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# Grade 2 Matter

*Anchoring Phenomenon: Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle.*

## Introduction

<table>
<thead>
<tr>
<th>Overview</th>
<th>2.0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Sequence Narrative</td>
<td>2.0.7</td>
</tr>
<tr>
<td>Lesson 1: Properties of Matter</td>
<td>2.0.9</td>
</tr>
<tr>
<td>Lesson 2: Properties of Liquids</td>
<td>2.0.9</td>
</tr>
<tr>
<td>Lesson 3: Different Properties for Different Purposes</td>
<td>2.0.10</td>
</tr>
<tr>
<td>Lesson 4: Reversible and Irreversible Changes</td>
<td>2.0.10</td>
</tr>
<tr>
<td>Lesson 5: The Great Wax Disaster</td>
<td>2.0.10</td>
</tr>
<tr>
<td>Learning Sequence 3-Dimensional Progressurations</td>
<td>2.0.11</td>
</tr>
<tr>
<td>Assessment System</td>
<td>2.0.14</td>
</tr>
<tr>
<td>Scaffolds for Students with Reading and Writing Difficulties</td>
<td>2.0.15</td>
</tr>
<tr>
<td>Grade 2 Matter Conceptual Flow</td>
<td>2.0.16</td>
</tr>
</tbody>
</table>

*Engineering/Design Problem: How did the objects get this way?*

*How can we keep this from happening to the objects?*

## Lessons

**Lesson 1: Properties of Matter** .................................................................2.1.1

*Investigative Phenomenon: Objects, such as a crayon, a candle, lip balm, and other objects in the classroom, look and feel different from one another.*

<table>
<thead>
<tr>
<th>Introduction</th>
<th>2.1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure</td>
<td>2.1.3</td>
</tr>
<tr>
<td>Toolbox 2.1</td>
<td>2.1.8</td>
</tr>
<tr>
<td>Appendix 2.1 Standards</td>
<td>2.1.A1</td>
</tr>
</tbody>
</table>

**Lesson 2: Properties of Liquids** .........................................................2.2.1

*Investigative Phenomenon: Water poured from one container to a different container takes the shape of the new container.*

<table>
<thead>
<tr>
<th>Introduction</th>
<th>2.2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure</td>
<td>2.2.3</td>
</tr>
<tr>
<td>Toolbox 2.2</td>
<td>2.2.9</td>
</tr>
<tr>
<td>Appendix 2.2 Standards</td>
<td>2.2.A1</td>
</tr>
</tbody>
</table>
Lesson 3: Different Properties for Different Purposes ................................................................. 2.3.1
Investigative Phenomenon: Crayon marks are difficult to remove from school surfaces. I wonder what materials would work best to remove them.

Introduction .................................................................................................................................... 2.3.1
Procedure ...................................................................................................................................... 2.3.4
Toolbox 2.3 ..................................................................................................................................... 2.3.10
Appendix 2.3 Standards .............................................................................................................. 2.3.A1

Lesson 4: Reversible and Irreversible Changes ............................................................................. 2.4.1
Investigative Phenomenon: The corn kernel changed after it went into the hot air popper.

Introduction .................................................................................................................................... 2.4.1
Procedure ...................................................................................................................................... 2.4.4
Toolbox 2.4 ..................................................................................................................................... 2.4.14
Appendix 2.4 Standards .............................................................................................................. 2.4.A1

Lesson 5: The Great Wax Disaster ................................................................................................. 2.5.1
Investigative Phenomenon: Crayons are made of wax in a shape we can hold with our fingers. Birthday candles are made of wax in a shape that we can put on a cake. Lip balm is made of wax in a shape that we can apply to our lips.

Introduction .................................................................................................................................... 2.5.1
Procedure ...................................................................................................................................... 2.5.4
Toolbox 2.5 ..................................................................................................................................... 2.5.13
Appendix 2.5 Standards .............................................................................................................. 2.5.A1
The California K–8 NGSS Early Implementation Initiative, developed by the K–12 Alliance at WestEd with close collaborative input on its design and objectives from the State Board of Education, the California Department of Education, and Achieve is a fast-start demonstration project to build local education agency (LEA) capacity to fully implement the Next Generation Science Standards (NGSS) as a core subject in the elementary grades (K–5) and as the SBE’s preferred integrated model in grades 6–8. The 4-year Initiative provides teachers and administrators with in-depth, content-rich professional development to build leadership capacity and teacher acumen to deliver high-quality 3-dimensional learning for K-8 students. In addition, through collaborations among the K–12 Alliance, Achieve, and others, the LEAs in the Collaborative have opportunities to pilot test new NGSS-aligned tools, processes, assessment item prototypes, and digital and other instructional materials. The LEAs serve as resources for NGSS implementation across California, and in other NGSS-adopting states as well.

