Pace
Charter School of Hamilton

Science Curriculum
Grade 2

The Mission

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 and Changes to Matter: Grade 2

LESSON 1- "What Is The World Made Of?" (Launching Part 1)		
Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #** 1 **in a series of** 7 **lessons** **3-4 class periods**

Brief Lesson Description: Different kinds of matter exist. Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured. To begin the unit students plan and conduct an investigation to describe different kinds of material using observable properties. They will collect data, analyze the data to find patterns, such as similar properties that different materials share, and use the data to classify materials.

Performance Expectation(s):

Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. *[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]* **(2-PS1-1)**

Specific Learning Outcomes:
Explore and describe properties of solid objects.
Use senses to observe different solid objects and sort them in different ways.
Develop vocabulary that describes the properties of solid objects.
Students will observe, compare and contrast, sort and describe objects by their properties.
Discuss properties of all solids.
Develop a working definition of solids.

Narrative / Background Information

Prior Student Knowledge:

1. The students should be able to work in cooperative learning groups.
2. The students should be able to sort objects.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Planning and Carrying Out Investigations ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2-PS1-1) **Constructing Explanations and Designing Solutions** ● Make observations	**PS1.A: Structure and 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. (2-PS1-1)	**Patterns** ● Patterns in the natural and human designed world can be observed. (2-PS1-1)

(firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)		

Possible Preconceptions/Misconceptions:
Students may arrive with a fixed mindset that the only way to identify properties is by color, shape, size, texture. Observations should include color, texture, hardness, strength, absorbency, and flexibility.

EVALUATE:
Formative Monitoring (Questioning / Discussion):
Teacher will observe students as they discuss and sort materials.
Teacher will look for use of vocabulary in discussions.
Summative Assessment (Quiz / Project / Report):
What is a property?
When you sorted objects by properties what did you find out?

LESSON 2 - States of Matter (Launching Part 2)

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #** __2___**in a series of** _7__**lessons** **One Class Period**

Brief Lesson Description: Different kinds of matter exist. In this lesson students make observations about solids and liquids in order to explain the properties of each. They collect and analyze data to find patterns, such as similar properties that different materials share, and use the data to classify materials.

Performance Expectation(s):

Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. *[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]* **(2-PS1-1)**

Specific Learning Outcomes:
The students will observe, sort and describe materials the properties of solids and liquids.
With guidance, students plan and conduct and investigation in collaboration with peers to produce data to serve as the basis for evidence to answer the questions; What is a solid? What is a liquid?
Make observations to collect data that can be used to make comparisons.
Students will use science vocabulary to describe materials by their observable properties.

Narrative / Background Information

Prior Student Knowledge:
The students learned the definition of matter and sorted objects by observable properties in Lesson One. Here their understanding of matter is extended to include three states of matter, solid, liquid and gas.

Science & Engineering Practice:	Disciplinary Core Ideas:	Crosscutting Concepts:
Constructing Explanations and Designing Solutions ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3) **Engaging in Argument from Evidence** Construct an argument with evidence to support a claim. (2-PS1-4)	**PS1.A: Structure and 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. (2-PS1-1)	**Patterns** ● Patterns in the natural and human designed world can be observed. (2-PS1-1)

Possible Preconceptions/Misconceptions:
Students might think that solids are hard and cannot be broken. They might think pourability is only a criterion for a liquid.

EVALUATE: Students and teachers evaluate how well
Formative Monitoring (Questioning / Discussion):
Recording sheet data,
Summative Assessment (Quiz / Project / Report):
Sort materials by solids and liquids. Explain how and why they sorted materials into each group.

LESSON 3 - Objects May Break Into Smaller Pieces & Put Back Together

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #** 3 **in a series of** 7 **lessons** **2 Class Periods**

Brief Lesson Description: In this session students learn more about the properties of matter, in order to understand that different properties are suited for different purposes. Students use this understanding as they construct evidence-based accounts of how an object made of small pieces can be disassembled and made into new objects. In order to do this, they need multiple opportunities to take apart and reassemble objects that are made of small pieces. For example, using blocks, building bricks, and other small objects such as Legos, small groups of students can build an object, and then a second group of students can take the object apart and build another object using those same small blocks or bricks. As students construct and deconstruct objects, then reconstruct the pieces into new objects, they will document the process in their science journals, explaining how they went about reconstructing the pieces into a new object.

