**Grade 2 Model Science Unit 2: Properties of Matter** (draft 1.27.16) **Instructional Days: 20**

| Unit Summary |
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| ***How do the properties of materials determine their use?***<br><br>In this unit of study, students demonstrate an understanding of observable properties of materials through analysis and classification of different materials. The crosscutting concepts of patterns, cause and effect, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in planning and carrying out investigations and analyzing and interpreting data. Students are also expected to use these practices to demonstrate understanding of the core ideas. |
| **Student Learning Objectives** |
| **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)** |

**Quick Links**

| **Unit Sequence** | |
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| **Part A:** ✓ *How can we sort objects into groups that have similar patterns?*<br>✓ *Can some materials be a solid or a liquid?* | |
| **Concepts** | **Formative Assessments** |
| • Patterns in the natural and human-designed world can be observed.<br>• Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature.<br>• Matter can be described and classified by its observable properties. | *Students who understand the concepts can:*<br>• Observe patterns in the natural and human-designed world.<br>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.<br>• Plan and conduct an investigation to describe and classify different kinds of material by their observable properties.<br>✓ Observations could include color, texture, hardness, and flexibility.<br>✓ Patterns could include the similar properties that different materials share. |

| **Unit Sequence** | |
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| **Part B:** What should the three little pigs have used to build their houses? | |
| **Concepts** | **Formative Assessments** |
| • Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.<br>• Simple tests can be designed to gather evidence to support or refute student ideas about causes.<br>• Different properties are suited to different purposes.<br>• Because there is always more than one possible solution to a problem, it is useful to compare and test designs. | *Students who understand the concepts can:*<br>• Design simple tests to gather evidence to support or refute student ideas about causes.<br>• Analyze data from tests of an object or tool to determine if it works as intended.<br>• Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. (Assessment of quantitative measurements is limited to length.) Examples of properties could include:<br>✓ Strength<br>✓ Flexibility |

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| | ✓ Hardness<br>✓ Texture<br>✓ Absorbency<br>• Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of each. |

**What It Looks Like in the Classroom**

In this unit of study, students look for patterns and cause-and-effect relationships as they describe and classify materials using physical properties. In addition, students collaboratively plan and carry out investigations and analyze and interpret data in order to determine which materials are best suited for an intended purpose.

In the natural world, different types of matter exist, and all matter can be described and classified according to physical properties. To begin this unit's progression of learning, students plan and conduct investigations to describe different kinds of material using observable properties. They will collect data during these investigations; analyze the data to find patterns, such as similar properties that different materials share; and use the data to classify materials. Materials can be classified by color, texture, hardness, flexibility, or state of matter. For example, students can explore hardness of rocks by shaking them in containers to see how easily they break apart. They can explore viscosity by pouring a set amount of various liquids, such as glue, oil, and water from one container to another to observe the relative speed that each flows. Students can also heat or cool a variety of materials, such as butter, chocolate, or pieces of crayon, in order to determine whether or not these materials can be either solid or liquid depending on temperature.

Because every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world, it is important that students understand that different properties are suited to different purposes. After investigating and classifying a variety of materials based on their physical properties, students will engage in the engineering design process. Students can work collaboratively, with adult guidance, to test different materials to determine which have properties that are best suited for an intended purpose. For example, this project could be launched using the children's story, *The Three Little Pigs*. After reading the story, students would:

- ✓ Investigate the physical properties of straw, sticks, and bricks in order to determine what properties make bricks the material best suited for building a house.
- ✓ Work together to brainstorm a list of possible structures that could be built with different materials. For example, students could build bridges or simple roller coasters for marbles.
- ✓ Select one structure from the list and determine the intended purpose of that structure.
- ✓ Select two or three different materials that could be used to build the structure.
- ✓ Investigate the physical properties of the materials, including shape, strength, flexibility, hardness, texture, or absorbency.
- ✓ Collect and analyze data to determine whether or not the given materials have properties that are suited for the intended purpose of the selected structure.
- ✓ In groups, use one of the materials to build the structure. (Teachers should have different groups use different materials.)
- ✓ Test and compare how each structure performs. Because there is always more than one possible solution to a problem, it is useful to compare the strengths

and weaknesses of each structure and each material used.

