West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 5 - Energy and Matter in Ecosystems

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.
  - Cultivate an inclusive and diverse community where all learners are welcomed, valued, respected, and celebrated.

Unit: Energy and Matter in Ecosystems	
Content Area: Science	
Course & Grade Level: Science Grade 5	
Summary and Rationale	
In this unit, students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment, and they can explain that energy in animals' food was once energy from the sun. Students will use engineering practices to propose a design for a life sustaining dome for nonterrestrial planetary expedition and evaluate proposed organisms for life survival.	
Recommended Pacing	
20 days	
New Jersey Student Learning Standards for	
Standard: 5-PS3: Energy	
CPI #	**Cumulative Progress Indicator (CPI)**
5-PS3-1	Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. [Clarification Statement: Examples of models could include diagrams, and flow charts.].
PS3.D	Energy in Chemical Processes and Everyday Life The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).
Standard: 5-LS1: From Molecules to Organisms: Structures and Processes	
CPI #	**Cumulative Progress Indicator (CPI)**
5-LS1-1	Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]
LS1.C	Organization for Matter and Energy Flow in Organisms Plants acquire their material for growth chiefly from air and water.
Standard: 5- LS2: Ecosystems: Interactions, Energy, and Dynamics	
CPI #	**Cumulative Progress Indicator (CPI)**
5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]
LS2.A	Interdependent Relationships in Ecosystems The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.

LS2.B	Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: English Language Arts	
CPI #	**Cumulative Progress Indicator (CPI)**
RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
RI.5.9	Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from several texts on the same topic in order to write or speak about the subject knowledgeably.
W.5.1	Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CI.1	Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions
9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue
9.4.5.CI.3:	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process
9.4.5.IML.2	Create a visual representation to organize information about a problem or issue
New Jersey Student Learning Standards for Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.TL.2	Sort and filter data in a spreadsheet to analyze findings.
Interdisciplinary Standards	
Mathematics	
MP.2	Reason abstractly and quantitatively.
MP.4	Model with mathematics.
MP.5	Use appropriate tools strategically.
5.MD.A.1	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
Instructional Focus	
Unit Enduring Understandings	
● Plants get the materials they need for growth chiefly from air and water. ● Plants use energy from the sun to start the movement of energy and matter in an ecosystem.	

- Matter moves among plants, animals, decomposers, and the environment.
- Producers, consumers, and decomposers interact in food chains, which make up food webs.
- Energy in animals' food was once energy from the sun.

Unit Essential Questions

- Where do organisms get the energy they need for living?
- How do organisms use energy that originally comes from the sun?
- How can I show cycles of matter in an ecosystem?

Objectives

Students will know:

- Plants get the materials needed for growth and reproduction through air, water and energy from the sun.
- Matter moves among plants, animals, decomposers, and the environment to create food webs and chains.
- Matter moves through an ecosystem when organisms interact with each other and the environment.
- The energy in an animal's food was once energy from the sun.

Students will be able to:

- Support an argument with evidence that plants get the materials they need for growth and reproduction chiefly through a process in which they use air, water, and energy from the sun to produce sugars and plant materials.
- Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- Students will use a model to describe how interactions between each part of an ecosystem contribute to the movement of matter through the whole system.
- Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Evidence of Learning

Assessment

- Claims, evidence, and reason statements
- Pre and Post Assessment data
- Observational notes
- Graphs, charts, and data

Resources

Core Texts:

- Hydroponics Video
- Ecosystem in a Bottle (Daily Mail)
- *Who eats what? Food Chains and Food Webs* by P. Lauber
- Composting Ideas for Children
- National Geographic Kids - Composting
- Trout are Made of Trees by April Pulley Sayre
- Finding Fresh Foods in Poor Neighborhoods is Challenging (NEWSELA)
- Supermarkets Have the Ability to Revive Low-income Neighborhoods (NEWSELA)
- Half of All Food Produce is Thrown Away (NEWSELA)
- U.N. Says Climate Change is Affecting the Cost and Availability of Food (NEWSELA)

Lesson 1: Plant Growth

Grade/ Grade Band: 5th grade	**Topic:** Energy and Matter in Ecosystem	**Lesson #** __1___ **in a series of** ___4__ **lessons**

Brief Lesson Description: In this lesson, students will design and conduct an experiment to discover the materials plants need to survive. Students will record the growth of plants over a 2-3 week period to understand if/how plants can survive under different conditions.

Performance Expectation(s): 5-LS1-1. Support an argument with evidence that plants get the materials they need for growth and reproduction chiefly through a process in which they use air, water, and energy from the sun to produce sugars and plant materials .

Specific Learning Outcomes:
Students will question and explain what material is most important for plant growth.
Students will plan and carry out an investigation to determine which material is most important to plant growth.

Narrative / Background Information

Prior Student Knowledge:
1-LS1-1b: Use evidence to explain that plants have roots, stems, leaves, flowers, and fruits that are used to take in nutrients, water, and air, produce food (sugar), and make new plants.
4-LS1-1: Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction.

Science & Engineering Practices:
- ❑ Asking Questions (science) and defining problems (engineering).
- ❑ Developing and using models.
- ❑ Planning and carrying out investigations.
- ❑ Analyzing and interpreting data.
- ❑ Using mathematics and computational thinking.
- ❑ Constructing explanations (science) and designing solutions (engineering).
- ❑ Engaging in argument from evidence.
- ❑ Obtaining, evaluating, and communicating information.

Disciplinary Core Ideas:

LS1.C: Organization for Matter and Energy Flow in Organisms
- **Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. *(secondary to 5-PS3-1)***
- **Plants acquire their material for growth chiefly from air and water. (5-LS1-1)**

LS2.A: Interdependent Relationships in Ecosystems
- **The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and**

Crosscutting Concepts:
- ❑ Patterns
- ❑ Cause and effect: Mechanism and explanation
- ❑ Scale, proportion, and quantity
- ❑ Systems and system models
- ❑ Energy and matter: Flows, cycles, and conservation
- ❑ Structure and function
- ❑ Stability and change

	therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** ● **Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)**	

Possible Preconceptions/Misconceptions:

- Students may assume that plants get their materials from soil. They may have difficulty grasping the concept that the matter needed to survive and grow comes from water and air.
- Students may not perceive sunlight to be energy, and assume that the plant's energy is generated internally or assume that dirt provides energy to the plant in the form of calories

LESSON PLAN – 5-E Model

Lesson 2: Flow of Matter

Grade/ Grade Band: 5th Grade	**Topic:** Energy and Matter in Ecosystems	**Lesson # _2_ in a series of __4___ lessons**

Brief Lesson Description: This lesson is designed to introduce students to the flow of matter in an ecosystem. They will understand what components are needed within an ecosystem. Through this understanding, students will be challenged with thinking about what matter would be needed in an ecosystem to support human life on a mission to Mars.

Performance Expectation(s):

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. *[Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]*

Specific Learning Outcomes:

- **Students will obtain information from the readings and videos about the interactions among living and nonliving things in an ecosystem.**
- **Students will use a model to describe how interactions between each part of an ecosystem contribute to the movement of matter through the whole system.**

Narrative / Background Information

Prior Student Knowledge:

- Matter is the "stuff" that makes up all objects.
- Matter is conserved, meaning that it can change state or composition but it is never created or destroyed.
- Models are representations used to describe real-world phenomenon.

Science & Engineering Practices:

- ❑ Asking Questions (science) and defining problems (engineering).
- ❑ Developing and using models.
- ❑ Planning and carrying out investigations.
- ❑ Analyzing and interpreting data.
- ❑ Using mathematics and computational thinking.
- ❑ Constructing explanations (science) and designing solutions (engineering).
- ❑ Engaging in argument from evidence.
- ❑ Obtaining, evaluating, and communicating information.

Disciplinary Core Ideas:

LS2.A: Interdependent Relationships in Ecosystems
The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Matter

Crosscutting Concepts:

- ❑ Patterns
- ❑ Cause and effect: Mechanism and explanation
- ❑ Scale, proportion, and quantity
- ❑ Systems and system models
- ❑ Energy and matter: Flows, cycles, and conservation
- ❑ Structure and function
- ❑ Stability and change

	cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.	

Possible Preconceptions/Misconceptions:

1. When plants and animals die their matter disappears.
2. Humans can eliminate or remove apex predators with no harm to an ecosystem.
3. Mars is currently habitable.

