

NGSS Support Guide

Publisher	Kit Title
FOSS	Solids and Liquids

Background

In 2013 the Washington State Legislature adopted the *Next Generation Science Standards* as the 2013 Washington State Science Learning Standards. The *Next Generation Science Standards* are built upon a “three-dimensional” vision of science learning that exists at the intersection of the *Science and Engineering Practices*, the *Crosscutting Concepts*, and the *Disciplinary Core Ideas*. The Office of the Superintendent of Public Instruction established a multi-year transition timeline and plan to achieve full implementation by the Spring of 2018. Informed by this transition plan, regional LASER science materials centers decided to bring together experienced teachers to provide guidance to those who shared their instructional materials about how best to begin moving to this new paradigm of science learning while still using their existing instructional materials. This guide is one product of that work.

What this Guide Is

The writers of this guide want to help you put the kids in the driver’s seat of engaging in science – a key shift in the *Next Generation Science Standards*. They intend this guide to provide you with ideas on how best to build student capacity to work as a scientist or engineer using the *Science and Engineering Practices*; on how best to think about the learning by engaging students in using the *Crosscutting Concepts*; and all while engaging in the content ideas that already exist within this instructional material.

This guide does not align this instructional material to the Next Generation Science Standards, but it assists teachers in aligning instruction and student experiences with the goals of the Next Generation Science Standards. **This guide does not** represent a re-write of the instructional material, neither does it present newly-developed material. It is meant to help you adjust your use of your existing unit toward a more “three-dimensional” approach to learning. It is strongly recommended that you have an understanding of the shifts envisioned by the NGSS by familiarizing yourself with the [Framework for K-12 Science Education](#). If you would like more information on the Disciplinary Core Ideas that are the focus of the Solids and Liquids kit, please read [Physical Science Core Idea PS1.A](#) as well as PS1.B

Directions for Using this Guide

Before teaching this unit, please refer to the NGSS Transition Support Guide to review the *Science and Engineering Practices* and *Crosscutting Concepts* for each investigation. The guide highlights what the teacher and student does in each investigation to support the *Science and Engineering Practices* and *Crosscutting Concepts* that are already implicit in the instructional materials. If you need support on using *Science and Engineering Practices* refer to [Appendix F](#) and for *Crosscutting Concepts* refer to [Appendix G](#) in the *Next Generation Science Standards*.

Be aware that most early elementary students associate solids with being rigid or difficult to bend materials, and liquids as substances that are able to be poured. In order to combat misconceptions and create enduring understanding, it's very important to expose students to a large variety of solids, liquids and even present them with materials that are not easily categorized to challenge and extend their thinking. Many students will accept solids as matter but may have difficulty with liquids.

Heads-Up/

Things you might need in order to use this guide

Science notebooks are encouraged for all instruction in science. If you would like information on using science notebooks in the classroom, refer to the FOSS Folio included in your teacher guide or visit the LASER Science Notebooking website at www.sciencenotebooks.org. The guide references the use of Page Keeley's Formative Assessment Probes for Uncovering Student Ideas in Primary Science (2013 NSTA Press). Check in your school or district science library, or contact your Science Materials Center for this resource.

The guide suggests several adaptations to Investigation 4. In particular, the suggestion for engaging students using Oobleck and the associated literature. Please be sure to follow safety and allergy guidelines with this adaptation. Most notably, investigation 4 has been adapted to include a written performance assessment. If you are unfamiliar with Claims-Evidence-Reasoning (CER) as a method for writing in science, please contact your Science Leadership teacher or Regional Science Coordinator.

For More Information

If you have questions about this guide or its content, please direct your inquiry to your science materials center.