*Integration of engineering*

In this unit, students investigate the physical properties of a variety of materials, and then build a structure with materials that are best suited for the structure's intended purpose. This process is outlined in greater detail in the previous section.

**Connecting with English Language Arts/Literacy and Mathematics**

*English Language Arts*

The CCSS for English Language Arts can be incorporated in this unit in a number of ways. Students can participate in shared research, using trade books and online resources, to learn about the properties of matter. As students explore different types of materials, they can record their observations in science journals, and then use their notes to generate questions that can be used for formative or summative assessment. Students can add drawings or other visual displays to their work, when appropriate, to help clarify their thinking. To teach students how to describe how reasons support specific points an author makes in a text, teachers can model the comprehension skill of main idea and details using informational text about matter. Technology can be integrated into this unit of study using free software programs (e.g., Animoto) that students can use to produce and publish their writing in science.

*Mathematics*

Throughout this unit of study, students have opportunities to model with mathematics and reason abstractly and quantitatively. During investigations, students can collect and organize data using picture graphs and/or bar graphs (with a single-unit scale). This can lead to opportunities to analyze data and solve simple put together, take-apart, and compare problems using information presented in these types of graphs. Some examples of ways to sort and classify materials in order to create graphs include:

- ✓ Classifying materials as solids, liquids, or gases.
- ✓ Classifying materials by color, shape, texture, or hardness.
- ✓ Classifying materials based on what they are made of (e.g., wood, metal, paper, plastic).
- ✓ Classifying materials based on potential uses.

With any graph that students create, they should be expected to analyze the data and answer questions that require them to solve problems.

**Modifications**

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

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

helping with a project, journal articles, and biographies).

- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

| **Research on Student Learning** |
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| N/A |

| **Prior Learning** |
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| **Kindergarten Unit 1: Pushes and Pulls** (engineering practices)<br>• A situation that people want to change or create can be approached as a problem to be solved through engineering.<br>• Asking questions, making observations, and gathering information are helpful in thinking about problems.<br>• Before beginning to design a solution, it is important to clearly understand the problem.<br>• Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. |

| **Future Learning** |
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| **Grade 5 Unit 1: Properties of Matter**<br>• Measurements of a variety of properties can be used to identify materials. *(Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)*<br>• Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. |

- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.

**Grade 5 Unit 2: Changes to Matter**

- When two or more different substances are mixed, a new substance with different properties may be formed.
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. *(Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)*

| Connections to Other Units |
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| N/A |

| Sample of Open Education Resources |
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Exploring Reversible Changes of State and Exploring Irreversible Changes of State: These two lessons work together to explore reversible and irreversible changes of state through guided investigations. The PDF is a set of activities focusing on materials followed by some optional post-activity lessons.

Discovering Science: classifying and categorizing (matter, grades 2-3): This resource is a day, or longer, lab activity aimed for second and third grade students. The lesson starts with a guided discussion and an activity identifying and classifying materials, then it guides students through a series of observations of mixing and changing different materials of different states and observing the resulting effects. Overall, the lesson targets the states of matter, and forces and motion. Some of the ideas (i.e., gas and energy) are aimed at the third grader and beyond. Please note that the link above goes to a larger set of activities and you need to click on the link Discovering science: Classifying and categorizing matter grades 2-3.

Materials and Their Properties, lessons Comparing the Properties of Different Materials (pp. 22); and Exploring Thermal Insulators and Conductors (pp. 23): Students participate in an open-ended sort using various materials. Based on their self-selected categories, students explain their reasoning. Next, through a fair test trial, students use new information to decide, using evidence, which material is best suited for maintaining cold the longest.