LESSON PLAN – 5-E Model

Lesson 3: Decomposers

Grade/ Grade Band: 5	**Topic:** Energy and Matter in Ecosystems	**Lesson #** __3___ **in a series of** __4__ **lessons**

Brief Lesson Description: In this lesson, students discover the role fungi play in decomposing dead materials and in creating soil. In the activity, Mold Terrarium, students plan and conduct an investigation to discover the factors affecting decomposition. Students fill Ziploc bags with different types of foods and change environmental conditions to study how different variables affect mold growth. They then observe mold growth over a period of two weeks.

Materials needed: Loaf of bread, salt and/or sugar, and ziploc bags.

Performance Expectation(s):

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.[Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed
materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

Specific Learning Outcomes:

- **Students will use a model to describe how interactions between each part of an ecosystem contribute to the movement of matter through the whole system.**

Narrative / Background Information

Prior Student Knowledge:

- **Students may know that spoiled or rotten food will grow mold.**

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and	LS1.C: Organization for Matter and Energy Flow in Organisms Plants acquire their material for growth chiefly from air and water. (5-LS1-1) LS2.A: Interdependent Relationships in Ecosystems	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function

computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) <u>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems</u> Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1) <u>PS3.D: Energy in Chemical Processes and Everyday Life</u> The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1) <u>LS1.C: Organization for Matter and Energy Flow in Organisms</u> Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)	❑ Stability and change

Possible Preconceptions/Misconceptions:

- Students may assume that matter disintegrates on its own.

LESSON PLAN – 5-E Model

Lesson 4: Energy from the Sun

Grade/ Grade Band: 5	**Topic:** Energy and Matter in Ecosystems	**Lesson #** __4___ **in a series of** __4__ **lessons**

Brief Lesson Description: Students will play a game which teaches the transfer of energy from the sun throughout an ecosystem.

Performance Expectation(s): Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Specific Learning Outcomes: Students will play a food chain game to determine how energy from the sun is transferred through an ecosystem.

Narrative / Background Information

Prior Student Knowledge:

<u>Kindergarten Unit 4: Basic Needs of Living Things</u>

- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

<u>Grade 2: Relationships in Habitats</u>

- Plants depend on water and light to grow.
- Plants depend on animals for pollination or to move their seeds around.

<u>Grade 4: Weathering and Erosion</u>

- Living things affect the physical characteristics of their regions.

<u>Grade 4 Unit 5: Transfer of Energy</u>

- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.)
- Light also transfers energy from place to place.
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

<u>Grade 4 Unit 6: Forces and Motion</u>

- The faster a given object is moving, the more energy it possesses.
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.)

<u>Grade 4 Unit 7: Using Engineering Design with Force and Motion Systems</u>

- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out	<u>LS1.C: Organization for Matter and Energy Flow in Organisms</u> Plants acquire their material for growth chiefly from air and water. (5-LS1-1)	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models

investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	LS2.A: Interdependent Relationships in Ecosystems The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1) PS3.D: Energy in Chemical Processes and Everyday Life The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1) LS1.C: Organization for Matter and Energy Flow in Organisms Food provides animals with the materials they need for body repair and growth and the energy they	❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

	need to maintain body warmth and for motion. (secondary to 5-PS3-1)	

Possible Preconceptions/Misconceptions:

Students can understand simple food links involving two organisms. Yet they often think of organisms as independent of each other but dependent on people to supply them with food and shelter. Upper elementary-school students may not believe food is a scarce resource in ecosystems, thinking that organisms can change their food at will according to the availability of particular sources. Students of all ages think that some populations of organisms are numerous in order to fulfill a demand for food by another population.

Some students have difficulty in identifying the sources of energy for plants and also for animals. Students tend to confuse energy and other concepts such as food, force, and temperature. As a result, students may not appreciate the uniqueness and importance of energy conversion processes like respiration and photosynthesis.

Many students see food as substances (water, air, minerals, etc.) that organisms take in directly from their environment. In addition, some students think food is a requirement for growth, rather than a source of matter for growth. They have little knowledge about food being transformed and made part of a growing organism's body. They often think the arrows in a food web represent something being eaten when the arrows represent energy being transferred.

Students' meaning for “energy,” both before and after traditional instruction, is considerably different from its scientific meaning. In particular, students believe energy is associated only with humans or movement, is a fuel-like quantity which is used up, or is something that makes things happen and is expended in the process. Students rarely think energy is measurable and quantifiable. Although students typically hold these meanings for energy at all ages, upper elementary-school students tend to associate energy only with living things, in particular with growing, fitness, exercise, and food.

LESSON PLAN – 5-E Model

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 5 – Interactions: Earth, Sun, and Moon

The Mission of the West Windsor-Plainsboro Science Department

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- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.
  - Cultivate an inclusive and diverse community where all learners are welcomed, valued, respected, and celebrated.

Unit: Interaction of Earth, Sun, and Moon	
Content Area: Science	
Course & Grade Level: Science Grade 5	
Summary and Rationale	
Earth has a unique relationship between the Sun and its natural satellite the moon. The Sun, Earth, and Moon interact in a delicate balance of motions and force. The moon has a predictable 30-day orbit that is observable through the visible moon phases. The Earth orbits around the Sun every 365.25 days or 1 Earth year. This happens as a result of the gravitational attraction between these three bodies with mass. The Earth's gravitational pull on the Moon keeps the Moon in orbit and the Sun's pull on the Earth keeps the Earth in Orbit. Furthermore, students will develop an understanding that our Sun is the brightest object in the day sky due to its relative closeness to the Earth. This interaction in the Sun-Earth-System allows for observable seasons, tides, moon phases, eclipses, and patterns in the observable night-time sky. Students will be able to examine these observable patterns and gather data to demonstrate these patterns. Students will be able to use gathered data to make predictions about star locations, seasons, and tides.	
Recommended Pacing	
15 days	
New Jersey Student Learning Standards for	
Standard: 5-ESS1: Earth's Place in the Universe	
CPI #	**Cumulative Progress Indicator (CPI)**
5-ESS1-1	Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]
5-ESS1-2	Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]
Standard: 5-PS2: Motion and Stability: Forces and Interactions	
CPI #	**Cumulative Progress Indicator (CPI)**
5-PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]
Standard: 5-ESS3: Earth and Human Activity	
CPI #	**Cumulative Progress Indicator (CPI)**
5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources, environment, and address climate change issues.
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: English Language Arts	

CPI #	Cumulative Progress Indicator (CPI)
RI.5.1	Quote accurately from a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
RI.5.8	Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).
RI.5.9	Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from several texts on the same topic in order to write or speak about the subject knowledgeably.
W.5.1	Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.CI.1	Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions
9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue
9.4.5.CI.3:	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process
9.4.5.IML.2	Create a visual representation to organize information about a problem or issue
New Jersey Student Learning Standards for Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.5.TL.2	Sort and filter data in a spreadsheet to analyze findings.
Interdisciplinary Standards	
Mathematics	
MP.2	Reason abstractly and quantitatively.
MP.4	Model with mathematics.
5.NBT.A.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.
5.G.A.2	Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
Instructional Focus	
Unit Enduring Understandings	
● The Sun is the brightest object (star) in our sky due to its relative distance from the Earth. ● The interaction between the Sun-Earth-Moon system creates predictable patterns in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. ● Earth's gravitational force on an object appears to be directed downward.	
Unit Essential Questions	
● Which of the brightest stars is actually the brightest? Why is the sun the brightest object in Earth's sky? ● Why do shadows on Earth change direction and length?	

- Is the Earth Flat or Spherical?

Objectives

Students will know:

- The relative distance of our sun compared to other stars in the night sky.
- The sun and other stars are natural bodies in the sky that give off their own light.
- The apparent brightness of a variety of stars, including the sun.
- A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person.
- The length and direction of shadows observed several times during one day.
- The duration of daylight throughout the year, as determined by sunrise and sunset times.
- Presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
- Multiple lines of evidence that indicate that the Earth's shape is spherical.
- That objects dropped appear to fall straight down.
- That people live all around the spherical Earth, and they all observe that objects appear to fall straight down.

Students will be able to:

- Support an argument about the difference in the apparent brightness of the sun compared to other stars due to their relative distances from the Earth.
- Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
- Support an argument that the gravitational force exerted by Earth on objects is directed down.