This resource presents the conceptual storyline for a unit of instruction at a specific grade level, then focuses on a portion of the storyline called a learning sequence. The learning sequence uses the 3 dimensions of the NGSS (disciplinary core ideas—DCI; science and engineering practices—SEP; and crosscutting concepts—CCCs) to build and deepen student understanding of natural phenomena and design challenges.

Participants in the CA NGSS K–8 Early Implementation Initiative developed and field-tested the lessons in the learning sequence.

Overview

The anchoring phenomenon for this unit is: Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle. In this unit, students explore, observe patterns, describe, and sort properties of solid and liquid matter by planning and carrying out investigations. Students collect and analyze data to determine that different properties of different materials suit them for different purposes. Students investigate phenomena illustrating reversible and irreversible changes caused by heating or cooling to write claims based upon observable evidence regarding the cause and effect of these changes. Students apply their understanding of changes made to matter by developing a plan that uses a design process. The design process ultimately leads students to understand what can cause a change in the shape of matter. Students also begin to use an engineering design process to solve a problem related to the anchoring phenomenon.

The Performance Expectations that is addressed in this unit are:

2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
Grade 2 Matter:
Introduction

2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

2-PS1-4 Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Learning Sequence Narrative

The Learning Sequence Narrative briefly describes what students do in each lesson and helps to establish links between the lessons as a conceptual storyline. At the end of each lesson, students make connections to their understanding of the investigative phenomenon (and to the anchoring phenomenon, if appropriate). The investigative phenomenon for the lessons are: objects, such as a crayon, candle, lip balm, and objects in the classroom, look and feel different from one another (Lesson 1: Properties of Matter); water poured from one container to a different container takes the shape of the new container (Lesson 2: Properties of Liquids); crayon marks are difficult to remove from school surfaces. I wonder what materials would work best to remove them (Lesson 3: Different Properties for Different Purposes); corn kernels changed after they went into the hot air popper (Lesson 4: Reversible and Irreversible Changes); and crayons are made of wax in a shape we can hold with our fingers; birthday candles are made of wax in a shape that we can put on a cake; lip balm is made of wax in a shape that we can apply to our lips (Lesson 5: The Great Wax Disaster).

Students figure out this phenomenon by:

Science and Engineering Practices (SEPs)

Planning and Carrying Out Investigations

• Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.
• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.
• Make predictions based on prior experiences.

Analyzing and Interpreting Data

• Record information (observations, thoughts, and ideas).
• Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
Constructing Explanations and Designing Solutions

- Use information from observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
- Generate and/or compare multiple solutions to a problem.

Engaging in Argument from Evidence

- Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.
- Construct an argument with evidence to support a claim.

Asking Questions and Defining Problems

- Ask questions based on observations to find more information about the natural and/or designed world(s).
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Obtaining, Evaluating, and Communicating Information

- Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Disciplinary Core Ideas (DCIs)


- 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.

PS1.B: Chemical Reactions

- Heating or cooling a substance may cause changes that can be observed.
- Some changes are reversible and some are not.

ETS1.A: Defining and Delimiting an Engineering Problem

- Asking questions, making observations, and gathering information are helpful in thinking about problems.

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.
Crosscutting Concepts (CCCs)

Patterns
- Patterns in the natural and human-designed world can be observed, used to describe phenomena, and used as evidence.

Cause and Effect
- Events have causes that generate observable patterns.
- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Structure and Function
- The shape and stability of structures of natural and designed objects are related to their function(s).

Energy and Matter
- Objects may break into smaller pieces and be put together into larger pieces, or change shapes.

Lesson 1: Properties of Matter

Investigative Phenomenon: Objects, such as a crayon, a candle, lip balm, and other objects in the classroom, look and feel different from one another.

