsunami.	
Lesson 8: How can we model the systems put into place to protect communities? • Construct a system model to represent the interactions of subsystems designed to detect, warn communities, and reduce damage from a tsunami hazard.	Lesson 8: • Develop a model of a tsunami system. • Analyze model to figure out the subsystems within the modela, and the interactions between the subsystems. • Create a diagram to organize how engineers solve problems.	Lesson 8: • Exit Ticket: Systems components • Teacher observation of student discussions related to systems and subsystems processes
Lesson 9: How can we effectively prepare our communities for a natural hazard? • Critically read scientific texts adapted for classroom use to obtain scientific and technical information related to the likely locations and severity of a local hazard and response systems designed to protect communities from damage that might result. • Communicate scientific and technical information in writing and/or oral presentations about a system designed to prepare community members before a hazard happens, respond during a hazard, and recover after a hazard.	Lesson 9: • Collect and communicate information about a local hazard in our community. • Collect information from agencies and organizations that specialize in hazards and emergencies. • Create a plan or product to present the information to stakeholders in the community.	Lesson 9: • Teacher observation of student preparation for summative project • Progress Tracker check

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

- Accommodations as per IEP/504/ELL
- Utilize and/or encourage use of graphic organizers
- Encourage students to use words and/or drawings when representing and recording their investigation setup and observations.
- Having different modes for interacting with the readings and/or provide different ways to access the readings (Text to Speech/Speech to Text, read-aloud, etc.)
- Provide options for investigations when applicable (giving students a choice to pursue a line of inquiry that is more relevant to them)

- Utilize hands-on materials for students to demonstrate their ideas when possible/relevant
- Utilize prompting/sentence starters when relevant/as needed
- Provide paper copies as needed (when appropriate)
- Utilize models/examples when appropriate
- Scaffold graphs and/or diagrams/pictures (pre-labeling as needed)
- Supplement auditory materials with visual aids/supplement visual materials with auditory aids
- Encourage students to use key vocabulary concepts (domain-specific) in written responses
- Convey information via pictures, maps, charts, films, diagrams etc.
- Emphasize associations for newly taught material which relate to realm of student experiences

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Summative Assessment: Develop a Natural Hazard Plan for Local Community	• Utilize study questions/study sheets ahead of time when applicable • Allow extra time for completion of task • Bolded key words in directions and/or questions (encourage highlighting) • Word banks (when appropriate) • Read aloud words, phrases, questions, and/or directions • Provide access to anchor charts and classroom labels relevant to science concepts • Written explanations may be scribed by teacher and/or speech to text feature on the Chromebooks may be used to assist students with their explanations, when needed • Any other specific modifications listed in a students IEP/504

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Unit Title	Time Frame/Pacing
Cells & Systems	30 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Injuries that prevent individuals from doing actions that they previously did but after healing, can do again.

Anchoring Question:
How do living things heal?

Supporting Questions:

- Lesson 1: What happened in the foot so that the person could walk again?
- Lesson 2: What do our bones, skin, and muscles do for us?
- Lesson 3: What connections can we see between the structures inside the body?
- Lesson 4: Why is there blood in all of these places in the body?
- Lesson 5: What do nerves do and why are they in different parts of the body?
- Lesson 6: What will we see if we look at the skin, bone, and muscle with the microscope, too?
- Lesson 7: How does what we figured out about the different parts of our body help us identify similar structures in other living things
- Lesson 8: What happened as the skin on top of the foot healed?
- Lesson 9: What happens at the site of injury to fill the gap?
- Lesson 10: What do cells need to grow and make more of themselves?
- Lesson 11: How do cells get what they need to grow?
- Lesson 12: How do the structures and systems in the body work together to heal the injury?
- Lesson 13: How do actions that people do support healing inside the body?
- Lesson 14: How is the process of growing similar to healing?
- Lesson 15: How do other living things heal and grow?