Evidence of Learning

Assessment

- Claims, evidence, and reason statements
- Pre and Post Assessment data
- Observational notes
- Graphs, charts, and data

Resources

Core Text:

- **Exploring Constellations - Sara Latta**
- **Gravity - Jason Chin**

Lesson 1: Relative Distance from the Sun

Grade/ Grade Band: 5th Grade	**Topic:** Interactions within the Earth, Sun, and Moon system	**Lesson #** 1 **in a series of** 5 **lessons**

Brief Lesson Description: This lesson is designed to introduce students to the concept that the apparent brightness of the sun and other celestial objects is due to their relative distance from us.

Performance Expectation(s):

5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]

Specific Learning Outcomes:

- Students *develop a model* to show how the *scale* of the distance to stars affects the apparent brightness.
- Students *construct an explanation* for how the *scale* of the distance to stars *affects* the apparent brightness of the stars.

Narrative / Background Information

Prior Student Knowledge:

- The Earth receives the majority of its light from our sun.
- Some stars appear "brighter" in the night sky than others (may know the big dipper or north star)

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	ESS1.A: The Universe and Its Stars ● The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

Possible Preconceptions/Misconceptions:

- The sun and the moon are the same size
- The sun is brighter because it is hotter than other stars
- Suns and Stars are different objects, and stars are actually very small

LESSON PLAN – 5-E Model

Lesson 2: Constellations

Grade/ Grade Band: 5	**Topic:** Interactions Within the Earth, Sun, and Moon System	**Lesson #** __2___ **in a series of** __5___ **lessons**

Brief Lesson Description: Students will participate in a modified mystery science activity. In this activity, students will explore what constellations can be seen at different types of the year.

Performance Expectation(s): Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. *[Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.]* [Assessment Boundary: Assessment does not include causes of seasons.*]* (5-ESS1-2)

Specific Learning Outcomes: Students will create a universe in a box to reveal seasonal patterns in constellations.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 1: Patterns of Change in the Sky

- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

Grade 3 Unit 2: Forces and Motion

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

Grade 3 Unit 3: Electrical and Magnetic Forces

- Objects in contact exert forces on each other.
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	**ESS1.A: The Universe and its Stars** The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1) **ESS1.B: Earth and the Solar System** The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

	different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)	

Possible Preconceptions/Misconceptions:

- The ideas "the sun is a star" and "the earth orbits the sun" appear counterintuitive to elementary school students.
- The ideas "the sun is a star" and "the earth orbits the sun" are challenging for students.

LESSON PLAN – 5-E Model

Lesson 3: Shadows

Grade/ Grade Band: 5	**Topic:** Interactions Within the Earth, Sun, and Moon System	**Lesson #** __3___ **in a series of** __5___ **lessons**

Brief Lesson Description: Students will be introduced to a phenomenon of a tree's shadow changing over time. Students will then investigate this phenomenon and use graphs to identify or confirm these patterns.

Performance Expectation(s): Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. *[Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.]* [Assessment Boundary: Assessment does not include causes of seasons.*]* (5-ESS1-2)

Specific Learning Outcomes: Students will graph how shadows change over time by investigating the location of the sun in the sky, the length of shadows, and the direction of shadows over time.

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 1: Patterns of Change in the Sky

- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

Grade 3 Unit 2: Forces and Motion

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

Grade 3 Unit 3: Electrical and Magnetic Forces

- Objects in contact exert forces on each other.
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	**ESS1.A: The Universe and its Stars** The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1) **ESS1.B: Earth and the Solar System** The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

Possible Preconceptions/Misconceptions:

Explanations of the day-night cycle and the seasons are very challenging for students. To understand these phenomena, students should first master the idea of a spherical earth. Students often confuse revolution and reflection and this may influence their ability to understand day and night, the change in length and direction of shadows during the day, the apparent motion of the sun across the daytime sky and the moon across the nighttime sky, and the seasonal changes in the position of the stars in the night sky. Finally, students may not be able to understand explanations of these phenomena before they reasonably understand the relative size, motion, and distance of the sun, moon, and the earth.

LESSON PLAN – 5-E Model

Lesson 4: Day and Night

Grade/ Grade Band: 5	**Topic:** Interactions Within the Earth, Sun, and Moon System	**Lesson #** __4___ **in a series of** __5___ **lessons**

Brief Lesson Description: Students will work in partnerships to create a graph of the length of day in their assigned city over the course of a year. Students will then analyze their graphs to reveal patterns about the length of daylight over time and the change of seasons.

Performance Expectation(s): Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. *[Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.]* [Assessment Boundary: Assessment does not include causes of seasons.] (5-ESS1-2)

Specific Learning Outcomes:

- Students will collect and graph data to reveal patterns of changes in length of day and night over time

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 1: Patterns of Change in the Sky

- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

Grade 3 Unit 2: Forces and Motion

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

Grade 3 Unit 3: Electrical and Magnetic Forces

- Objects in contact exert forces on each other.
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Science & Engineering Practices:

- ❏ Asking Questions (science) and defining problems (engineering).
- ❏ Developing and using models.
- ❏ Planning and carrying out investigations.
- ❏ Analyzing and interpreting data.
- ❏ Using mathematics and computational thinking.
- ❏ Constructing explanations (science) and designing solutions (engineering).
- ❏ Engaging in argument from evidence.
- ❏ Obtaining, evaluating, and communicating information.

Disciplinary Core Ideas:

ESS1.A: The Universe and its Stars
The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)

ESS1.B: Earth and the Solar System
The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)

Crosscutting Concepts:

- ❏ Patterns
- ❏ Cause and effect: Mechanism and explanation
- ❏ Scale, proportion, and quantity
- ❏ Systems and system models
- ❏ Energy and matter: Flows, cycles, and conservation
- ❏ Structure and function
- ❏ Stability and change

Possible Preconceptions/Misconceptions:

- The ideas "the sun is a star" and "the earth orbits the sun" appear counterintuitive to elementary school students.
- The ideas "the sun is a star" and "the earth orbits the sun" are challenging for students.

LESSON PLAN – 5-E Model

Lesson 5: Gravity

Grade/ Grade Band: 5	**Topic:** Interactions Within the Earth, Sun, and Moon System	**Lesson #** _5___ **in a series of** ___5__ **lessons**

Brief Lesson Description: In this lesson, students will design and test "whirligigs" to investigate gravity. Students will also investigate/discuss the effects of surface area, wind resistance, and weight on falling objects and distinguish these features as separate from the pull of gravity.

Performance Expectation(s): Support an argument that the gravitational force exerted by Earth on objects is directed down. *[Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.]* [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.] **(5-PS2-1)**

Specific Learning Outcomes:

- **Students design and test objects that will fall slowly when dropped**
- **Students will discuss the relationship between gravity, air, and surface area when objects are dropped**
- **Students will craft an argument describing gravity as a constant, downward force enacted upon all objects**

Narrative / Background Information

Prior Student Knowledge:

Grade 1 Unit 1: Patterns of Change in the Sky

· Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.

· Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

Grade 3 Unit 2: Forces and Motion

· Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)

· The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Grade 3 Unit 3: Electrical and Magnetic Forces

· Objects in contact exert forces on each other.

Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant	PS2.B: Types of Interactions ● The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's	<u>Cause and Effect</u> ● <u>Cause and effect relationships are routinely identified and used to explain change.</u>

evidence about the natural and designed world(s). ● Support an argument with evidence, data, or a model.	center.	

Possible Preconceptions/Misconceptions:

- Students may assume that gravity is “stronger” for heavy items than for light items
- Students may assume that objects will always fall in the same way, regardless of wind/air resistance
- Students may assume that the rate of gravity changes with slight changes to height (gravity is different at the top of a building vs. at street level)
- Students may assume that gravity is fundamentally different on the moon than it is on Earth

LESSON PLAN – 5-E Model

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 5 - Properties and Changes to Matter

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.

