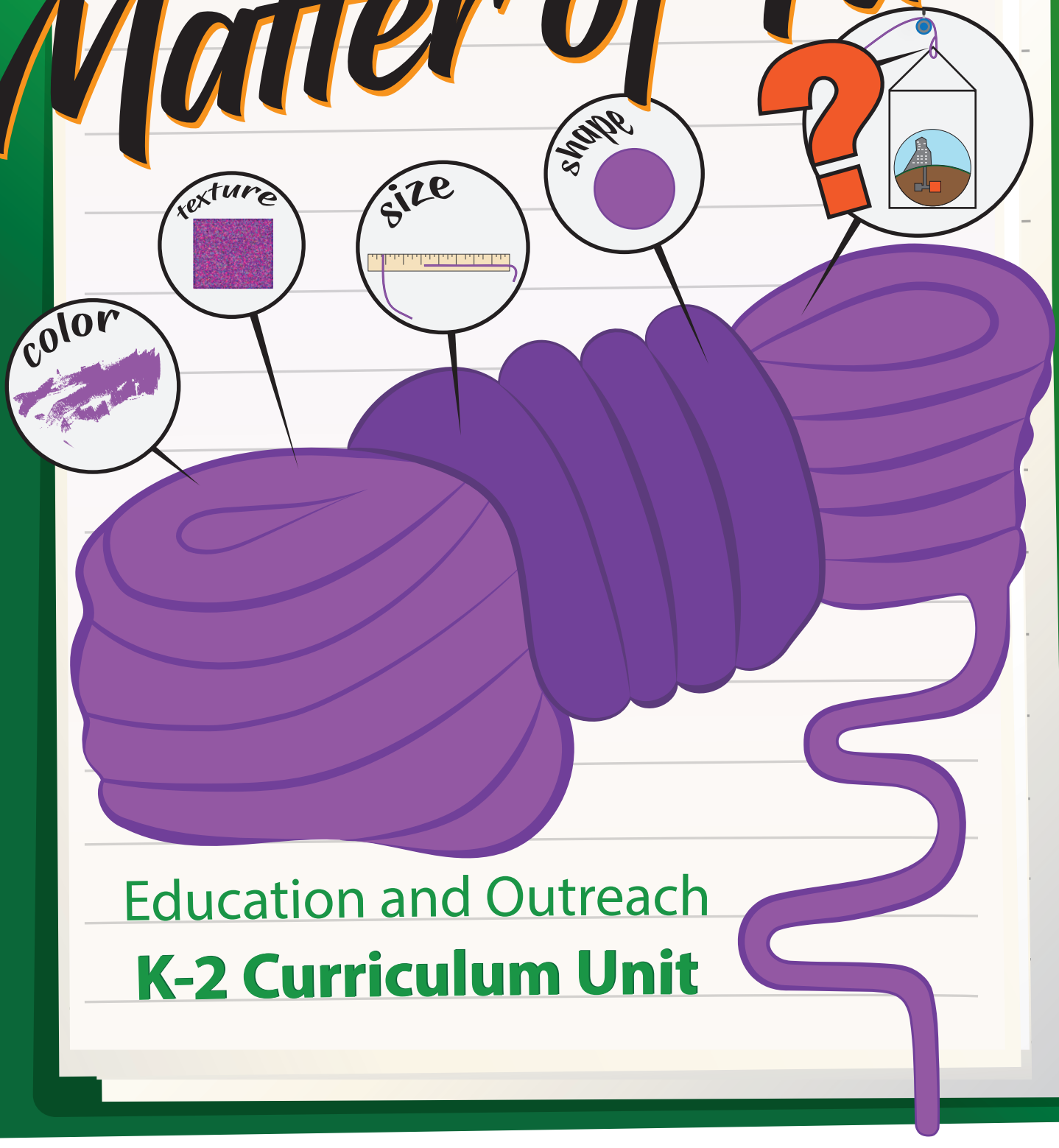
As a Matter of Fact



Education and Outreach

K-2 Curriculum Unit

As a Matter of Fact

"Properties of Matter"

Science Focus: Using Observations to Support Reasoning

Lesson #	Lesson Title	Suggested Time
1	Observable Properties What's the Matter?	40 minutes
2	Classifying Objects Treasures of Many Sorts	40 minutes- part 1 40 minutes- part 2
3	Materials and Their Uses What Matters Most?	40 minutes
4	Putting it All Together Engineering a Solution	40 minutes- part 1 40 minutes- part 2

As a Matter of Fact- K-2 (Physical Science)

Students learn that matter can be described and classified by its observable properties. They test a variety of materials to determine which have properties that are best suited for an intended purpose. Students will ask questions, make observations, and gather information about a simple problem that can be solved through the development of an improved object. They then make a recommendation to SURF engineers about which materials they consider to be the best fit for the job and why.