NGSS Transition Support Guide – FOSS Template

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Investigation 1	Classroom Instruction	Science and Engineering Practice	Crosscutting Concept	Helpful Modifications
Solids	What the student does – Overview	<p>Asking Questions</p> <p>Before the first lesson, engage students the topic ‘Solids, Liquids & Gasses’. Show them a frozen popsicle and a melted popsicle and ask what the differences and similarities are. Take students on a scavenger hunt for states of matter and in pairs document their observations and questions in their science notebooks. Each pair should record 5 solids, 5 liquids, and as many gasses as they can find.</p>	<p>Patterns</p> <p>Patterns in the natural world can be observed and used as evidence to describe phenomena.</p>	<p>Core Idea Question</p> <p>What do all solids have in common? What properties of solids can be used to sort them? (PS1.A)</p> <p>Use the Page Keeley probe “Is it matter?” (Keeley, 2013, pg 53). Allow time for students to discuss their initial reasoning. It’s very important not to correct the probes or the students’ initial categorizations of observations.</p>
1.1 Introduce Solids	What the student does	<p>Planning and Conducting Investigations</p> <p>Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. Students record properties of solids using Properties of Solid Object sheet.</p>	<p>Patterns</p> <p>Students explore and observe solids looking for patterns to understand the properties that are common to all solids.</p>	<p>In a group meeting, have students share their recorded observations and transpose onto the class Properties of Solids chart. (CCSS – ELA S/L Grade 2: Participate in collaborative conversations with diverse partners about <i>grade 2 topics and texts</i> with peers and adults in small and larger groups.)</p>
1.2 Sort Solid Objects	What the student does	<p>Constructing Explanations</p> <p>Students play the sorting game and use their understanding of properties of solids as evidence for explaining their sorting rule.</p>	<p>Patterns</p> <p>Students apply properties of solids to understand the patterns that are common to all solids.</p>	<p>As an extension to the Sorting Game have students find/ bring an object from their backpack/ home. Have students play the sorting game again in a whole group setting. In group discussion, add students’ sorting</p>

				rules to the Properties of Solids Chart.
1.3 Construct with Solids	What the student does	<p>Designing Solutions</p> <p>Students use a design process to construct a tower based on defined criteria and constraints. How do the properties of solids relate to their use? (What properties of the building materials make it good for the tallest/strongest tower?)</p>	<p>Cause and Effect</p> <p>Students test their designs to gather evidence to support or refute which design is the best solution to the problem.</p>	<p>Engineering Modification</p> <p>Use an engineering design process to guides students through developing their solution. Have students work in groups of 2-3 to brainstorm a design, sketch it, build and then present to the class.</p> <p>Engineering in the NGSS</p> <p>Use CCSS 2.MD.D.10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Have students create a bar graph showing the height of each group's tower.</p>
Throughout the investigation:	What the teacher does	<ul style="list-style-type: none"> • Generate interest and curiosity in the subject by presenting engaging examples. As the instructor do not provide definite answers. • Asks probing, open-ended questions to redirect students and press for explanation. • Observe and assess students as they use practices to apply learning. 	<ul style="list-style-type: none"> • Use the common language of patterns, and cite when patterns occur in other subjects. This will help to strength the crosscutting nature of patterns and help students' transfer new learning. 	<ul style="list-style-type: none"> • Before starting unit, have students set up their science notebooks. Devise a classroom chart to record properties of solids and keep posted throughout the unit. • Read <i>'Everything Matters'</i> from FOSS Science Stories or another text, such as <i>'Wemberly's Ice Cream Star'</i> by Kevin Henkes, after Investigation 1.

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Investigation 2	Classroom Instruction	Science and Engineering Practice	Crosscutting Concept	Helpful Modifications
Liquids	What the student does – Overview	Asking Questions At this point, anchor the lesson by drawing a class chart to begin to compare and contrast solids & liquids.	Patterns Patterns in the natural world can be observed and used as evidence to describe phenomena, such as how solids behave as liquids even though they are not.	Core Idea Question What do all liquids have in common? What properties of liquids can be used to sort them? (PS1.A)
2.1 Liquids in Bottles	What the student does	Analyzing and Interpreting Data Students are engaged in observing liquids in the bottles. They will use these observations to describe patterns in the properties of liquids.	Patterns Patterns in the traits and behavior of liquids are observed. Students will also be using these patterns to compare liquids to solids.	This investigation part is best structured as a center. Students should record information in their science notebooks as they engaged in exploring the liquids. Create a simple template listing the liquid, space for a picture, and a word or two that students write to describe each liquid.
2.2 Properties of Liquids	What the student does	Obtaining, Evaluating and Communicating Information Students are engaged in developing precise academic vocabulary during this investigation. They are obtaining information about properties of liquids, evaluating when to apply these descriptions to examples and communicating with peers as the use the language during the games.	Patterns Patterns in the traits and behavior of liquids are observed.	Use the <i>Properties of Liquids</i> student sheet as you demonstrate the liquids with the class. Display a copy on the overhead and have students glue a copy into their notebooks so that they can record properties as you demo. After playing the games, review with students how liquids can be sorted by these properties. Add terms to glossary.