Properties of Matter and Changes to Matter	
Content Area: Elementary Science NGSS Grade Five - Unit 2: Properties of Matter and Changes to Matter	
Course & Grade Level:	
Summary and Rationale	
If I have a frozen water bottle that weighs 500 mg, how much will it weigh if the water melts? In this unit of study, students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. The crosscutting concepts of *cause and effect* and *scale, proportion, and quantity* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations* and *using mathematics and computational thinking*. Students are expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 5-PS1-4 and 5-PS1-2.	
Recommended Pacing	
15 days	
New Jersey Student Learning Standards for Science	
Standard: Standards for Student Learning Objectives (Properties of Matter and Changes to Matter)	
CPI #	**Cumulative Progress Indicator (CPI)**
5-PS1-3	**Make observations and measurements to identify materials based on their properties.** ***[Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]***
5-PS1-1	**Develop a model to describe that matter is made of particles too small to be seen.** ***[Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]***
5-PS1-4	**Conduct an investigation to determine whether the mixing of two or more substances results in new substances.**
5-PS1-2	**Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.** ***[Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.].***
5-ESS3-1	**Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources, environment, and address climate change issues.**
New Jersey Student Learning Standards for English Language Arts Companion Standards	
CPI #	**Cumulative Progress Indicator (CPI)**
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of

	different aspects of a topic. (5-PS1-2),(5-PS1-4)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-PS1-2)(5-PS1-4)
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2),(5-PS1-4)
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills.	
CPI #	**Cumulative Progress Indicator (CPI)**
9.2.5.CAP1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
9.4.5.CI.1	Use appropriate communication technologies to collaborate with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions.
9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue.
9.4.5.CI.3	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity.
9.4.5.CI.4	Research the development of a product and identify the role of failure as a part of the creative process.
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process.
9.4.5.IML.3	Represent the same data in multiple visual formats in order to tell a story about the data.
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.2.A.4	Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games, museums).
8.1.5.A.3	Use a graphic organizer to organize information about a problem or issue.
New Jersey Student Learning Standards for Mathematics and Social Studies	
MP.2	Reason abstractly and quantitatively. (5-PS1-2)
MP.4	Model with mathematics. (5-PS1-2)
MP.5	Use appropriate tools strategically. (5-PS1-2)
Standard 6.1 U.S. History: America in the World. All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions that reflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.	
Instructional Focus	
Unit Enduring Understandings	

- Matter can be identified based on its external properties.
- Matter is made of particles that are often too small to be seen.
- When mixing two or more substances the result will be a new substance.
- Weight of matter will stay the same regardless of the type of change that occurs.

Unit Essential Questions

- How can properties of matter be used to identify materials?
- How is weight of a material effected by heating, cooling, or mixing?

Objectives

Students will know:

- matter can exist in 3 different states (solid, liquid, gas) and the properties of these states are different.
- matter can be classified as a liquid, solid, or gas based on its properties.
- not all substances fit perfectly into one of the three states of matter.
- all matter can be heated or cooled, but it takes different temperatures in order to cause a phase change of a substance
- no matter what reaction or change in properties occurs, the total weight of the substances does not change
- no matter what reaction or change in properties occurs, the total weight of the substances does not change.
- sometimes combining more than one substance can result in a new substance
- a mixture is made up of substances that can be separated and returned to their original state
- a solution is a type of mixture
- in a chemical change substances cannot return to their original state
- when two substances are mixed, a new substance with different properties may be formed
- matter does not disappear
- chemical reactions may produce gas (which they will often observe as a change in the state of matter)
- a change in weight can be explained by containing the gas that is released by a chemical reaction (fizzing) into its surroundings

Students will be able to:

- name properties of different types of matter.
- classify matter as a solid, liquid, gas, or something in between.
- use various tools to measure and graph substances to address scientific and engineering question and problems
- use measurement descriptions to describe physical quantities such as weight, time, temperature, and volume
- identify physical changes to matter
- use various tools to measure and graph substances to address scientific and engineering questions and problems.
- use measurement descriptions to describe physical quantities such as weight, time, temperature, and volume.
- use various tools to measure and graph substances to address scientific and engineering questions and problems.
- use measurement descriptions to describe physical quantities such as weight, time, temperature, and volume

Evidence of Learning

Assessment

- Class discussions and reflections on various topics and activities throughout the unit.
- Make observations and measurements to identify materials based on their properties.
- Develop a model to describe that matter is made of particles too small to be seen.
- Develop a model showing the reaction between stone and acid rain.

Unit Sequence (Properties of Matter)	
Part A: *How can properties be used to identify materials?*	
Concepts	**Formative Assessments**

• Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.
 	
• Measurements of a variety of properties can be used to identify materials. *(At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)*
	Students who understand the concepts can:
	• Measure and describe physical quantities such as weight, time, temperature, and volume.
	
	• Make observations and measurements to produce data that can serve as the basis for evidence for an explanation of a phenomenon.
	
	• Make observations and measurements to identify materials based on their properties.
	  ○ Examples of materials to be identified could include:
	  ■ Baking soda and other powders
	  ■ Metals
	  ■ Minerals
	  ■ Liquids
	  ○ Examples of properties could include:
	  ■ Color
	  ■ Hardness
	  ■ Reflectivity
	  ■ Electrical conductivity
	  ■ Thermal conductivity
	  ■ Response to magnetic forces
	  ■ Solubility

Unit Sequence (Properties of Matter)	
Part B: *What kind of model would best represent/describe matter as made of particles that are too small to be seen?*	
Concepts	**Formative Assessments**

● Natural objects exist from the very small to the immensely large. ● Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by means other than seeing. ● A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	*Students who understand the concepts can:* ● Develop a model to describe phenomena. ● Develop a model to describe that matter is made of particles too small to be seen. (Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.) **<u>Examples of evidence could include</u>**: ○ Adding air to expand a basketball ○ Compressing air in a syringe ○ Dissolving sugar in water ○ Evaporating salt water

Unit Sequence (Changes to Matter)	
Part A: *How can we make slime?*	
Concepts	**Formative Assessment**
● Cause-and-effect relationships are routinely identified, tested, and used to explain change. ● When two or more different substances are mixed, a new substance with different properties may be formed.	*Students who understand the concepts are able to:* ● Identify, test, and use cause-and-effect relationships to explain change. ● Conduct an investigation collaboratively to produce data that can serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered. ● Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Unit Sequence (Changes to Matter)	
Part B: *How can baking soda and vinegar burst a zip-lock bag?*	
Concepts	**Formative Assessment**
• Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. • No matter what reaction or change in properties occurs, the total weight of the substances does not change. *(Note: Mass and weight are not distinguished at this grade level.)* • Science assumes consistent patterns in natural systems.	*Students who understand the concepts are able to:* • Measure and describe physical quantities such as weight, time, temperature, and volume. • Measure and graph quantities such as weight to address scientific and engineering questions and problems. • Measure and graph quantities to provide evidence that regardless of the type of change that occurs when substances are heated, cooled, or mixed, the total weight is conserved. *(Note: Assessment does not include distinguishing between mass and weight.)* • Examples of reactions or changes could include: ✓ Phase changes ✓ Dissolving ✓ Mixing

What It Looks Like in the Classroom
In this unit of study, students will use mathematical and computational thinking to understand the cause and effect relationship between physical changes in matter and conservation of weight. Throughout the unit, students need multiple opportunities to observe and document changes in matter due to physical changes, and to analyze data to explain changes that do or do not occur in the physical properties of matter. Students begin by planning and conducting investigations to determine whether or not a new substance is made when two or more substances are mixed (see the Sample Open Education Resources). As they work with a variety of substances, they should: ✓ Measure, observe, and document physical properties (e.g., color, mass, volume, size, shape, hardness, reflectivity, conductivity, and response to magnetic forces) of two or three substances. ✓ Mix the original substances. ✓ Measure, observe, and document the physical properties of the substance produced when the original substances are mixed. ✓ Compare data from the original substances to data from the substance produced, and determine what changes, if any, have occurred. ✓ Use observations and data as evidence to explain whether or not a new substance was produced, and to explain any changes that occurred when the original substances were mixed. With each set of substances that students investigate, it is important that they use balances or digital scales to

measure the mass of the original substances and the mass of the substance made when the original substances are mixed. This data should be documented so that students can analyze the data. As they compare the data, they should recognize that when two or more substances are mixed, the mass of the resulting substance equals the sum of the masses of the original substances. In other words, the total mass is conserved.

Conservation of mass is a critical concept that is developed over time; therefore, students need multiple opportunities to investigate this phenomenon. Students should measure the mass of each substance, document the data they collect in a table or chart, and use the data as evidence that regardless of the changes that occur when mixing substances, the total weight of matter is conserved.

In addition to observing changes that occur when substances are mixed, students should also have opportunities to investigate other types of physical changes. For example, students can observe changes in matter due to heating, cooling, melting, freezing, and/or dissolving. As before, students should measure, observe, and document the physical properties of the substance before and after a physical change, and use the data as evidence to explain any changes that occur. The data should also provide evidence that regardless of the type of change that matter undergoes, the mass is conserved.