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Properties of Matter

Matter is everywhere! Scissors…windows…lunch boxes…sneakers. These are objects that students see every day. They give them more attention than you might realize, and they have a lot of ideas about them – including how to describe them, what they're made of, and what they are used for.

Although students may not use the word “matter,” they are able to describe objects in many different ways by using their senses. Identifying observable properties helps students make sense of the world around them. For example, students are familiar with the sight of a colorful ball in their hands or the soft texture of a scarf on their neck. By using words that distinguish properties-color, shape, size, and texture- students are learning how to organize their observations.

As students explore their surroundings, they often notice how things are alike and how they are different. They naturally sort them by characteristics that have meaning to them, often using observable properties such as color, shape, size, and texture. Students develop the ability to classify gradually, first by one property and later by two or more properties at the same time.

Young students have countless ideas about how objects are associated, but by challenging them to use their observations to support their reasoning, you can help them begin to notice similarities and differences that can be used to group items systematically. They may relate this to everyday tasks such as putting away silverware, or how certain types of items are grouped together when cleaning their room.

In our daily lives there are countless objects- each made of different kinds of materials. Students will learn that properties can vary across different materials, and begin to see their world as composed of a wide variety of materials with different properties that make them suited to different purposes.

Everywhere we look we find objects that have been designed to serve a certain purpose. By stepping into the role of an engineer students can investigate more closely the relationships between materials, their properties, and an object’s function. They will discover that materials can be used in different ways to solve different problems.

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Standards Addressed in the Unit

2-PS1-1 Plan and carry out an investigation to describe and classify different kinds of materials by their observable properties.

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.*

K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Standards with an emphasis on engineering are marked by an asterisk (*).

For more information on Engineering, see the Framework page 201and Appendix C of the South Dakota Science Standards.

Science and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) Designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. (NRC, 2012)

Crosscutting Concepts

1. Patterns 
2. Cause and Effect: 
   Mechanism and explanation
3. Scale, proportion, and quantity 
4. Systems and system model 
5. Energy and matter: 
   Flows, cycles, and conservation
6. Structure and function 
7. Stability and change 

A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. (NRC, 2012)

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Materials List

- **Teacher-Provided**

Lesson	Materials Needed
1	*For each student:* ➢ Science notebook *For the teacher:* ➢ Chart paper and markers (or whiteboard) • Bird nest pictures • Bag of 'stuff' *For each small group:* • Bag of objects
2	*For each student:* ➢ Science notebook *Part 1* *For the teacher:* • Book- *Grandma's Button Box* by Linda Williams Aber ➢ Chart paper and markers (or whiteboard) • Treasure Box *For each small group:* • Treasure to sort Part 2 *For the teacher:* • Variety of shapes • Sorting Circles • Compare/contrast objects *For each pair:* • Compare/contrast cards

3	*For each student:* ➢ Science notebook *For the teacher:* • Spoon Set- metal, plastic, wood ➢ Chart paper and markers (or whiteboard) *For each small group:* • Testing supplies: variety of materials, ruler, spray bottle, washers, jumbo paper clips ➢ Paper towel
4	*For each student:* ➢ Science notebook *For the teacher:* ➢ Chart paper and markers (or whiteboard) • Section of Yates Rope *For each pair:* • Paracord • Toothpick

Adjusting Modules to Accommodate Your Classroom Needs

Timing

The education team at the Sanford Underground Research Facility has done its best to develop curriculum modules that are flexible and incorporate both facilitator and student supports. As you explore this module with your students, please keep in mind that these curriculum modules are grade banded. If your students are at the lower end of the grade band, or if they come to you with limited experiences in science, you should fully expect the module to take more time than designated in the facilitator's guide. This is especially true if you teach very young students.

As an effective educator, you will know how to adjust the timing of these lessons to best fit your classroom and students. Please feel free to break any of the lessons into shorter segments, over multiple days, to accommodate the learners in your classroom.

Follow-up/Practice

Lessons in this unit include 'Follow-up/Practice' sections. These are useful (optional) resources proposed to enrich classroom practices for diverse learners. These resources are not included in the time designations of the unit; if you feel your students will benefit by pursuing these resources, please plan for additional time.

Design Principles

Effective educators alter, adjust, and change their instruction depending on who is in the classroom and the extent to which those students are succeeding. Frequently, educators will augment curriculum with additions of instructional strategies. However, please keep in mind that best practices in science education have shifted from merely *learning about* to *figuring out.* These units are designed to provide opportunities for students to figure out phenomena and design solutions to problems.