The Properties of Materials and their Everyday Uses: This wonderful set of lessons engage students in testing materials to understand their properties and discuss appropriate uses for the materials based on those properties. For example, one activity has the students examining the materials that a number of balls are made out of (plastic, rubber, aluminum, etc.) and describing the properties of the materials (light, stretchy, rigid). Next, the students test balls made of those materials for bouncing height and record their data. The students discuss which materials are best for bouncing and why. The teacher could choose to do all of the activities and have a robust alignment with the three dimensions of the NGSS PS1-2, an engineering physical science Performance Expectation.

Matter song a music video by untamed Science: This is an engaging music video that defines and gives examples of matter. The video is fun, colorful and explores many different kinds of matter as part of the music video sequence. Young students will love the song and the interactive dance sequences.

Science Games For Kids: Properties of Materials: This resource is an interactive simulation designed to have students test various materials for different properties including flexibility, strength, waterproof, and transparency. The simulation includes a workshop where students can select different materials to see if the selected property matches the intended use.

| **Teacher Professional Learning Resources** |
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| **Using the NGSS Practices in the Elementary Grades**<br><br>The presenters were Heidi Schweingruber from the National Research Council, Deborah Smith from Penn State University, and Jessica Jeffries from State College Area School District. In this seminar the presenters talked about applying the scientific and engineering practices described in A Framework for K–12 Science Education in elementary-level classrooms.<br><br>Continue the discussion in the community forums.<br><br>**Teaching *NGSS* in K-5: Constructing Explanations from Evidence**<br><br>Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the NGSS for K-5th grade. The web seminar focused on the three dimensional learning of the NGSS, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena.<br><br>View the resource collection.<br><br>Continue discussing this topic in the community forums.<br><br>**NSTA Web Seminar: NGSS Core Ideas: Matter and Its Interactions**<br><br>Dr. Krajcik began the presentation by defining disciplinary core ideas and discussing the value of using core ideas to build understanding across time. He also talked about the way disciplinary core ideas work together with the other components of *NGSS*: scientific and engineering practices and crosscutting concepts. The program featured strategies for teaching about physical science concepts that answer questions such as "How do particles combine to form the variety of matter one observes?" and "How do substances combine or change (react) to make new substances?" Dr. Krajcik talked about the disciplinary core ideas for Properties of Matter and shared examples of student work. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.<br><br>View the the resource collection.<br><br>Continue discussing this topic in the community forums. |

| **Appendix A: NGSS and Foundations for the Unit** | | |
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| **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)** | | |
| The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*: | | |
| **Science and Engineering Practices** | **Disciplinary Core Ideas** | **Crosscutting Concepts** |
| **Planning and Carrying Out Investigations**<br>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.(2-PS1-1)<br>**Analyzing and Interpreting Data**<br>• Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2)<br>**Analyzing and Interpreting Data**<br>• Analyze data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3) | **PS1.A: Structure and Properties of Matter**<br>• 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)<br>• Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3)<br>• A great variety of objects can be built up from a small set of pieces. (2-PS1-3)<br>**ETS1.C: Optimizing the Design Solution**<br>• 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**<br>• Patterns in the natural and human designed world can be observed. (2-PS1-1)<br>**Cause and Effect**<br>• Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)<br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<br>***Connections to Engineering, Technology, and Applications of Science***<br>**Influence of Engineering, Technology, and Science, on Society and the Natural World**<br>• 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) |

| English Language Arts | Mathematics |
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| Describe how reasons support specific points the author makes in a text. (2-PS1-2) **RI.2.8**<br><br>With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-3) **W.2.6**<br><br>Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1),(2-PS1-2) **W.2.7**<br><br>Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1),(2-PS1-2),(K-2-ETS1-3) **W.2.8** | Reason abstractly and quantitatively. (2-PS1-2), (K-2-ETS1-3) **MP.2**<br><br>Model with mathematics. (2-PS1-1),(2-PS1-2, (K-2-ETS1-3)) **MP.4**<br><br>Use appropriate tools strategically. (2-PS1-2), (K-2-ETS1-3) **MP.5**<br><br>Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-PS1-1),(2-PS1-2), (K-2-ETS1-3) **2.MD.D.10** |