Performance Expectation(s):

Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. *[Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]* **(2-PS1-3)**

Specific Learning Outcomes:

Can disassemble an object into its pieces and is reassembled into a new object or objects.
Can build many different objects from the same set of pieces.
Make observations to show that a new object or objects can have different characteristics, even though they were made of the same set of pieces.
Make observations to collect data that can be used to make comparisons.
· Use and share pictures, drawings, and/ or writings of observations.
Make observations to construct an evidence based account for natural phenomena.

Narrative / Background Information

Students know that objects and organisms can be described in terms of their parts and properties and natural and manmade systems have parts that work together.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Constructing Explanations and Designing Solutions Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)	**PS1.A: Structure and Properties of Matter** Different properties are suited for different purposes A great variety of objects can be built up from a small set of pieces. (2-PS1-3)	**Energy and Matter** Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-3)

Possible Preconceptions/Misconceptions:

EVALUATE:
Formative Monitoring (Questioning / Discussion):
Students can articulate a statement that relates to the given phenomenon to the scientific idea that an object made of a small set of pieces can be disassembled and made into a new object.
Summative Assessment (Quiz / Project / Report):

LESSON 4 - Identifying the Parts of Everyday Classroom Objects

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #** 4 **in a series of** 7 **lessons** **2 Class Periods**

Brief Lesson Description:
In this session students learn more about the properties of matter, in order to understand that different properties are suited for different purposes. Students use this understanding as they construct evidence-based accounts of how an object made of small pieces can be disassembled and made into new objects. In order to do this, they need multiple opportunities to examine everyday

man made objects and identify the smaller pieces it's composed of. For example, a pencil is composed of smaller parts such as wood, metal, graphite, rubber, glue, and paint.
As students observe classroom objects, they observe that materials have different properties and provide evidence that materials can be combined to form different things. As they observe they will notice and name the functions of the smaller parts. They will record the materials and their properties on a poster, labeling the smaller parts that make up the whole object. By doing this students learn how parts of a product are related to the whole thing.

Performance Expectation(s): Students will observe and describe materials by properties of matter.

Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. *[Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]* **(2-PS1-3)**

Specific Learning Outcomes:

- Objects may break into smaller pieces and be put together into larger pieces or changeshapes.
- Different properties are suited to different purposes.
- A great variety of objects can be built up from a small set of pieces.

Explore how objects may break into smaller pieces and be put together into larger pieces or change shapes.
Explore how parts of something are related to the whole thing.
Create diagrams to identify the objects' materials and the properties of the materials that support the object's purpose.
Man made products have been designed by scientists and engineers for our use. They study the particular properties of materials (wood, plastic, glass, metal) and solve problems by designing products for us to make life easier.
· Record information (observations, thoughts, and ideas).

Narrative / Background Information

Prior Student Knowledge:
Materials are made up of properties of matter.
Man made materials are composed of smaller pieces, which have properties that contribute to its function.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Constructing Explanations and Designing Solutions ● Make observations (firsthand or from media) to construct an evidence-based account for natural	**PS1.A: Structure and Properties of Matter** ● Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) ● A great variety of objects can be built up from a small	**Energy and Matter** ● Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-3)

phenomena. (2-PS1-3)	set of pieces. (2-PS1-3)	

Possible Preconceptions/Misconceptions:
Many children haven't given thought to what things are made of. To them, a chair is a chair.