Enduring Understandings

- Bones move when the muscles attached to them move.
- When one part of the system is broken or injured, the whole system is affected and can't function the way it used to.
- There are blood vessels in the different parts of the bone, muscle, and skin.
- There are nerves that run through the layers of the skin, the muscle, and the bone.
- There are structures that connect the skin to the muscles and muscles to the bone.

- Skin has different layers.
- Blood is composed of a mixture of structures that we cannot see without a microscope.
- Blood is made of red blood cells, white blood cells, platelets, and blood plasma.
- The structure of blood cells relates to their function: their round shape helps them travel easily through the tubular blood vessels.
- Blood's function as a whole is to travel around carrying many different things the body needs, and its structure (flowy liquid mixture) allows it to do that.
- There are nerve endings in skin, bones, muscles, and other parts of the body.
- Nerve cells have a very unique structure - they have long, thin "branches" or "tentacles" extending from a central portion. Nerve cells branch out and connect to other nerve cells, forming a network of nerves that carry signals between all parts of the body and the brain.
- Bone, muscle, and skin have repeating patterns of microscopic structures called cells, and cells work together to form tissues.
- The unique structures of the cells that make up these different tissues are related to their function in the body.
- Structure is the characteristic of something (the shape or way it's made or arranged) that supports its function.
- Other living things besides humans are made of cells.
- Within the cells of other things that look similar to human cells, there are special structures that could be responsible for particular functions.
- New skin (which is made of cells) forms as the site of the injury gets smaller and smaller.
- New cells come from preexisting cells, which grow and split through a repeated and non-random process.
- When cells grow and split, they make new cells of the same type (i.e. skin cells make new skin cells and bone cells make new bone cells).
- A gap in the skin, muscle, or bone is filled by new cells as a result of cells growing and splitting.
- Cells need food to make more cells.
- There are single-celled (unicellular) and many-celled (multicellular) living things.
- Cells are living things.
- Plant cells have a cell wall and a cell membrane.
- The cell wall is a structure that is unique to plants and helps the cell maintain its shape.
- The cell membrane is a structure that allows what the cell needs into the cell and allows whatever needs to leave the cell out.
- The body reacts to an injury by swelling, which increases blood flow and brings extra fluid to injured tissue to help it heal.
- A person could be healed, but that part of the body may have completely different functions than before.
- Growth in humans is similar to healing.
  - Cells fill a gap in each tissue/body part.
  - The same structures and systems that are needed to heal are needed to grow.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

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

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- MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- MS-LS1-3 Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Developing and Using Models • Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. **Planning and Carrying Out Investigations** • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.	**MS.LS1.A: 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. **MS.LS1.D: Information Processing:** • Signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors.	**Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. • Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. • Phenomena that can be observed at one scale may not be observable at another scale. • The observed function of natural and designed systems may change with scale. • Scientific relationships can be represented through the use of algebraic expressions and equations **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

• Collect data about the performance of a proposed object, tool, process, or system under a range of conditions. **Engaging in Argument from Evidence** • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.		• Models are limited in that they only represent certain aspects of the system under study. **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (lesson 4)
- 6.RP.A.3.C Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. (lesson 4)

ELA

- SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (lesson 5)
- SL.6.1.A Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. (lesson 5)
- SL.6.1.C Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. (lesson 1)
- SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text,

or issue under study. (lesson 5)
- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (lesson 3)
- RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (lesson 1)
- RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (lesson 4)
- WHST.6-8.1 Introduce and support a claim about how the mysterious object could be similar to humans. (lesson 7)

Computer Science and Design Thinking
- 8.2.8.ED.1 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.ED.2 Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model.

Career Readiness, Life Literacies, and Key Skills

By the end of grade 8:
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 9.4.8.CT.3 Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
- 9.4.8.CT.1 Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
- 9.4.8.DC.5 Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
- 9.4.8.DC.7 Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.GCA.1 Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
- 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations
- 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
- 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.