This emphasis on *figuring out* represents a revolution in how we teach science at all grade levels. In their learning, students must use all three dimensions of the science standards—crosscutting concepts (CCCs), disciplinary core ideas (DCIs), and science and engineering practices (SEPs)—in an integrated fashion in order to make sense of phenomena or design solutions to problems.

Classrooms incorporating three-dimensional learning will have students build models, design investigations, share ideas, develop explanations, and argue using evidence. All of which allow students to develop important 21st century skills such as problem solving, critical thinking, communication, collaboration, and self-management. Three-dimensional learning also helps students apply new knowledge to other situations. Every student will benefit from this instructional approach.

Important Note	
Science Notebooks	**You may wish to have students set up their Science Notebooks prior to the first lesson.** Science notebooks are an important part of solidifying your students' learning. Student scientists record their observations, questions, evidence, and ideas in a running record of their thinking. Science notebooks are also a great way to practice writing skills! As students develop their understanding of science concepts, they may use drawings and other illustrations- such as charts, tables, models, and graphs. The science notebook can be used by the teacher to assess the development of student understanding. Science notebooks may be a printed booklet prepared by the teacher, a bound composition, or a spiral notebook. A printable science notebook specific to this unit is available in the print masters section.

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Lesson 1	What's the Matter?
Overview Standard(s) & Objectives	**Overview** Students are presented with a dilemma- their class has been gifted several boxes of stuff. So much stuff that there is enough to share with another class. But first the teacher must be able to describe the objects to see if others are interested. During this lesson, students will work together as they investigate objects to "discover" some common properties of matter. Observations and descriptions may include words that distinguish properties including, color, shape, size, and texture. **Building Toward** **2-PS1-1** Plan and carry out an investigation to describe and classify different kinds of materials by their observable properties. Crosscutting Concept • Patterns- patterns in the natural and human designed world can be observed. Science and Engineering Practice • Asking questions and defining problems-ask questions based on observations to find more information about the natural and/or designed world(s). **Objectives** Students • Describe a variety of objects based on their observable properties. • Explain that observations of the objects provide evidence about their properties. • Describe objects using words that distinguish properties including, color, shape, size, and texture.
Background Information	**What is matter?** Objects that take up space and have mass are called matter. Everything that we can see, touch, or feel is made of matter. Matter exists in an incredible variety of forms, from the tiniest speck of dust to our giant sun (and everything in between). Even you are made of matter! **Making Observations** To make sense of the world around us, we must constantly make observations. Most often we use our senses to make observations - sight, sound, and touch. In the real world taste and smell can also be used, but explorations in this unit do not include observations based on those properties. We can also use tools such as rulers, scales, microscopes, and hand lenses to look at something closely and gather information.

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	What words can we use to describe things around us? Using sensory words- those that appeal to our senses- describe objects in a way that helps create an image in our mind of the object being described. For example, a student who describes an object in their jacket pocket may say, "It's small, round, smooth, hard, and blue. Whereas, simply naming the object "a marble" is not as descriptive. **Properties of Matter** Matter in our world exists as a variety of materials, each having different observable properties. People describe objects in many ways using words that distinguish properties including, color, shape, size, and texture, hardness, or flexibility. A property describes how an object looks, feels, or performs.
Materials	*For each student:* • Science notebook *For the teacher:* • Chart paper and markers (or whiteboard) • Bird nest pictures • Bag of 'stuff' *For each small group:* • Bag of objects
Prior Knowledge	Students should be familiar with (observable) descriptive words related to color, size, shape, and texture.
Launch (20 minutes)	
Engagement and Communication of Student Expectations	Today we are going to start a unit that will require us to pay close attention to the things around us. We will be making careful observations. • Think about what it means to make an **observation**? Turn to the person next to you and explain what is meant by the term observation. (*Using your senses to collect information and describe something)* • What senses do we have? (sight, sound, touch, smell, taste- *in this unit students will not be expected to use smell or taste)* • Who can share an example of an **observation?** *-The object is green.* • Who can add another? *-The _____ is _____.* Continue until everyone is on the same page about what it means to make an observation. (They will be making lots!)

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Ask the following questions to get students thinking about bird nests.

- Has anyone in the class ever seen a bird's nest?
- What did it look like? What was it made from?
- Why do you think a bird would use that material to build a nest?
- What else did you observe?

The facilitator should act as recorder. Keep a record of student ideas on chart paper or the whiteboard.

Form small working groups, then pass out pictures of some unusual bird nests.

Provide time for students to examine the pictures before asking questions.

- What do you notice? (observations) What do you wonder? (questions)
- Did anything about these nests surprise you? Why or why not?
- Why do you think birds select certain materials when making things?
- If something is unfamiliar to birds, how do they decide if it might work for a certain purpose? (The birds who built these nests had access to things that were probably unfamiliar to them and they could not ask each other about them)
- How can we use our senses to describe things to others?
- What descriptive words could be used to describe the objects in the nests?