EVALUATE:
Formative Monitoring (Questioning / Discussion): *Students who understand the concepts are able to:*

- Break objects into smaller pieces and put them together into larger pieces or change shapes.
- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
- Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

Summative Assessment (Quiz / Project / Report):

LESSON 5A - Reversible Changes : Identify Cause & Effect to Explain Natural Events (Heating and Cooling Investigation)

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #** 5A **in a series of** 7 **lessons** **1 Class Periods (50 minutes)**

Brief Lesson Description: In this lesson, students investigate changes to materials caused by adding heat (butter, chocolate, popcorn, ice). Students will then remove the materials from the heat source and predict what will happen.

Performance Expectation(s):

Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. *[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]* **(2-PS1-1)**

Specific Learning Outcomes:
Students can prove that adding heat to certain substances causes a change from solid to liquid.
With guidance, students plan and conduct an investigation in collaboration with peers to produce data to serve as the basis for evidence to answer a question.
Make observations to collect data that can be used to make comparisons about heating and cooling.

Narrative / Background Information

Prior Student Knowledge:
Students discussed temperature in math and in the weather unit in science in first grade. They have observed that when it is cold it can snow and water freezes outside. When the temperature rises the snow melts.

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Planning and Carrying Out Investigations ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2-PS1-1) **Analyzing and Interpreting Data** ● Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2) **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3) **Engaging in Argument from Evidence** Construct an argument with evidence to support a claim. (2-PS1-4)	**PS1.A: Structure and 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. (2-PS1-1) **PS1.B: Chemical Reactions** ● Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)	**Cause and Effect** ● Events have causes that generate observable patterns. (2-PS1-4) ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2) ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Science searches for cause and effect relationships to explain natural events. (2-PS1-4)

Possible Preconceptions/Misconceptions:

Students may believe all materials (solids) can be melted through heating on a stove.

EVALUATE:
Formative Monitoring (Questioning / Discussion):
Record of observations on the recording sheet.
Notes on collaboration and discussion with team members.

LESSON 5B - Constructing an Argument about Reversible Changes

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson # 5B in a series of 7 lessons]** **1 Class Period**

Brief Lesson Description:
In this lesson students use what they learned in the previous 2 lessons to construct an argument with evidence that some changes caused by heating or cooling that can be reversed and some cannot.

Performance Expectation(s):

Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. *[Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include* ***cooking an egg, freezing a plant leaf, and heating paper.****]* **(2-PS1-4)**

Specific Learning Outcomes:

Students will use their observations to construct an argument with evidence using shared writing.
Students will engage in whole class conversations using 'talk moves.'
Students will use scientific vocabulary.

Narrative / Background Information

Prior Student Knowledge:

In the last lesson students gathered the data they will need to write an argument with evidence that some changes caused by heating or cooling that can be reversed and some cannot.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in Argument from Evidence Construct an argument with evidence to support a claim. (2-PS1-4)	**PS1.A: Structure and 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. (2-PS1-1) **PS1.B: Chemical Reactions** ● Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and	**Patterns** ● Patterns in the natural and human designed world can be observed. (2-PS1-1) **Cause and Effect** ● Events have causes that generate observable patterns. (2-PS1-4) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Science searches for cause and effect relationships to explain natural events. (2-PS1-4)

	sometimes they are not. (2-PS1-4)	

Possible Preconceptions/Misconceptions:
2nd graders often know about water melting and freezing but they have not thought about it in terms of reversible and irreversible changes.

EVALUATE:
Formative Monitoring (Questioning / Discussion):
Summative Assessment (Quiz / Project / Report):
Students articulate the results of the experiments orally or in writing.

LESSON 6 – Irreversible Changes
http://www.bbc.co.uk/schools/scienceclips/ages/10_11/rev_irrev_changes_fs.shtml

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson # 6 in a series of 7 lessons** **2 Class Periods**

Brief Lesson Description: Students identify key properties and take observations of a material as it heated and cooled. They describe how the material's properties change when heat is removed and added and decide if it is a reversible or an irreversible change. Then support their answer with their data.

Performance Expectation(s):

Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. *[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]* **(2-PS1-1)**

Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. *[Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]* **(2-PS1-4)**

Specific Learning Outcomes:
Students observe how adding or removing heat can cause a material's properties to change.
Some things can be changed back when heated or cooled, but others cannot. Some changes that we make to materials are irreversible. This is part of the basic understanding of how things are made, and how the materials matter.
Students can observe that different materials melt at different temperatures.