Connecting with English Language Arts/Literacy and Mathematics

English Language/Arts

Students can conduct short research projects, using both print and digital sources, to build their understanding of physical changes to matter. While reading, they should take notes of relevant information, and summarize that information so that it can be used as evidence to explain the changes that occur as substances are heated, cooled, dissolved, or mixed. When drawing evidence from texts to support analysis, reflection, and research, students should provide a list of sources.

Mathematics

- Use appropriate tools in strategic ways when measuring physical properties of substances, such as weight or volume.
- Model with mathematics when organizing data into tables or charts, and using the data as evidence to explain changes that occur.
- Convert among different-sized standard measurement units within a given measurement system and use these conversions to explain changes that occur.

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tools such as SKYPE, experts from the community helping with a project, journal articles, and

biographies).

- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (About Universal Design for Learning).

Research on Student Learning

Student thinking about chemical change tends to be dominated by the obvious features of the change. For example, some students think that when something is burned in a closed container, it will weigh more because they see the smoke that was produced. Further, many students do not view chemical changes as interactions. They do not understand that substances can be formed by the recombination of atoms in the original substances. Rather, they see chemical change as the result of a separate change in the original substance, or changes, each one separate, in several original substances. For example, some students see the smoke formed when wood burns as having been driven out of the wood by the flame (NSDL, 2015).

Prior Learning

Grade 2 Unit 2: Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.

Grade 2 Unit 3: Changes to Matter

- A great variety of objects can be built up from a small set of pieces.
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

Future Learning

Grade 7 Unit 1: Structure and Properties of Matter

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

Grade 7 Unit 2: Interactions 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.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.

Grade 7 Unit 3: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

Connections to Other Units

In **Unit 1: Properties of Matter**, students describe that matter is made of particles too small to be seen.

In **Unit 2: Water on Earth**, students explore the changes of water through the three phases and make connections to the interactions of the Earth spheres.

Teacher Professional Learning Resources

Using the NGSS Practices in the Elementary Grades
The presenters were Heidi Schweingruber from the National Research Council, Deborah Smith from Penn State University, and Jessica Jeffries from State College Area School District. In this seminar the presenters talked about applying the scientific and engineering practices described in A Framework for K–12 Science Education in elementary-level classrooms.

Continue the discussion in the community forums.

Teaching *NGSS* in K-5: Constructing Explanations from Evidence
Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the NGSS for K-5th grade. The web seminar focused on the three dimensional learning of the NGSS, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena.

View the resource collection.

Continue discussing this topic in the community forums.

NGSS Core Ideas: Matter and Its Interactions

The presenter was Joe Krajcik from Michigan State University. The program featured strategies for teaching about physical science concepts that answer questions such as "How do particles combine to form the variety of matter one observes?" and "How do substances combine or change (react) to make new substances?"

Dr. Krajcik began the presentation by defining disciplinary core ideas and discussing the value of using core ideas to build understanding across time. He also talked about the way disciplinary core ideas work together with the other components of NGSS: scientific and engineering practices and crosscutting concepts. Dr. Krajcik talked about the disciplinary core ideas for PS1 and shared examples of student work. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

Visit the resource collection.

Continue discussing this topic in the community forums.

Appendix A: NGSS and Foundations for the Unit		
Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)		
Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. *[Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [*Assessment Boundary: Assessment does not include distinguishing mass and weight.*].* **(5-PS1-2)**		
The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models • Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. (5-PS1-1) **Planning and Carrying Out Investigations** • Conduct an investigation collaboratively to produce	**PS1.A: Structure and Properties of Matter** • Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. (5-PS1-4) **Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2) - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4) **Using Mathematics and Computational Thinking** ● Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)	on larger particles or objects. (5-PS1-1) The amount (weight) of matter ● The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) ● Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3) **PS1.B: Chemical Reactions** ● When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4) **Climate Change** ● **5-ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources, environment, and address climate change issues.	● Science assumes consistent patterns in natural systems. (5-PS1-2)

Grade/ Grade Band: 5th Grade	**Topic:** States of Matter	**Lesson # 1 in a series of 4 lessons**

Brief Lesson Description: Students will explore different objects and decide what phase of matter the object is based on its properties.

Recommended Pacing: 4 days

Performance Expectation(s):

- Make observations and measurements to identify materials based on their properties (5-PS1-3).

Specific Learning Outcomes: Students will be able to determine the properties of different types of matter and use this information to classify the matter as a solid, liquid, gas, or something in between.

Students will be able to:

- Name properties of different types of matter.
- Classify matter as a solid, liquid, gas, or something in between.

Students will understand:

- Matter can exist in 3 different states (solid, liquid, gas) and the properties of these states are different.
- Matter can be classified as a liquid, solid, or gas based on its properties.
- Not all substances fit perfectly into one of the three states of matter.

Narrative / DCI: Background Information

Prior Student Knowledge:

Grade 2 Unit 2: Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.

Grade 2 Unit 3: Changes to Matter

- A great variety of objects can be built up from a small set of pieces.
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence.	**PS1.A: Structure and Properties of Matter** ● The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) ● Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

❑ Obtaining, evaluating, and communicating information.	the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)	

Possible Preconceptions/Misconceptions:

- All matter fits the description of a solid, liquid, or gas.
- Sand is a liquid because it seems to flow like water when wet and may mold to its container.
- Oobleck is a solid or liquid (only one).
  - It is something in between. It has properties of a liquid and a solid (non-newtonian fluid).
- Toothpaste is a solid or liquid (only one).
  - It is something in between. It has properties of a liquid and solid (non-newtonian fluid).
- Shaving Cream is a solid, liquid, or gas (only one).
  - It is something in between. It is a foam and therefore has properties of a liquid and gas. It consists of tiny air bubbles dispersed in liquid.

Some students may come with the belief/understanding that:

- Matter is any object that takes up space and has mass.
- There are three states of matter.
  - A solid has a fixed shape and volume. The molecules are packed tightly together.
  - A liquid has a fixed volume, but can flow and take on the shape of the container in which they are placed. Molecules are somewhat close together but further apart in comparison to a solid.
  - A gas has neither a defined volume nor defined shape. The particles are much further apart and, because there is a lot of space in between the particles, move easily.
- Less commonly known 4th state of matter is plasma.
  - A plasma is a hot ionized gas consisting of approximately equal numbers of positively charged ions and negatively charged electrons. The characteristics of plasmas are significantly different from those of ordinary neutral gases so that plasmas are considered a distinct "fourth state of matter."
- Sand is a solid (it often is listed in informational texts).

LESSON PLAN – 5-E Model

Grade/ Grade Band: 5th Grade	**Topic:** Physical Changes to Matter	**Lesson # 2 in a series of 4 lessons**

Brief Lesson Description: Students will explore that adding and removing heat causes some materials to change form by working through four investigative stations.

Recommended Pacing: 1 day

The main lesson will take place in one period. Students will need to take 5 minutes from homeroom/morning meeting/beginning of period each day for a week to continue adding information to the class graph. Additional time at the end of the week will be required to analyze the data collected.

Performance Expectation(s):

- Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. **5-PS1-2**
- Measure and graph quantities such as weight to address scientific and engineering questions and problems. **5-PS1-2**

Specific Learning Outcomes:

Students will be able to:

- use various tools to measure and graph substances to address scientific and engineering question and problems
- use measurement descriptions to describe physical quantities such as weight, time, temperature, and volume
- identify physical changes to matter

Students will understand:

- all matter can be heated or cooled, but it takes different temperatures in order to cause a phase change of a substance
- no matter what reaction or change in properties occurs, the total weight of the substances does not change

Narrative / DCI: Background Information

Prior Student Knowledge:

- This is the first opportunity for students to encounter these ideas.

Grade 2 Unit 2: Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.

Grade 2 Unit 3: Changes to Matter

- A great variety of objects can be built up from a small set of pieces.
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ **Developing and using models.** ❑ **Planning and carrying out investigations.** ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	**PS1.A: Structure and Properties of Matter** ● The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) ● Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)	❑ Patterns ❑ **Cause and effect: Mechanism and explanation** ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ **Structure and function** ❑ Stability and change

Possible Preconceptions/Misconceptions:

Some students may come with the belief/understanding that:

- Heat is a substance.
- Heat is not energy. (Heat is energy)
- Temperature is a property of a particular material or object. (For example, students may believe that metal is naturally cooler than plastic.)
- The temperature of an object depends on its size. (Temperature does not depend on size.)
- Heat and cold are different. (Cold is the absence of heat. Heat and cold can be thought of as opposite ends of a continuum.)
- Cold is transferred from one object to another. (Heat is transferred from one object to another. Heat moves from the warmer object to the cooler object.)
- Some substances (flour, sugar, air) cannot heat up. (All substances heat up, although some gain heat more easily than others.)