This lesson primarily serves as an introduction to properties of matter, with the focus on building an understanding the properties of solids. As students engage in observations of solid matter around them, they have opportunities to connect their language to the corresponding scientific vocabulary. Lesson 1: Properties of Matter introduces students to the anchoring phenomenon: Materials are made of matter; We can observe misshapen objects, including a crayon, lip balm, and a candle. Students are introduced to the development of an engineering problem by posing questions such as: How did the objects get this way? How can we keep this from happening to the objects? Students use their prior knowledge of daily interactions with matter as they begin thinking about the everyday objects around them and the properties of the materials from which they are made. Students use prior knowledge of the five senses to make observations and find patterns in their observations to sort solid materials and classify them by their properties. In Lesson 2: Properties of Liquids, students investigate the properties of liquids.

Lesson 2: Properties of Liquids

Investigative Phenomenon: Water poured from one container to a different container takes the shape of the new container.

In Lesson 1: Properties of Matter, students observed, described, and classified the properties of solid materials. Students also began to develop an engineering problem. In this lesson, students plan and conduct investigations to observe and classify patterns of properties of liquids to answer a question generated by the class. Students use their observations to
Grade 2 Matter:
Introduction

compare the properties of liquids and solids. The properties of liquids relate to the observable part of the anchoring phenomenon (misshapen objects, including a crayon, lip balm, and a candle) because eventually students are going to understand that when some solids melt, they spread out to take the shape of their container and later return to a solid state, e.g., chocolate bars, chocolate bunnies, etc. This foundational understanding of the properties of matter will help students with the Plan phase of the Engineering Design Process. In Lesson 3: Different Properties for Different Purposes, students explore the idea that materials are used for different purposes depending on their properties.

Lesson 3: Different Properties for Different Purposes
Investigative Phenomenon: Crayon marks are difficult to remove from school surfaces. I wonder what materials would work best to remove them.

This lesson builds on ideas developed in the two prior lessons in which students planned and conducted investigations to explore patterns in the properties of solid and liquid materials. In this lesson, students are presented with a problem and record data as they test the use of materials with different properties to solve the problem. Students collect and analyze more data to determine the materials that can be used to solve the problem and to explain the properties of the materials that made them suited for the solution. Students use what they have learned in this lesson to add to their engineering design plan. In Lesson 4: Reversible and Irreversible Changes, students learn to make a claim based on evidence that they gain from exploring the reversible and irreversible changes caused by heating or cooling matter.

Lesson 4: Reversible and Irreversible Changes
Investigative Phenomenon: The corn kernel changed after it went into the hot air popper.

In Lesson 3: Different Properties for Different Purposes, students investigated the use of materials for different purposes depending upon their properties. In this lesson, students learn to construct a claim based on evidence they observe from exploring the reversible and irreversible changes that are caused by heating or cooling different substances. In Lesson 5: The Great Wax Disaster, students build on their new understandings as they return to the anchoring phenomenon of observing misshapen objects in order to develop a plan to change the shape of a piece of chocolate.

Lesson 5: The Great Wax Disaster
Investigative Phenomenon: Crayons are made of wax in a shape we can hold with our fingers. Birthday candles are made of wax in a shape that we can put on a cake. Lip balm is made of wax in a shape that we can apply to our lips.

In Lesson 4: Reversible and Irreversible Changes, students constructed a claim based on evidence as they explored the reversible and irreversible changes that are caused by heating or cooling different substances. In this final lesson, students return to the observable part of the anchoring phenomenon in order to develop a plan to support their understanding from Lesson 4: Reversible and Irreversible Changes that the changes that occurred to the misshapen objects are reversible or irreversible. Students use a design process and the Engineering Planning Sheet to develop a plan, compare plans with others, and collaboratively revise their
plans. After conducting the investigation, students use their data to write a claim of how and if solid objects can be turned into a different shape. From their experiences with properties of materials and whether properties of materials are affected by heating and cooling, the students are now able to explain the phenomena of the misshapen objects.

Learning Sequence 3-Dimensional Progressions

SEP Progression

Only SEPs that have a strong progression are detailed here. While other SEPs are included in the sequence and important to the lesson in which they are used, they are not outlined here if they did not appear in multiple lessons.