Narrative / Background Information

Prior Student Knowledge:

Students know that heat can cause materials to melt and some can go back to their original state when cooled and some do not.
Students know that higher temperature means that something is hotter.

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Planning and Carrying Out Investigations ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2-PS1-1) **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)	**PS1.A: Structure and 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. (2-PS1-1) **PS1.B: Chemical Reactions** ● Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)	**Patterns** ● Patterns in the natural and human designed world can be observed. (2-PS1-1) **Cause and Effect** ● Events have causes that generate observable patterns. (2-PS1-4) ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)

Possible Preconceptions/Misconceptions:
Children may be surprised to find out that
Second graders may think that if something changes it is different, and if it changes back, it has to be exactly as it started.
Students may think that any difference in form and it is a different thing.
Students may lack experiences with things that have been heated and cooled.

EVALUATE:

Formative Monitoring (Questioning / Discussion): *Students who understand the concepts are able to:*

- Observe patterns in events generated due to cause-and-effect relationships.
- Construct an argument with evidence to support a claim.
- Construct an argument with evidence that some changes caused by heating or cooling can be reversed, and some cannot.
  - Examples of reversible changes could include materials such as water and butter at different temperatures.
  - Examples of irreversible changes could include
    - Cooking an egg
    - Freezing a plant leaf
    - Heating paper

Use this opportunity to informally assess if students can state that:

- some matters can be reversed, while others cannot
- reversible changes usually occur when the material changes phases
- heat can be added and removed from all materials

LESSON 7 - Engineering Challenge (Option 1)

A House for Chase the Dog by By Meghan E. Marrero, Amanda M. Gunning, and Christina Buonamano, *Science and Children,* January 2016 pages 76-83

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #___7___in a series of____7___ lessons** **2 Class Periods**

Brief Lesson Description: In this investigation, students use observations and engineering design to decide which material would make the best roof for a doghouse. The project requires that the students apply what they have learned in the unit about physical properties and how that can determine how a material is used.

Performance Expectation(s):

Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. *[Clarification Statement: Examples of properties could include strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]* **(2-PS1-2)**

Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. (K-2-ETS1-3)

Specific Learning Outcomes:

- Students should be able to explain that different materials have different characteristics,or properties. Some of the materials, for example, have the property of absorbing or repelling water.
- Students will be introduced to the Next Generation Science Standards model of the engineering design process and be given different materials to test to determine the best solution for creating the roof of a dog house to withstand rain.

- Interpret data to determine whether each material was effective.
- Test materials' suitability for use as a roofing material.

Narrative / Background Information

Prior Student Knowledge:

Students know that materials have properties and properties help scientists figure out how to use them.
Students can work in cooperative groups and record observations.
Students can write claims with evidence from observations.

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Planning and Carrying Out Investigations ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2-PS1-1) **Analyzing and Interpreting Data** ● Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2) **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)	**PS1.A: Structure and Properties of Matter** ● Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) **ETS1.C: Optimizing the Design Solution** ● Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	**Patterns** ● Patterns in the natural and human designed world can be observed. (2-PS1-1) **Structure and Function.** ● ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science, on Society and the Natural World** ● Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (2-PS1-2) ●

Possible Preconceptions/Misconceptions:

EVALUATE:
Formative Monitoring (Questioning / Discussion):
Note students' prior understandings of shelter and its function.
Observe how student teams are testing the materials, and note student conversation and the observations and explanations cited on their worksheets to assess how they use engineering practices.
During the class discussion, assess how students are constructing their explanations and designing solutions.
Summative Assessment (Quiz / Project / Report):

LESSON 7 - Engineering Challenge (Option 2)
Build a Sail: Part 1 of 2

Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #** 7 **in a series of** 7 **lessons** **4 Class Periods**

Brief Lesson Description: In this lesson students follow the Engineer Design Process to explore which materials are best to make a sail that will catch the wind to propel a boat. They will observe the structure and properties of various solids to select the best materials for constructing a model sail. An effective model sail will enable a plastic boat to catch wind and propel across a surface of water. Students will collect and analyze data to determine whether or not their selected materials are best suited for their sail and then make improvements..