LESSON PLAN – 5-E Model

Grade/ Grade Band: 5th Grade	**Topic:** Physical vs. Chemical Changes	**Lesson # 3 in a series of 4 lessons**

Brief Lesson Description: Students will rotate through six different stations carrying out investigations that cause changes to matter. Students will determine whether matter is undergoing a physical or chemical change. They will then engage in arguments using evidence from their investigation to conclude what type of change took place at each station.

Recommended Pacing: 6 days

Performance Expectation(s):

- Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. **5-PS1-2**
- Measure and graph quantities such as weight to address scientific and engineering questions and problems. **5-PS1-2**
- Conduct an investigation to determine whether the mixing of two or more substances results in new substances. **5-PS1-4**

Specific Learning Outcomes:

Students will be able to:

- use various tools to measure and graph substances to address scientific and engineering questions and problems.
- use measurement descriptions to describe physical quantities such as weight, time, temperature, and volume.

Students will understand that:

- no matter what reaction or change in properties occurs, the total weight of the substances does not change.
- sometimes combining more than one substance can result in a new substance
- a mixture is made up of substances that can be separated and returned to their original state
- a solution is a type of mixture
- in a chemical change substances cannot return to their original state

Narrative / DCI: Background Information

Prior Student Knowledge:

- This lesson is intended to build on students' knowledge that matter can undergo a physical change.

Grade 2 Unit 2: Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.

Grade 2 Unit 3: Changes to Matter

- A great variety of objects can be built up from a small set of pieces.
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ **Asking Questions (science) and defining problems (engineering).** ❑ **Developing and using models.** ❑ **Planning and carrying out investigations.** ❑ **Analyzing and interpreting data.** ❑ **Using mathematics and computational thinking.** ❑ **Constructing explanations (science) and designing solutions (engineering).** ❑ **Engaging in argument from evidence.** ❑ **Obtaining, evaluating, and communicating information.**	**S1.A: Structure and Properties of Matter** ● The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) ● Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3) **PS1.B: Chemical Reactions** ● **When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)**	❑ **Patterns** ❑ **Cause and effect: Mechanism and explanation** ❑ **Scale, proportion, and quantity** ❑ **Systems and system models** ❑ **Energy and matter: Flows, cycles, and conservation** ❑ **Structure and function** ❑ **Stability and change**

Possible Preconceptions/Misconceptions:

- changes to matter can only occur physically
- the only proof of a chemical reaction is an explosion
- when matter goes through a chemical change, some of it disappears
- a solution is a chemical change because we can no longer see the solute (solid)

LESSON PLAN – 5-E Model

Grade/ Grade Band: 5th Grade	**Topic:** Law of Conservation of Mass	**Lesson #4** in a sequence of 4 lessons

Brief Lesson Description:

Students will carry out investigations to explain how a phenomenon that seems to break the law of conservation of mass can exist in the natural world. They will be provided with substances that can be used to produce chemical reactions and materials that can be used to create closed systems to investigate and try to explain why the weight changed after the baking soda and vinegar reacted in the phenomenon. If they are successful in creating a closed system, they will see that the weight does not change (or changes only slightly due to human error) if the reaction is closed off from its surroundings compared to the phenomenon which released gas(air) into its surroundings.

Recommended Pacing: 5 days

Performance Expectations:

- Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. **5-PS1-2**
- Measure and graph quantities such as weight to address scientific and engineering questions and problems. **5-PS1-2**
- Conduct an investigation to determine whether the mixing of two or more substances results in new substances. **5-PS1-4**

Specific Learning Outcomes:

Students will be able to:

- use various tools to measure and graph substances to address scientific and engineering questions and problems.
- use measurement descriptions to describe physical quantities such as weight, time, temperature, and volume.

Students will understand that:

- when two substances are mixed, a new substance with different properties may be formed
- matter does not disappear
- chemical reactions may produce gas (which they will often observe as a change in the state of matter)
- a change in weight can be explained by containing the gas that is released by a chemical reaction (fizzing) into its surroundings
- extension: mass and weight are different

Narrative / DCI: Background Information

Prior Student Knowledge:

Students will build on their prior knowledge of the different phases of matter and how matter can change from one phase to another. They will also build on knowledge from the previous lessons in the unit that some substances, but not all, form a chemical reaction when they are mixed together. The Law of Conservation of Mass

will most likely be a new concept for the students, so a brain pop video may be used to provide background knowledge at the teacher's discretion.

brain pop video: computer Video: Law of Conservation of Mass (Brainpop)

Grade 2 Unit 2: Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

Grade 2 Unit 3: Changes to Matter

- A great variety of objects can be built up from a small set of pieces.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ **Asking Questions (science) and defining problems (engineering).** ❑ **Developing and using models.** ❑ **Planning and carrying out investigations.** ❑ **Analyzing and interpreting data.** ❑ **Using mathematics and computational thinking.** ❑ **Constructing explanations (science) and designing solutions (engineering).** ❑ **Engaging in argument from evidence.** ❑ **Obtaining, evaluating, and communicating information.**	**S1.A: Structure and Properties of Matter** ● **The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)** ● **Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)** **PS1.B: Chemical Reactions** ● **No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)**	❑ **Patterns** ❑ **Cause and effect: Mechanism and explanation** ❑ **Scale, proportion, and quantity** ❑ **Systems and system models** ❑ **Energy and matter: Flows, cycles, and conservation** ❑ **Structure and function** ❑ **Stability and change**

Possible Preconceptions/Misconceptions:

- Matter can disappear
- When matter goes through a chemical change, some of it disappears
- Mass and weight are the same (distinction does not have to be made - the choice is at teacher discretion)
- Every product weighs less than the reactants

● Human error is the sole cause of weight change (human error may be applicable, but is not the sole reasons why the weight changes)
LESSON PLAN – 5-E Model

West Windsor-Plainsboro Regional School District
Science Curriculum
Grade 5 - Water on Earth-Earth Systems

The Mission of the West Windsor-Plainsboro Science Department

Our mission is to cultivate science learners who have the foundational knowledge to make ethical, scientifically literate decisions and the ability to apply scientific practices in order to contribute to the needs of society and a changing world.

- **Vision**

  We envision a K-12 science experience that supports and challenges every student in their science learning journey. We will:

  - Capitalize on diversity by reaching and exciting students at all levels and interests by differentiating learning within classrooms and by offering a robust program of studies.
  - Emphasize authentic science and engineering practices and leverage the interdisciplinary nature of science with arts, technology, math, reading, and writing.
  - Integrate scientific knowledge and 21st century competencies to prepare students to make informed decisions and take action to address real world problems.

Water on Earth/Earth Systems	
Content Area: Grade Five – Unit: Water on Earth/Earth Systems Unit	
Course & Grade Level:	
Summary and Rationale	
How do individual communities use science ideas to protect Earth's resources and environment? In this unit of study, students describe and graph data to provide evidence about the distribution of water on Earth. The crosscutting concepts of *scale, proportion, quantity* and *systems, and systems models* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *using mathematics and computational thinking* and in *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 5-ESS2-2 and 5-ESS3-1.	
Recommended Pacing	
22 DAYS -	
New Jersey Student Learning Standards for	
Standard: Standards for Appendix A: NGSS and Foundations for the Unit	
5-ESS2-2	**Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** *[*Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*]*
5-ESS3-1	**Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources, environment, and address climate change issues.**
Standard: NJ Student Learning Standards for Mathematics	
CPI #	**Cumulative Progress Indicator (CPI)**
MP.2	Reason abstractly and quantitatively. (5-ESS2-2), (5-ESS3-1) **MP.2**
MP.4	Model with mathematics. (5-ESS2-2), (5-ESS3-1)
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard:	
CPI #	**Cumulative Progress Indicator (CPI)**
RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-2), (5-ESS3-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2), (5-ESS3-1)
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-2)