Social-Emotional Learning Competencies

- **Self-Awareness:** Recognize the importance of self-confidence in handling daily tasks and challenges
- **Self-Management:** Recognize the skills needed to establish and achieve educational and personal goals
- **Social Awareness**
  - Demonstrate an understanding of the need for mutual respect when viewpoints differ.
  - Recognize and identify the thoughts, feelings, and perspectives of others.

- Demonstrate an awareness of the expectations for social interactions
- **Responsible Decision-Making:** Develop, implement, and model effective problem solving and critical thinking skills
- **Relationship Skills**
  - Utilize positive communication and social skills to interact effectively with others.
  - Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways

Learning Targets	Investigations/Resources	Formative Assessment
Lesson 1: What happened in the foot so that the person could walk again? • Obtain information from images and doctors notes to identify patterns between the relationship of important events (effect) that could be evidence of interacting subsystems healing. • Develop an initial model of the healing process within multiple interacting systems and subsystems that restores the foot's function. • Ask questions that arise from observations of injuries to multiple subsystems resulting in loss of a particular body function to the larger complex system of the foot.	Lesson 1: • Share experiences with personal examples of injuries. • Read doctors notes and view images of an injury and the healing process. • Create a timeline that shows important events and evidence of healing. • Develop models to show how the structures of the foot work together in the healing process. • Identify related phenomena of other types of healing. • Ask questions for the Driving Question Board (DQB) and determine possible experiments that could help provide answers to the questions.	Lesson 1: • Teacher Observation for Evidence for Healing to each student. Assign each pair of students one of the four recovery reports to read. record clues they notice in their assigned report that could serve as evidence that the foot was healing. Also for the development of an initial model for healing. • Develop questions for the driving question board.
Lesson 2: What do our bones, skin, and muscles do for us? • Analyze and interpret data to highlight the interactions between subsystems within the larger system. • Revise the experimental design and conduct an investigation to predict the change in function of the chicken wing when injured.	Lesson 2: • Conduct an investigation to identify the parts of a chicken wing that allow movement. • View a video that shows the dissection of chicken skin, muscle, and bone. • Compare the parts of a chicken wing to the parts of a human foot to show how the parts work together to allow movement in similar ways. • Adjust investigation to include how an	Lesson 2: • Student observations of analysts on a demonstration of a dissection of a chicken wing to make sense of how the different parts of the wing work together for the wing to move. Focus is on how the skin,muscles, and bones work together. • Teacher observations from brainstorming ideas for how to revise the dissection investigation to figure out more about how the injury to the

	injury to a structure can affect its function.	person's foot affected different parts of the foot and prevented the student from being able to walk. • Start a new Progress Tracker: add ideas from today's lesson.
Lesson 3: What connections can we see between the structures inside the body? • Critically read and interpret scientific texts adapted for classroom use to obtain scientific and technical information about various parts of the human foot and leg to describe patterns among interacting systems.	Lesson 3: • View medical images of a leg to see different structures within the leg. • View scientific diagrams to aid in understanding of the structures viewed in images.	Lesson 3: • Teacher observations on ideas about (1) how we can use multiple sources of information(images taken with different tools and from different perspectives) together in order to gain a fuller understanding of a structure or system, (2) by using multiple sources of scientific or technical information (images), a more complete representation can be used to connect information from multiple sources (in this case, to notice that blood vessels and nerves are located throughout skin, muscle, bone, and even in the material connecting all three structures).
Lesson 4: Why is there blood in all these places in the body? • Collect data at different scales to answer scientific questions about the structures and function of blood. • Critically read scientific text to make sense of patterns within structures we observed in the blood related to their function in the body.	Lesson 4: • Look at a blood vessel image to figure out that blood circulates throughout the body. • Observe that blood separates into layers. • View human and other mammal blood under a microscope to determine that blood is composed of smaller parts. • Read an article to acquire additional information to help understand the patterns observed in structures of blood.	Lesson 4: • Teacher observation: Collect data at different scales to answer scientific questions about the structures and function of blood. • Progress Tracker: update chart regarding information about blood.
Lesson 5:	• Observe nerves under a microscope to notice the structure of nerve cells.	Lesson 5: • Check-Ins (Do Nows, Entrance Tickets,