<p>2.3 Liquid Level</p>	<p>What the student does</p>	<p>Planning and Conducting Investigations</p> <p>To support student thinking toward planning an investigation, pose the question “what might we find out by observing the ways that liquids behave in bottles?”</p>	<p>Cause and Effect</p> <p>Cause and effect relationships can be used to explain change.</p>	<p>This <i>Liquid Level in a Bottle</i> student sheet presents an opportunity to have students develop spatial reasoning skills. Copy double sided. As you introduce the activity, have students predict by visualizing what will happen to the liquid in the bottle and draw this onto the sheet. As students visit the center they can conduct the investigation and check against their prediction.</p> <p>As an extension students could design a 2 dimensional container shape and predict how the liquid would behave in that container.</p>
<p>Throughout the investigation</p>	<p>What the teacher does</p>	<ul style="list-style-type: none"> Models making observations and describing properties. Teacher can model with class observing and describing liquid in 1 bottle before students visit center. 	<ul style="list-style-type: none"> Use language of pattern and comparison. 	<ul style="list-style-type: none"> Read <i>‘Solids and Liquids’</i> from FOSS Science Stories. As you read, create a class T-chart that models the differences in solids and liquids. Use Math Problem A after Part 3 to support CCSS 2.MD.D.10 (pg 28).

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Investigation 3	Classroom Instruction	Science and Engineering Practice	Crosscutting Concept	Necessary Modifications
Bits and Pieces	What the student does – Overview	<p>Asking Questions and Defining Problems</p> <p>Engage the students prior to Investigation 2 by showing them a solid such as sugar or sand compared to a liquid like water or vegetable oil. Pour both substances back and forth between two containers and have students pose questions about their similarities and differences.</p>	<p>Scale, Proportion and Quantity</p> <p>Relative scales allow objects to be compared and described (bigger and smaller, faster and slower, etc.)</p>	<p>Core Idea Question</p> <p>How are solids and liquids different and similar to each other? How can we use properties to determine if something is solid or liquid?</p> <p>Introduce Box and T-Chart to record information.</p>
3.1 Solids in Containers	What the student does	<p>Analyzing and Interpreting Data</p> <p>Students are observing and interacting with the small solids. Students should record their observations in their notebooks so that they can refer to this as evidence later.</p>	<p>Scale, Proportion and Quantity</p> <p>Smaller particles affect the way a solid behaves. Students will be able to discuss that the small solids can be poured, but do not spread the way liquids do. Small solids can be piled up, liquids cannot.</p>	As opposed to the vocabulary suggested in the Investigations guide, focus vocabulary on Tier 2 words associated with properties of small solids: powdery, lumpy, grainy, etc.
3.2 Separating Soup Mix	What the student does	N/A	N/A	In the interest of time, this part of the investigation can be skipped. Alternatively, teachers could choose to modify the investigation into an engineering design problem by giving students the challenge of devising a way to filter solids of the same size using a set assemblage of materials.

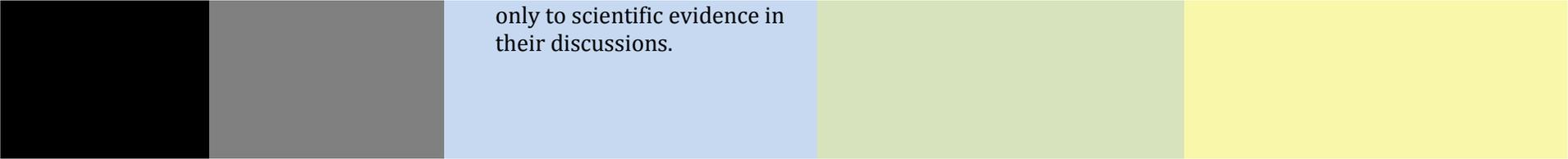
				Pose the question, What are some things you can think of that are composed of different bits and pieces?
3.3 Solids in Bottles	What the student does	Analyzing and Interpreting Data Students are observing and interacting with the small solids. Students should record their observations in their notebooks so that they can refer to this as evidence later.	Scale, Proportion and Quantity Smaller particles affect the way a solid behaves. Students will be able to discuss that the small solids can be poured, but do not spread the way liquids do. Small solids can be piled up, liquids cannot.	Prior to this lesson, take a moment to revisit what the class has learned about the properties of solids and liquids. Make a class prediction about how solid particles will move in the bottles. Use a sentence frame and have student record this in their notebooks prior to conducting the investigation.
3.4 Separating Beads with a Screen	What the student does	N/A	N/A	Again, this lesson could be skipped or adapted to an engineering design problem. The Language Extension on pg. 28 of the Investigations Manual is an effective use of this time and serves to summarize the big ideas in the first three investigations. Pose the question, When would you need to separate solids?
Throughout the investigation:	What the teacher does	<ul style="list-style-type: none"> • Use language that supports scientific practices (investigation instead of experiment). • Prepares templates for inclusion in student science notebooks for recording data. 	<ul style="list-style-type: none"> • Uses a content chart and word bank in order to reinforce and organize the concepts in the unit. • Poses questions related to the crosscutting concepts to reveal student understanding and transfer of learning between solids and liquids. 	