New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.1.5.CR.1	Compare various ways to give back and relate to your strengths, interests, and other personal factors
9.1.5.FI.1	Identify various types of financial institutions and the services they offer including banks, credit unions, and credit card companies.
9.1.5.PB.1	Develop a personal budget and explain how it reflects spending, saving, and charitable contributions.
9.1.5.PB.2	Describe choices consumers have with money (e.g., save, spend, donate).
9.1.5.RMI.1	Identify risks that individuals and households face.
9.1.5.RMI.2	Justify reasons to have insurance.
9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
9.2.5.CAP.2	Identify how you might like to earn an income.
9.4.5.CI.1	Use appropriate communication technologies to collaborate with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions.
9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue.
9.4.5.CI.3	Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity.
9.4.5.CI.4	Research the development of a product and identify the role of failure as a part of the creative process.
9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process.
9.4.5.CT.2	Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental agencies, online) that can aid in solving the problem.
9.4.5.CT.3	Describe how digital tools and technology may be used to solve problems.
9.4.5.CT.4	Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global.
9.4.5.GCA.1	Analyze how culture shapes individual and community perspectives and points of view.
9.4.5.IML.1	Evaluate digital sources for accuracy, perspective, credibility and relevance (e.g., Social Studies Practice - gathering and evaluating sources)
9.4.5.IML.2	Create a visual representation to organize information about a problem or issue.
9.4.5.IML.3	Represent the same data in multiple visual formats in order to tell a story about the data.
8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
8.1.2.A.4	Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games, museums).
8.1.5.A.3	Use a graphic organizer to organize information about a problem or issue.
New Jersey Student Learning Standards for Mathematics and Social Studies	
MP.2	Reason abstractly and quantitatively. (5-PS1-2)
MP.4	Model with mathematics. (5-PS1-2)

MP.5	Use appropriate tools strategically. (5-PS1-2)

Standard 6.1 U.S. History: America in the World. All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions that reflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.

Instructional Focus

Unit Enduring Understandings

- A system can be described in terms of its components and their interactions.
- Science findings are limited to questions that can be answered with empirical evidence.
- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.
- Individuals and communities are doing things to help protect Earth's resources and environments.

Unit Essential Questions

- How do individual communities use science ideas to protect Earth's resources and environment?

Objectives

Students will know:

- nearly all of Earth's available water is in the ocean.
- most freshwater is in glaciers or underground and that only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
- the water cycle is the change of water over time
- an interaction between hot (hot water in model) and cold (ice in model) temperatures is necessary for condensation to happen
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans).
- the water cycle includes many different processes which involve the different spheres
- winds and clouds in the atmosphere interact with landforms to determine patterns of weather.
- earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), **the atmosphere** (air), and the biosphere (living things, including humans).
- a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
- human activity has negative impacts on the environment and the well-being of animals
- changes to the environment affect animals
- humans can use scientific ideas to protect or prevent further damage to the environment
- humans have a responsibility to protect and conserve the environment and animals

Students will be able to:

- use standard units to measure weight and volume
- describe physical quantities such as weight and volume
- identify the major parts of the water cycle and explain what is happening at each step
- identify what each part of the Water Cycle in a Bowl model represents in the real world
- identify examples of each of the spheres in their water cycle diagram and label these examples with the correct sphere they belong to
- discuss how the different processes of the water cycle fit within the different spheres
- identify patterns across the interaction of winds, weather and atmospheric pressure
- observe variable change in terms of differences in atmospheric and weather conditions
- measure the frequency of storm systems over time

Evidence of Learning

Assessment

- Class discussions and reflections on various topics and activities throughout the unit
- Students will evaluate human solutions of protection during natural and man made disasters.

Resources

Core Text:

Mystery Science
How Much Water Is In the World?
When you Turn on the Faucet
WATERY PLANET NATURAL DISASTERS and ENGINEERING

Gizmos
Phases of Water
Water Cycle
Hurricane Motion

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking ● Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2) **Obtaining, Evaluating, and Communicating Information** ● Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)	**ESS2.C: The Roles of Water in Earth's Surface Processes** ● Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2) **ESS3.C: Human Impacts on Earth Systems** ● Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1) **Climate Change** ● **5-ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect	**Scale, Proportion, and Quantity** ● Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2) **Systems and System Models** ● A system can be described in terms of its components and their interactions. (5-ESS3-1) --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** ● Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)

	the Earth's resources, environment, and address climate change issues.	

Distribution of Water on Earth Lesson

Grade/ Grade Band: 5th Grade	**Topic:** Distribution of Water on Earth	**Lesson # _1_ in a series of _5_ lessons**

Brief Lesson Description: Students will investigate the distribution of water on Earth and graph their results in a circle graph.

This lesson, *The Distribution of Water on Earth*, begins with students brainstorming ways people use water and generating a top ten list. A class list is compiled based on students' ideas. This leads into a conversation about the sources of water from which people might get water. Students will then take part in an investigation to determine how much water is available for human consumption. There are three options for a teacher to choose from based upon student needs. In each investigation, students will explore how much water on earth is saltwater and freshwater and how much freshwater is available for human consumption. They organize their data into a table which is then used to create a circle graph to visually depict the information. The lesson concludes with an oral or written analysis of what they notice about water distribution on Earth. This lesson also provides extension activities to have students investigate conservation efforts on the available water supply.

Recommended Pacing: 5 Days

Performance Expectation(s):

- Develop graphs to provide evidence about the distribution of water on Earth

Specific Learning Outcomes: Students will be able to determine where water is found on Earth and what percentage of the Earth's water is freshwater.

Students will be able to:

- use standard units to measure weight and volume
- describe physical quantities such as weight and volume

Students will understand:

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

Narrative / Background Information

Prior Student Knowledge:

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

- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering).	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2) **ESS2.A: Earth Materials and Systems**	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)	

Possible Preconceptions/Misconceptions:

- Students may think that in order for it to be water needs to be in the liquid form
- Students may think that water is only found in the oceans, lakes, rivers, ponds, and streams missing out on groundwater, ice caps, permafrost, atmospheric
- Students may think that rain is "new" water
- Anchor Phenomenon-Interaction of Earth's Spheres and Modeling

LESSON PLAN – 5-E Model

Water Cycle Lesson

Grade/ Grade Band: 5	**Topic:** Water Cycle	**Lesson #** __2_ **in a series of** 5 **lessons**

Brief Lesson Description: Students will learn about the major steps of the water cycle and explain what is happening at each step.

Recommended Pacing: 3 Days

Performance Expectation(s):

- Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (Water Cycle is an interaction of the spheres - we will revisit this idea in a later lesson)

Specific Learning Outcomes:

Students will be able to

- identify the major parts of the water cycle and explain what is happening at each step
- identify what each part of the Water Cycle in a Bowl model represents in the real world

Students will understand:

- the water cycle is the change of water over time
- an interaction between hot (hot water in model) and cold (ice in model) temperatures is necessary for condensation to happen

Narrative / Background Information

Prior Student Knowledge:

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

• Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.
• Wind and water can change the shape of the land.

Grade 3 Unit 1: Weather and Climate

• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
• Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

Grade 4 Unit 1: Weathering and Erosion

• Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2) **ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

	and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)	

Possible Preconceptions/Misconceptions:

- Students may think that rain is "new" water
- Students may think that the water cycle is only evaporation, precipitation, and condensation
- Students may think the Earth has an endless supply of water

LESSON PLAN – 5-E Model

Earth's Spheres Lesson

Grade/ Grade Band: 5	**Topic:** Earth Systems	**Lesson # _3_ in a series of _5_ lessons**

Brief Lesson Description: Students will label examples of the four different spheres on their water cycle models.

Recommended Pacing: 4 Days

Performance Expectation(s): Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Specific Learning Outcomes: Students will be able to identify and label examples of each of the spheres in their water cycle diagrams or add examples to their diagrams with labels if needed.

Students will be able to:

- identify examples of each of the spheres in their water cycle diagram and label these examples with the correct sphere they belong to
    - add an example of each sphere into their water cycle diagram, if needed
- discuss how the different processes of the water cycle fit within the different spheres

Students will understand:

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans).
- The water cycle includes many different processes which involve the different spheres

Narrative / Background Information

Prior Student Knowledge:

Grade 2 Unit 4: The Earth's Land and Water
• Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.
• Wind and water can change the shape of the land.

Grade 3 Unit 1: Weather and Climate
• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
• Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

Grade 4 Unit 1: Weathering and Erosion
• Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2) **ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) **Climate Change**	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

	● **5-ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources, environment, and address climate change issues.	