<table>
<thead>
<tr>
<th>SEP PROGRESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asking Questions and Defining Problems</strong></td>
</tr>
<tr>
<td>Lessons 1 and 2</td>
</tr>
<tr>
<td>Lesson 3</td>
</tr>
<tr>
<td>Lesson 4</td>
</tr>
<tr>
<td>Lesson 5</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Planning and Carrying Out Investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1</td>
</tr>
<tr>
<td>Lesson 2</td>
</tr>
<tr>
<td>Lesson 3</td>
</tr>
<tr>
<td>Lesson 4</td>
</tr>
<tr>
<td>Lesson 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analyzing and Interpreting Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1</td>
</tr>
<tr>
<td>Lesson 2</td>
</tr>
</tbody>
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## Learning Sequence 3-Dimensional Progressions (continued)

**SEP PROGRESSION**  (continued)

### Analyzing and Interpreting Data (continued)

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Description</th>
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<tbody>
<tr>
<td>Lesson 3</td>
<td>Students represent data in tables and/or various graphical displays to reveal patterns that indicate relationships.</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>Students record information (observations).</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>Students record information and use their firsthand observations to describe relationships in the natural and designed worlds in order to answer scientific questions about reversible and irreversible changes in matter.</td>
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### Engaging in Argument from Evidence

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Description</th>
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<tbody>
<tr>
<td>Lesson 3</td>
<td>Students make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence in order to state which properties of materials are best suited for a purpose.</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>Students use evidence to agree or disagree with claims about reversible and irreversible changes.</td>
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</table>

### Constructing Explanations and Designing Solutions

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 3</td>
<td>Students use information from observations to construct an evidence-based account of the properties that caused a solution to a problem to work and compare multiple solutions to a problem.</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>This practice is in the background of the lesson.</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>Students use observational evidence to write and support a claim about irreversible and reversible changes.</td>
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</tbody>
</table>

### Obtaining, Evaluating, and Communicating Information

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1</td>
<td>Students communicate information about the investigation plans and their data analysis and present information about observed properties.</td>
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<tr>
<td>Lessons 2 and 3</td>
<td>This practice is in the background of the lesson.</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>Students communicate the observations and cause-and-effect relationships they determine during an investigation.</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>Students write and communicate a claim supported by evidence about reversible and irreversible changes.</td>
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**DCI PROGRESSION**

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<thead>
<tr>
<th>Lesson</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Lesson 1</td>
<td>Prior knowledge of everyday interactions with properties of matter. Solid matter can be described and classified by its observable properties. (PS1.A, ETS1.A)</td>
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<tr>
<td>Lesson 2</td>
<td>Liquid matter can be described and classified by its observable properties. Different kinds of matter exist, and many of them can be either solid or liquid. (PS1.A)</td>
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<tr>
<td>Lesson 3</td>
<td>Different properties are suited to different purposes. (PS1.A, ETA1.C)</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>Different kinds of matter exist, and many of them can be either solid or liquid, depending upon the temperature. Heating or cooling a substance may cause changes that can be observed. Some changes are reversible and some are not. (PS1.A, PS1.B)</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>Heating or cooling a substance may cause changes that can be observed. Some changes are reversible and some are not. (PS1.B, ETA1.A, ETA1.C)</td>
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</tbody>
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**CCC PROGRESSION**

**Patterns**

| Lessons 1–5 | Students use patterns in their observations as evidence to describe phenomena related to the properties of different kinds of matter. Students continue to use observed patterns when matter changes to determine and describe reversible and irreversible changes. |

**Cause and Effect**

| Lesson 3 | Students gather evidence to determine that events have causes and to support or refute student ideas about causes. |
| Lessons 4–5 | Students continue to explore the cause-and-effect relationships in reversible and irreversible changes in matter. |

**Structure and Function**

| Lesson 3 | Students observe that the shape and stability of structures of natural and designed objects are related to their function. |

**Energy and Matter**

| Lessons 4–5 | Students explore matter to determine that objects may change shape. |
Assessment System

The Grade 2: Matter unit provides multiple and ongoing strategies for teachers to assess student understanding as they progress toward mastery of Performance Expectations. These include:

- The Student Question Chart is referred to in each lesson. The Student Question Chart allows you to assess the sophistication of students’ prior knowledge, student questions, and student-generated responses as they progress through the unit.