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Investigation 4	Classroom Instruction	Science and Engineering Practice	Crosscutting Concept	Necessary Modifications
Solids and Liquids with Water Making Oobleck	What the student does – Overview	Constructing Explanations Engage students by pretending that the prior night as you were cooking you accidentally spilled some water onto corn starch. Demonstrate this in front of the class. Ask students to describe their observations as the material changes. Say that the best way for them to explain what this material is will be to create some themselves.	Cause and Effect Simple tests can be designed to gather evidence to support or refute student’s ideas about whether the material is a solid or liquid- or both!	<ul style="list-style-type: none"> Oobleck is messy but really fun for students. There are plenty of safe recipes on the internet. Be sure not to pour any down your drains as it will clog and check for any food allergies. Have students use a Claims-Evidence writing frame to construct their final explanations. Read “Bartholomew and the Oobleck” by Dr. Suess.
4.1 Solids and Water	What the student does	Analyzing and Interpreting Data Students are observing their investigations and recording incidences of change. They should graph these changes according to procedure on pg. 13.	Stability and Change Some things stay the same while others change.	<ul style="list-style-type: none"> Paste student sheets “Solid Materials in Water” into science notebooks.
4.2 Liquids and Water	What the student does	Analyzing and Interpreting Data Students are observing their investigations and recording incidences of change.	Stability and Change Some things stay the same while others change.	<ul style="list-style-type: none"> Paste “Liquid with Water” sheets into student notebooks. Read ‘Mix it Up’ from FOSS Science Stories.

<p>4.3 Toothpaste Investigation</p>	<p>What the student does</p>	<p>Engaging in Argument from Evidence</p> <p>Students conduct the investigation, and then identify arguments that are based in evidence. Students analyze the evidence and its relevance to the question, Is toothpaste a solid or a liquid? They listen actively to arguments and indicate agreement/disagreement based on evidence.</p>	<p>Patterns</p> <p>Students use their knowledge of the properties of solids and liquids to determine which pattern the toothpaste best fits, or if it does not fit the pattern at all.</p>	<ul style="list-style-type: none"> • Have students engage in a science meeting where they present their claims and evidence. • Before the <i>Ice Cream Soup</i> lesson invite students to think about baking mixtures. Are these mixtures things that you can separate them once mixed? Students can also separate the ingredients by their state of matter.
<p>4.4 Ice Cream Soup</p>	<p>What the student does</p>	<p>Planning and Conducting Investigations</p> <p>Pose the question “Is it possible to turn a liquid into a solid? What about changing a solid into a liquid?” Brainstorm a list of examples and non-examples of changing states of matter.</p>	<p>Stability and Change</p> <p>Some things stay the same while others change.</p>	<ul style="list-style-type: none"> • Make ice cream with the class following a simple procedure. Suggestions include “Freezing and Melting” from Even More Picture-Perfect Science Lessons, or example Engineering integration from “Inviting Engineering into the Science Lab” from NSTA Science and Children, Vol 52, No 7, pg 33. • Read FOSS Science Stories “Solids to Liquids and Back Again” after the ice cream activity.
<p>Throughout the Investigation:</p>	<p>What the teacher does</p>	<ul style="list-style-type: none"> • Uses Claims-Evidence language and provides scaffolds for using this method of constructing a scientific explanation. • Engages students in academically productive talk by encouraging them to be respectful of each other’s time and statements, and refer 	<ul style="list-style-type: none"> • Uses a content chart and word bank in order to reinforce and organize the concepts in the unit. • Poses questions related to the crosscutting concepts to reveal student understanding and transfer of learning between solids and liquids. 	<ul style="list-style-type: none"> • ReadWorks “Breakfast Time” (Lexile 490) passage and questions supports the idea of changes in states of matter from solid to liquid. • Here is a song on YouTube explaining the three states of matter. https://youtu.be/fhhFwdJqvw



only to scientific evidence in
their discussions.