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What do nerves do and why are they in different parts of the body? • Gather and synthesize information from scientific text and other sources to describe the basic structure of nerves and nerve cells and explain how the structure supports both the function of those cells within the nervous system and the interactions that occur between nerves and other parts of the body.	• Read an article to acquire information about the structure and function of nerves. • Participate in investigations to understand what nerves do in the body. • Return to foot injury to apply what we know about nerves to understand how the foot functions, how the skin heals, and how the bones and muscles are impacted by the injury.	Exit Tickets, Interactive Notebook) ○ Revisist Driving Question Board ○ Update Progress Tracker
Lesson 6: What will we see if we look at skin, bone, and muscle with the microscope, too? • Analyze and interpret observational data in the microscopic structures of skin, bone, and muscle, relating those structures to the functions of those parts of the body.	Lesson 6: • Use microscopes to view bone, skin, and muscle cells. • Determine how each cell's structure supports its function.	Lesson 6: • Progress Tracker: update progress tracker with information on cells. • Teacher observation: Analyze and interpret microscopic structures of skin, bone, and muscle.
Lesson 7: How does what we figured out about the different parts of our body help us identify similar structures in other living things? • Plan and carry out an investigation to produce data on what microscopic structures make up parts of a mysterious object (pattern) to conclude that more than just humans are made of cells. • Construct a written argument to support an explanation that humans and animals are made up of cells whose unique structures support their particular functions.	Lesson 7: • Develop Gotta-Have-It Checklist to review key ideas from previous lessons 1-6. • Assessment where students plan and carry out an investigation to evaluate if a mysterious object is similar to humans based off of its microscopic structures. • Use data and evidence to argue that other living things are similar to humans because they are made of cells.	Lesson 7: • Plan and carry out an investigation on what microscopic structures make up parts of an mysterious object (pattern) • Construct a written (or oral) argument about humans and animals being made of cells.

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Lesson 8: What happened as the skin on top of the foot healed? • Develop a model to predict how the interacting systems and subsystems of groups of skin cells work together to form or repair new tissues and organs.	Lesson 8: • Review timeline and Driving Question Board to make connections. • Revise definition of healing to include that healing must involve filling in the gaps in the injury cells but we are not sure of the process. • Observe a time-lapse video of a skin wound healing. • Revise our model to make predictions on what is happening with the cells for the skin to heal.	Lesson 8: • Skin Healing Predictive Model ○ Topic - Groups skin cells --->tissue--->organs
Lesson 9: What happens at the site of injury to fill the gap? • Analyze and interpret data from videos and images at varying spatial and time scales to conclude that new cells come from old cells following a predictable pattern of repeated steps.	Lesson 9: • Review videos and images of cells growing and splitting in different organisms. • Make sense of how our body fills a gap at the site of injury through observing the process of different spatial and time scales.	Lesson 9: • Progress Tracker ○ Update tracker: What happens at the site of an injury to fill the gap in the cells
Lesson 10: What do cells need to grow and make more of themselves? • Analyze and interpret data for patterns to identify the relationship between the amount of food and the amount of bacteria made to provide evidence that cells need food to live and make more of themselves. • Construct a written argument using cause and effect relationships to conclude that the cells that make up multicellular organisms need food to make more cells as do the cells of unicellular organisms.	Lesson 10: • Review what humans need to grow. • Investigate single-celled organisms. • Review data from scientists who grow bacteria on agar plants with different nutrient levels. • Read about unicellular organisms to determine that they are living things that need food to make more of themselves.	Lesson 10: • Progress Tracker ○ Update tracker: What cells need to make more cells (single celled vs. multi-celled) • Exit ticket: How does bacteria grow?
Lesson 11:	Lesson 11:	Lesson 11:

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How do cells get what they need to grow? • Develop a model to show that the cell membrane and/or cell walls let some things in and out of the cell.	• Use microscopes to observe onion cells. Then, use water and salt water to cause observable changes in the cells and notice that onion cells have a cell membrane • Observe a cell wall, which is a structure we did not see in blood, nerve, muscle, or bone cells. • Use models to show that the cell membrane and cell wall (structures) allow water into and out of the cell (function) • Use our observations as evidence to argue that the cell membrane (and cell wall) are structures that allow what the cell needs into the cell, and allow whatever the cell does not need to leave the cell (function).	• Progress Tracker: o Topic: How cells get what they need to grow. o Topic: cell wall vs. cell membrane and their function
Lesson 12: How do the structures and systems in the body work together to heal the injury? • Apply scientific ideas and evidence to construct an explanation for how subsystems of the body interact to support the healing process in the foot. • Develop a model to describe how systems interact to explain healing in a living thing.	Lesson 12: • Revisit timeline and develop explanations for how healing happens based on each event • Come to consensus about how the healing in the foot happened, developing a list of science ideas and a consensus model. • Use what we have figured out about healing so far to see if we can explain any of our related phenomena.	Lesson 12: • Teacher Observation of discussions for the worksheet: How Healing Happened Chart.
Lesson 13: How do actions that people do support healing inside the body? • Communicate scientific and/or technical information in writing and/or through oral presentations to identify common structures among community healing methods that support the healing process for cells within systems and subsystems in the body.	Lesson 13: • Share examples and types of healing from local community. • Develop a model of healing.	Lesson 13: • Develop a model to describe how systems interact to explain healing in a living thing.

Lesson 14: How is the process of growing similar to healing? • Apply science ideas and evidence from classroom investigations to explain a common, real-world phenomenon in which the specialized cells of living things serve particular functions as they work together to interact with each other and other systems to grow. • Identify and ask questions related to healing and growth of living things that can be investigated in the future.	Lesson 14: • Apply what we have learned about healing to a related phenomenon. • Revisit DQB to review what questions have been answered and revise the main question. • Reflect on experiences throughout the year.	Lesson 14: • Add to progress tracker
Lesson 15: How do other living things heal and grow?	Lesson 15: • Take on a project to investigate how other living things heal and grow with different structures. • Identify similar functioning structures in other living things and compare them to structures in humans.	Lesson 15: • Teacher observations on students planning and designing their organism project.

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

- Accommodations as per IEP/504/ELL
- Utilize and/or encourage use of graphic organizers
- Encourage students to use words and/or drawings when representing and recording their investigation setup and observations.
- Having different modes for interacting with the readings and/or provide different ways to access the readings (Text to Speech/Speech to Text, read-aloud, etc.)
- Provide options for investigations when applicable (giving students a choice to pursue a line of inquiry that is more relevant to them)
- Utilize hands-on materials for students to demonstrate their ideas when possible/relevant
- Utilize prompting/sentence starters when relevant/as needed
- Provide paper copies as needed (when appropriate)
- Utilize models/examples when appropriate
- Scaffold graphs and/or diagrams/pictures (pre-labeling as needed)
- Supplement auditory materials with visual aids/supplement visual materials with auditory aids
- Encourage students to use key vocabulary concepts (domain-specific) in written responses

• Convey information via pictures, maps, charts, films, diagrams etc. • Emphasize associations for newly taught material which relate to realm of student experiences

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Common Assessment - Growth (Lesson 14)	• Utilize study questions/study sheets ahead of time when applicable • Allow extra time for completion of task • Bolded key words in directions and/or questions (encourage highlighting) • Word banks (when appropriate) • Read aloud words, phrases, questions, and/or directions • Provide access to anchor charts and classroom labels relevant to science concepts • Written explanations may be scribed by teacher and/or speech to text feature on the Chromebooks may be used to assist students with their explanations, when needed • Any other specific modifications listed in a students IEP/504