Performance Expectation(s):

Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. *[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]* **(2-PS1-1)**

Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. *[Clarification Statement: Examples of properties could include strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]* **(2-PS1-2)**

Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. (K-2-ETS1-3)

Specific Learning Outcomes:

Investigate and describe the physical properties of a variety of materials. (shape, strength, flexibility, hardness, texture, and absorbency)

Use materials to build a sail, testing to see what materials are most effective for catching the wind.

Record information (observations, thoughts, and ideas).

Communicate the design process and solutions in written and or video format using an iPad as a possible communication device.

- Use and share pictures, drawings, and/ or writings of observations.
- Use observations to describe patterns and/ or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
- Analyze data from tests of an object or tool to determine if it works as intended.

Narrative / Background Information

Prior Student Knowledge:

Students understand that in the natural world, matter exists all around us and can be described and classified by its characteristics. Therefore, human made products are also constructed of various matter. Engineers and scientists must consider an object's properties before deciding if it is suitable for a certain purpose.

Different Properties Are Suited for Different Purposes.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Planning and Carrying Out Investigations · Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2-PS1-1) **Analyzing and Interpreting Data** · Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2) **Constructing Explanations and Designing Solutions** · Make observations	**PS1.A: Structure and 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. (2-PS1-1) · Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) · A great variety of objects can be built up from a small set of pieces. (2-PS1-3) **ETS1.C: Optimizing the Design Solution** · Because there is always	**Cause and Effect** · Events have causes that generate observable patterns. (2-PS1-4) · Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2) ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science, on Society and the Natural World** · Every human-made product is designed by

(firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3) **Engaging in Argument from Evidence** Construct an argument with evidence to support a claim. (2-PS1-4)	more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	applying some knowledge of the natural world and is built using materials derived from the natural world. (2-PS1-2)
Possible Preconceptions/Misconceptions: Students may arrive with the misconception that any paper or cloth material would serve as an effective sail for a boat. Students must consider such properties as strength, flexibility, hardness, texture, and absorbency when conducting and testing their models.		
EVALUATE: **Formative Monitoring (Questioning / Discussion):** Questions to ask during discussion…. Was your group successful with your design? How do you know? How was your group reflective and flexible with your thinking? Did your group follow The Engineering Design Process? What evidence do you have? Did your group work collaboratively and complete each component of your STEM journal? (either paper journal or e-journal) **Summative Assessment (Quiz / Project / Report):**		

LESSON 7 - Option 2 - Part 2 **Build a Sail Part 2 of 2- e-journaling, construct an argument w/evidence**		
Grade/ Grade Band: 2	**Topic:** Changes to Matter	**Lesson #** 7 **in a series of** 7 **lessons** **It is suggested this lesson be taught over 2 days**
Brief Lesson Description: This is a continuation of Lesson #4A "Build a Sail" where students are asked to follow the Engineering Design Process to plan and construct a sail that can catch a wind. Today students will be conducting trials to test the effectiveness of their model and make improvements as needed. Students will be recording their work in their STEM journals and		

constructing an argument from evidence gathered.

Performance Expectation(s):

Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. *[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]* **(2-PS1-1)**

Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. *[Clarification Statement: Examples of properties could include strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]* **(2-PS1-2)**

Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. (K-2-ETS1-3)

Specific Learning Outcomes:
Can plan and conduct an investigation to describe the physical properties of a variety of materials. (shape, strength, flexibility, hardness, texture, and absorbency)
Use materials to build a sail, testing to see what materials are most effective for catching the wind.
Communicate their design process and solutions in written, drawing and or video format using an iPad as a possible communication device.