- Science notebooks are used in each lesson. Student responses in the science notebook allow you to informally assess student progress. Expected Student Responses (ESRs) are used throughout the unit to guide you in the types of responses students may provide.

- Students’ oral language is an opportunity to assess their emerging understanding. You are encouraged to jot down students’ oral language and use it to inform instruction.

- The Engage stage of the 5E instructional model provides an opportunity for you to assess students’ prior knowledge. In Lesson 2: Properties of Liquids through Lesson 5: The Great Wax Disaster, a graphic representation of student thinking is used in the Engage stage and will be added to each subsequent learning sequence in this unit.

- The Evaluate stage of the 5E instructional model also provides an opportunity for you to more formally assess student progress. This is the point in instruction where you will make a decision as to whether students are ready to move forward or need additional interventions and accommodations.

- Rubrics for both you and the students are provided when appropriate and serve as an example of how to assess student progress. Throughout the unit, a flag (▶) denotes formative assessment opportunities where you may change instruction in response to students’ level of understanding and emergent sense-making of phenomena.

- The term Expected Student Response (ESR) offers a formative assessment opportunity as well. An ESR is what you can reasonably expect to be the students’ response to questions, prompts, activities, etc. The rationale for the inclusion of ESRs is to identify and assist you with the types of responses to expect and accept from students. Student language will be used to build toward scientific explanations as learning progresses. Note: ESRs are not the only possible student responses, and you should not provide the ESRs to the students. ESRs will be italicized.
Scaffolds for Students with Reading and Writing Difficulties

1. Have students speak their answers instead of writing them.
   View the Voice to Text video (https://www.youtube.com/watch?v=Hq6eLFnwzsI) which would allow a student to speak their answer and have it converted to text.
   Student Instructions:
   • Click on Tools and scroll down to Voice Typing. When you are ready to speak, click on the microphone.
   • When you are finished speaking, click on the microphone again.
   • Your teacher will be able to read your ideas!

2. Have students use Screencastify (https://www.screencastify.com/) to record themselves responding to a task.
   Students can create a digital science notebook that can be a combination of images and student recordings. Students can record themselves sharing what they observed/saw, thought/wondered, and learned during or after an experience.

3. Before reading aloud a book, do a picture walk. During a picture walk the text and graphics features of the book are identified and discussed. Special attention is given to the photographs or illustrations since many times the elements of the story can be predicted through the visuals. This preview helps students to understand the content of the text when it is read.
   This support can assist English Learners or students with reading difficulties by allowing time to activate prior knowledge and discuss new vocabulary.

References


Grade 2 Matter Conceptual Flow

**Anchoring Phenomenon**

Materials are made of matter. We can observe misshapen objects, including a crayon, lip balm, and a candle.

Matter has properties. Matter can be changed in many ways.

**Investigative Phenomenon**

Objects, such as a crayon, a candle, lip balm, and other objects in the classroom, look and feel different from one another.

Water poured from one container to a different container takes the shape of the new container.

Crayon marks are difficult to remove from school surfaces. I wonder what materials would work best to remove them.

The corn kernel changed after it went into the hot air popper.

Crayons are made of wax in a shape we can hold with our fingers. Birthday candles are made of wax in a shape that we can put on a cake. Lip balm is made of wax in a shape that we can apply to our lips.

Matter can be described and classified by its properties and uses. Matter keeps its shape depending upon temperature.

The properties of different types of matter are useful for making things suitable for different purposes.

We know matter has changed because its properties are different. One way to change matter is by changing its shape. Heating and cooling affect matter.

Changes can happen quickly or slowly. Some changes caused by heating or cooling can be reversed. Some changes caused by heating or cooling are irreversible.

Planning and carrying out investigations

Planning and carrying out investigations

Analyzing and interpreting data

Engaging in argument from evidence

Planning and carrying out investigations

Constructing explanations and designing solutions

Constructing explanations and designing solutions

Engaging in argument from evidence

Asking questions and defining problems

Patterns

Cause and Effect

Structure and Function

Energy and Matter

A project of CA NGSS K-8 Early Implementation Initiative.