Possible Preconceptions/Misconceptions:

- There are more than four spheres.
    - In later grades, the earth may be subdivided into more than 4 spheres. At grade 5, students are only expected to know that the earth is divided into the geosphere, hydrosphere, atmosphere, and biosphere.
- The lithosphere is an additional sphere.
    - The lithosphere is another name for the geosphere. The geosphere and the lithosphere are the same sphere.
- Plants are in the geosphere.
    - Plants are living things, so they are part of the biosphere.
- Students may think soil, sand, and rocks are living because living micro and macro-organisms live in, on, or around them.

LESSON PLAN – 5-E Model

Hurricane Lesson

Grade/ Grade Band: Fifth Grade	**Topic:** Hurricane	**Lesson #** _4_ **in a series of** _5_ **lessons**

Brief Lesson Description: Students will learn about the interaction of the atmosphere, winds and weather patterns and their collective impact on earth.

Recommended Pacing: 4 Days

Performance Expectation(s):
Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (5-ESS2-1)

Specific Learning Outcomes:

Students will be able to:

- identify patterns across the interaction of winds, weather and atmospheric pressure
- observe variable change in terms of differences in atmospheric and weather conditions
- measure the frequency of storm systems over time

Students will understand:

- Winds and clouds in the atmosphere interact with landforms to determine patterns of weather.
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), **the atmosphere** (air), and the biosphere (living things, including humans).
- A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

Narrative / Background Information

Prior Student Knowledge:

Grade 2 Unit 4: The Earth's Land and Water
• Wind and water can change the shape of the land.

Grade 3 Unit 1: Weather and Climate
• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
• Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2) **ESS2.A: Earth Materials and Systems** • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) **Climate Change** • **5-ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect the	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

	Earth's resources, environment, and address climate change issues.	

Possible Preconceptions/Misconceptions:

- Students may think local weather patterns and climate are the same thing
- Students may think that storms are only influenced by the water cycle and may not connect to the land
- Students may think that water only gets evaporated from the ocean or lakes.
- Students may think that clouds go to the sea and get filled with water.
- Students may think that rain falls out of the sky when the clouds evaporate or that rain comes from holes in clouds

LESSON PLAN – 5-E Model

NGSS Engineering Task (Oil Spill)

Grade/ Grade Band: 5	**Topic:** Oil Spills Engineering Task	**Lesson #** _5_ **in a series of** _5__ **lessons**

Brief Lesson Description: Students will be shown a video describing the effect of the Deepwater Horizon (BP) oil spill on Cat Island (a breeding ground for many species of migratory birds). Students will then engage in the engineering process to determine the quickest and most environmentally friendly way to clean up oil spills, test their solution, and reflect on their solution. See this link for an alternative lesson plan format.

Recommended Pacing: 4 Days

Engineering Notes

Performance Expectation(s): Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources, environment, and address climate change issues.

Specific Learning Outcomes:

Students will be able to:

- engage in all parts of the engineering design process
  - define the problem
  - design and test solutions
  - optimize their solution
- use research materials to choose and test possible ways to clean up oil spills
- evaluate (compare) solutions and choose the solution that best solves the problem while meeting the criteria and constraints provided to them
- work collaboratively with a team

Students will understand:

- human activity has negative impacts on the environment and the well-being of animals
- changes to the environment affect animals
- humans can use scientific ideas to protect or prevent further damage to the environment
- humans have a responsibility to protect and conserve the environment and animals

Narrative / Background Information

Prior Student Knowledge:

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

• Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. • Wind and water can change the shape of the land.

Grade 3 Unit 1: Weather and Climate

• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

• Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

Grade 4 Unit 1: Weathering and Erosion

• Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
❑ Asking Questions (science) and defining problems (engineering). ❑ Developing and using models. ❑ Planning and carrying out investigations. ❑ Analyzing and interpreting data. ❑ Using mathematics and computational thinking. ❑ Constructing explanations (science) and designing solutions (engineering). ❑ Engaging in argument from evidence. ❑ Obtaining, evaluating, and communicating information.	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2) **ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) **Climate Change** • **5-ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect the	❑ Patterns ❑ Cause and effect: Mechanism and explanation ❑ Scale, proportion, and quantity ❑ Systems and system models ❑ Energy and matter: Flows, cycles, and conservation ❑ Structure and function ❑ Stability and change

	Earth's resources, environment, and address climate change issues.	

Possible Preconceptions/Misconceptions:

Preconceptions:

- oil spills are bad for the environment
- oil spills are caused by humans
- knowledge of oil spills that have happened from the media

Misconceptions:

- oil spills only affect the ocean
- oil disappears in the ocean
- dawn is used to clean up oil spills (only animals in the commercials)
- oil spills are cleaned up quickly or are easy to clean up

LESSON PLAN – 5-E Model

Teacher Professional Learning Resources

Teaching *NGSS* in K-5: Making Meaning through Discourse

The presenters were Carla Zembal-Saul, (Penn State University), Mary Starr, (Michigan Mathematics and Science Centers Network), and Kathy Renfrew (Vermont Agency of Education). After a brief introduction about the Next Generation Science Standards (*NGSS*), Zembal-Saul, Starr, and Renfrew gave context to the *NGSS* specifically for K-5 teachers, discussing three-dimensional learning, performance expectations, and background information on the *NGSS* framework for K-5. The presenters also gave a number of examples and tips on how to approach *NGSS* with students, and took participants' questions. The web seminar ended with the presentation of a number of recommended NSTA resources for participants to explore.

View the resource collection.

Continue discussing this topic in the community forums.

Evaluating Resources for *NGSS*: The EQuIP Rubric

The presenters were Brian J. Reiser, Professor of Learning Sciences in the School of Education and Social Policy at Northwestern University, and Joe Krajcik, Director of the CREATE for STEM Institute.

After a brief overview of the *NGSS,* Brian Reiser, Professor of Learning Sciences, School of Education at Northwestern University and Joe Krajcik, Director of CREATE for STEM Institute of Michigan State University introduced the Educators Evaluating Quality Instructional Products (EQuIP) Rubric. The web seminar focused on explaining how the EQuIP rubric can be used to evaluate curriculum materials, including individual lessons, to determine alignment of the lesson and/or materials with the NGSS. Three-dimensional learning was defined, highlighted and discussed in relation to the rubric and the NGSS. An emphasis was placed on how to achieve the conceptual shifts expectations of NGSS and three-dimensional learning using the rubric as a guide. Links to the lesson plans presented and hard copies of materials discussed, including the EQuIP rubric, were provided to participants. The web seminar concluded with an overview of NSTA resources on the NGSS available to teachers by Ted, and a Q & A with Brian Reiser and Joe Krajcik.

View the resource collection.

Continue discussing this topic in the community forums

***NGSS* Crosscutting Concepts: Systems and System Models**

The presenter was Ramon Lopez from the University of Texas at Arlington. Dr. Lopez began the presentation by discussing the importance of systems and system models as a crosscutting concept. He talked about the key features of a system: boundaries, components, and flows and interactions. Dr. Lopez also described different types of system models, including conceptual, mathematical, physical, and computational models. Participants discussed their current classroom applications of systems and system models and brainstormed ways to address challenges associated with teaching this crosscutting concept.

NGSS Core Ideas: Earth's Systems

The presenter was Jill Wertheim from National Geographic Society. The program featured strategies for teaching about Earth science concepts that answer questions such as "What regulates weather and climate?" and "What causes earthquakes and volcanoes?"

Dr. Wertheim began the presentation by introducing a framework for thinking about content related to Earth systems. She then showed learning progressions for each concept within the Earth's Systems disciplinary core idea and shared resources and strategies for addressing student preconceptions. Dr. Wertheim also talked about changes in the way *NGSS* addresses these ideas compared to previous common approaches.

Continue the discussion in the community forums.

NGSS Core Ideas: Earth and Human Activity

The presenters were Susan Buhr Sullivan, Director of the CIRES Education and Outreach Group at University of Colorado; and Aida Awad, Science Department Chair at Maine East High School in Park Ridge, IL and president of the National Association of Geoscience Teachers (NAGT). The program featured strategies for teaching about Earth science concepts that answer questions such as "How do humans depend on Earth's resources?" and "How do humans change the planet?"

Dr. Buhr Sullivan began the presentation by describing the interconnections between this disciplinary core idea and other components of *NGSS*. She then talked about building a foundation for key concepts related to Earth and Human Activity at the elementary level. Ms. Awad continued the discussion by sharing the progression of this core idea through the middle school level and on to high school. The presenters provided a list of resources and activities that teachers can use to begin implementing *NGSS* in the classroom.

Visit the resource collection.

Continue discussing this topic in the community forums.