Narrative / Background Information

Prior Student Knowledge:
Students will be reminded that different properties of matter are suited for different purposes.
Man made materials can be composed of a small set of pieces.

Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Planning and Carrying Out Investigations · Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2-PS1-1) **Analyzing and Interpreting Data** · Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2) **Constructing Explanations and Designing Solutions** · Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3) **Engaging in Argument from Evidence** Construct an argument with evidence to support a claim. (2-PS1-4)	**PS1.A: Structure and 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. (2-PS1-1) · Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) · A great variety of objects can be built up from a small set of pieces. (2-PS1-3) **ETS1.C: Optimizing the Design Solution** · Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science, on Society and the Natural World** · Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (2-PS1-2)

Possible Preconceptions/Misconceptions:

EVALUATE:

Formative Monitoring (Questioning / Discussion):

Questions to ask during discussion….
Was your group successful with your design? How do you know?
How was your group reflective and flexible with your thinking?
Did your group follow The Engineering Design Process? What evidence do you have?
Did your group work collaboratively and complete each component of your STEM journal? (either paper journal or e-journal)

Summative Assessment (Quiz / Project / Report):

Was it the best solution? Would one of your other ideas have been better? Why or why not?
What would you have done differently?
Could you add to it to make it better? What would you add to it?

Grade 2 Changes: Required Materials

Quantity	Description	Potential Supplier (item #)
1 bag/class	cotton balls	
1 box/class	plastic spoons	
1 small bag	balloons	
1/class	sandpaper sheet (cut into 8 pieces)	
1 pack/class	pipe cleaners	
1 /class	small bag of pebbles or rocks	
1 /class	small set of shells	
1 box/class	Large paper clips	
1 box /school	Lincoln Logs- to be shared	
12 sheets/class	12 x 12” felt squares	
1/class	Glass pie plate	
1/class	metal pie plate	
1/class	Aluminum pie plate	
	Sponges	
1 box	Gallon size bags to keep materials for sorting	
1/class	*What Happened?* By Rozanne L. Williams	B&N

Quantity	Description	Potential Supplier (item #)

48/class	small jars with lids for liquid observation	
1 container / class	sea salt	
1 box/class	cornstarch	
1 pack/class	baby wipes	
1 small bottle	dishwashing liquid	
1 small bottle	molasses	
50 plates	small disposable plates	
50	plastic spoons	
1/class	*What' is the World Made Of? All About Solids, Liquids, and Gases by Kathleen Weidner Zoehfeld*	B&N
1 /class	*Touch It! Materials Matter, and You* by Primary Physical Science	B&N
1/class	*See It, Touch It, Taste It, Smell It* by Darlene Stille	B&N
1/class	*What's the Matter in Mr. Whisker's Room* by Michael Eisohn Ross	B&N
1	*If I Built a Car* by Chris Van Deusen	B&N
1/class	What is a Liquid by Jennifer Boothroyd	
1/class	What is a Solid by Jennifer Boothroyd	

Basic set per class with at least 400 pieces 8 sets/building	LEGO Classic Creative Building Box Set 10704	
1 book/class 2 per building	Build This City (Lego City Series) large clear plastic containers w/lids	B&N

Quantity	**Description**	**Potential Supplier (item #)**

1 pack of 24x32" per kit	white poster board	
6 sets of 12 markers per kit	Markers	

Quantity	**Description**	**Potential Supplier (item #)**
2 4-packs/kit	modeling clay	
8/class	styrofoam trays	
8/class	Glad plastic soup & salad containers with lids (24 ounce)	
1 box	tongue depressors	
1/class	Electric Kettle Item **#** 228558 **Model #** DCLW-2	Lowes
1/class	Timer	Learning Resources LER4339 Digital Timer, Count Down/Up
1/class	small mini cooler	
1 stick of butter/class	stick butter	McCaffreys
small bag /class	mini chocolate chips	McCaffrey's
box of 50	sandwich baggies	
1/class	ice cube mold	
1 roll/class	Paper towels	
1 set/class	Potholders	
24 child 1 adult	goggles 1 per child and 1 adult size for teacher	
1/class	*Joe Joe the Wizard Brews Up Solids, Liquids and Gases by Eric Braun*	Barnes and Noble
1 book/class	*Melting And Freezing* by Lisa Greathouse	Barnes and Noble
1 book/class	*Change It! Solids, Liquids, Gases and You by Adrienne Mason*	B&N
1	*All About Matter by Mari Shuh*	B & N
1 book/class	*Melting Matter* by Amy Hansen	

Quantity	**Description**	**Potential Supplier (item #)**
1 small bag	Popcorn kernels	Mccaffrey's
24	clear plastic cups - tumblers	
1/class	aluminum foil pie tin	
1 pack/class	matches	Mccaffrey's
2/building	Air Popcorn popper	
28	Plastic tweezers	

1 book	Rosie Revere Engineer by Andrea Beaty	B & N
6/class	small spray bottles	
15/class	Pipettes	
1 box/class	thin large rubber bands	
1 pk of 8/class	small aluminum baking pans disposable (9x11)	
1/class	wax paper	
1/class	Aluminum Foil	
1/class	Assorted 9x12 Construction paper	
1/class	Shower curtain	**Item #** 228558 **Model #** DCLW-2 Lowes

Quantity per class	**Description**	**Potential Supplier (item #)**

2 per building	fishing line 50Lb Test	
1 box per kit	plastic drinking straws (250 count)	
24 per kit	5 x 8 White Styrofoam Food Trays	
6 rolls per kit	clear scotch tape **on dispensers**	
2 per school	Honeywell HT-900 TurboForce Air Circulator Fan, Black Small Fan - 12 inches	
1 per kit	21 ft. measuring tape- 1" x 25' 7.5M	Lowes H-2494 Uline Metric Tape Measure
1 ream per kit	cardstock 8.5x11 inch	
1 pack	felt sheets 9x12 sheets	
25 per kit	9 oz. **paper** cups	
1 pack per kit	assorted colored tissue	
1 roll	masking tape	
6	Tacky Glue	

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Students need opportunities to read texts that give information about matter and the changes that can happen to matter. With adult support, students can identify the main idea and details in informational text in order to answer questions about matter. With teacher support and modeling, students can ask and answer who, what, where, when, why, and how questions to demonstrate their understanding of key details in informational text.
- As students investigate reversible and irreversible changes to matter, they should record observations in science journals, using drawings or other visual displays, when

appropriate, to help clarify their thinking. To further support their learning, students can conduct shared research using trade books and online resources in order to learn more about physical changes to matter.

- After reading informational texts and conducting investigations, students should be able to write opinion pieces in which they state an opinion, supply evidence to support their opinion, use linking words to connect opinion to evidence (reasons), and provide a concluding statement. For example, students can be presented with an example of matter that has been changed in some way, then asked to write an opinion piece in which they state whether or not they think the change is reversible or irreversible, and supply evidence to support their thinking. Evidence can include information recalled from experiences or information gathered from informational texts or other resources. Some possible changes that can be used are:

Mathematics

- N/A

21st Century Life and Careers/Technology Standards (as applied at grade level):

- Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
- Technology Education, Engineering, Design, and Computational Thinking - Programming:

All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

- Communicate clearly and effectively and with reason.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Employ valid and reliable research strategies.
- Demonstrate creativity and innovation.
- Apply appropriate academic and technical skills.

Social Studies

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.

NGSS ONLINE RESOURCES
General Information:

1. "Lab Before Blab" - Conducting investigations before explanations. Other PBS education videos are also instructive.

(http://www.thirteen.org/programs/pbs-newshour/lab-before-blab-lights-upelementary-school-science-1392155837/)

2. NJDOE model curricula: a framework of suggested topic sequences, course outlines, guiding questions, links to videos, etc. (http://www.state.nj.us/education/modelcurriculum/sci/)

3. The National Science Teachers Association website. For members and non-members, NGSS resources, conferences, webinars, books, free downloads, videos. (http://www.nsta.org/)

4. Free NGSS digital copies and ancillary materials, videos, curriculum ideas, embedded assessment unit plans. (www.nextgenscience.org)

5. NGSS Evidence Statements downloadable for every K-12 Performance Expectation. Also: videos and other free materials. (http://nextgenscience.org/evidence-statements)

6. Videos, lessons, NGSS information, and more. (http://www.teachingchannel.org/)

Instruction:

1. Brief summaries of STEM Teaching Tools that encapsulate the practices of NGSS reform. (http://stemteachingtools.org/tools)

2. PD strategies for NGSS. (http://www.cesa4.k12.wi.us/cms_files/resources/NGSS%20Professional%20Development%20Strategies.pdf.)

3. TERC provides online PD programs as part of their Inquiry Project for grades 3-5. The strategies for supporting productive science discourse in the classroom are applicable for higher grades as well. Online materials for the Talk Moves and Talk Science approaches are downloadable. (http://inquiryproject.terc.edu/)

4. Study Jams from Scholastic. Interactive science activities. (https://www.scholastic.com/teachers/activities/teaching-content/matter-9-studyjams-interactive-science-sctivities/

Assessment:

1. Developing assessments for the NGSS. It addresses K-12 including AP courses, explains the research on assessment providing examples, resources, unit outlines, rubrics, and examples of student responses. (http://www.nap.edu/catalog.php?record_id=18409)

2. NAEP interactive assessment tasks for elementary, middle, and high school, with scoring and analyses of student responses. (http://www.nationsreportcard.gov/science_2009/)

3. "Below you will find links to released test items for the New Jersey Student Learning Assessment-Science. Please know that the middle and high school assessments are said to be comprehensive, incorporating standards from physical, life, and earth/space sciences." (April 2018, Bergen County)

http://www.state.nj.us/education/aps/cccs/science/assessment.htm
https://nj.testnav.com/client/index.html#login?username=LGN))5710830&password=YTDEKPMW
http://ct.portal.airast.org/

4. "The URL below is being shared with you by Mike Heinz, Science Coordinator, NJDOE. The link contains the raw drafts of the science assessment tasks that counties have contributed to. **These are in DRAFT form**. They need to be reviewed, formatted, and field tested. This is a compilation of the assessment collaborations that were done since August 2017. When sharing with your teachers, please be sure to indicate that these are **draft tasks**; they have neither been reviewed nor vetted. Teachers **may** want to use them as formative assessment tasks that are **not graded**. Student performance will provide the teacher with some data about how well the task performs without impacting a student's grade. And of course, Mike would appreciate your feedback about the appropriateness and applicability of each task so that continuous improvements may be made." (March 2018, Bergen County) (https://tinyurl.com/draftstasksnj1)

Phenomena:

1. Finding phenomena for lessons, investigations, and/or units can be found at **https://thewonderofscience.com/phenomenal/**

2. Finding phenomena for lessons, investigations, and/or units can be found at **www.ngssphenomena.com**

CER: Claims – Evidence - Reasoning

1. Audi Commercial "Alien": Is the little girl's father an alien? Watch the video: make a claim, provide evidence, and offer reasons. (http://www.youtube.com/watch?v=89uJz_us4PM)

Authentic Data:

1. MY NASA DATA (MND)'s tools allow access real NASA Earth Science data. Through the use of MND's Live Access Server (LAS) data viewer, one can create a variety of charts, plots, and graphs to explore Earth systems and answer research questions. MY NASA DATA offers a large number of lesson plans, tools, and resources. (https://mynasadata.larc.nasa.gov/)
2. With NOAA's Data in the Classroom, students use real-time ocean data to explore today's environmental issues and develop problem-solving skills employed by scientists. Classroom-ready activities are available. (https://dataintheclassroom.noaa.gov/)
3. US Geological Survey (USGS) Real-time Data. USGS scientists gather information through periodic or continuous measurement in the field to provide a view of current conditions. (https://www.usgs.gov/products/data-and-tools/real-time-data)