We talked about lots of ideas related to the objects in the birds' nests. I'd like to spend a bit more time figuring out how we can use our senses to describe things (especially when they are unfamiliar to us).

- How do we use our senses to help make observations? (We use our senses to gather and respond to information about things around us)

Explain, "A family friend has gifted the classroom several boxes of stuff. There is lots of stuff! In fact, there is more than enough to share with another classroom, but I am having trouble trying to describe the objects to see if others are interested."

Ask the students for their help.

- Hand each pair of students an object from the bag and give them time to think of a few words to describe the object. Write these words on page 1 in your science notebook.

Handling objects allows students to learn about the characteristics of objects and provides an opportunity for them to select their own words to describe them.

- After everyone has had time to write a few words, ask each student for one word to describe his or her object without naming the object.

Record descriptions on chart paper or whiteboard. Accept all descriptive words. It's okay for students to use their own reflective descriptions (i.e. pointy, curvy, egg-shaped) before attaching "formal" names.

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	Teacher Tip: Statements containing "is a" and "looks like…" are inferences. You may need to ask the student a few questions to help them determine what they observed to guide them to that inference. *Make sure students are aware that they used their senses to observe, and describe, these objects. All of the words on this list are observations that used sight, touch and maybe sound (not taste or smell).* Explain, "When scientists are studying the world around us, they need an organized way to keep track of the information they are gathering. Let's look at our list to see if we can find a way to organize all of our observations." (For example) Color- work with students to circle all words related to color. Are there other color words that we could add to this list? *Add any new words to the list.* Do the same for shape, size, and texture. Use a different color marker for each set. • Introduce the term *properties*- a characteristic of a substance that is observed. • Introduce the term *matter*- anything that has mass and takes up space. Matter can be described using the properties…color, shape, size, texture. Begin a new chart listing properties of matter. Explain that the data table, page 2 and 3, in the science notebook is a way to keep all the information they will be collecting organized as they make their observations of matter. You may need to demonstrate how to use the data table. You can use the 'Properties of Matter' chart you just created to practice as a group. **(Sample at end of lesson)**
Explore (10 minutes)	
Procedure	**Properties of Matter** Distribute a bag to each small group of students. 1. Each student should select 1 object from the bag to observe. 2. They should write their observations (descriptive words) under the appropriate property heading in their notebook. 3. When each has finished describing the chosen object, ask students to share their observations with a partner- compare words used. *If time allows, students may work to describe another object from the bag.*
Questions	**Driving Question(s)** • How can we describe objects around us? **Probing Questions** • What words would you use to describe this to someone who is not here to see it? • What do you observe? Which of your senses are you using? • What can the properties of matter tell you?

	• How can the properties of matter be described? • What are observable properties? • How can observable properties be used to describe objects?
Summarize (10 minutes)	
Communicate	**Whole group** • How did you describe your object? What words did you use? Go around the room. Ask each student to hold up their object and share one word they used to describe the object. **Teacher tip:** You may have to remind students not to name objects. Ask for examples from several students (as time allows) Add any new words to properties of matter chart. • Do you think it is possible to describe anything with just one word? Why or why not? You might ask: • What was something you found that was (green)? • Can you think of other (green) things? • Is just saying something is (green) enough to describe it well? Encourage students to make use of the properties of matter chart. • (Green) is a word for what property? Ask similar questions about other properties of matter. • What is matter? Why is it important? Thank the students for their help. After today's lesson, you think you have lots of words that can be used to describe the objects in the box to see if anyone else might be interested in sharing :0)
Terminology and Concepts to Solidify	**Characteristic-** a distinguishing trait or quality **Describe-** to write, or tell, about something or someone **Mass-** the measure of how much material makes up the object **Material**- what an object is made of (a substance used to make things.) **Matter**- anything that has mass and takes up space **Object-** a thing that can be seen and touched **Observation-** using your senses to collect information **Property-** a characteristic of an object that is observed **Texture-** how an object feels when touched

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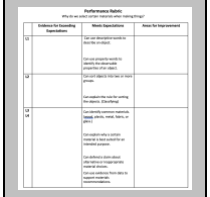
	All objects are similar in one way - they all contain matter. Objects have observable properties such as color, shape, size, and texture. A property describes how an object looks or feels.
Connection to Big Ideas (Phenomena)	**Structures and properties of matter** Matter can be described by its observable properties.
Follow Up/Practice	**Classroom I Spy** Level 1- Describe objects that can be seen in the room Level 2- Describe common objects, not in sight Level 3- Describe an object and have students draw what they think was described **Include Measurement/Weight** Introduce measurement tools, such as rulers or scales to help students gather a different type of information about an object. **Mystery Bag** Place an object inside a brown paper bag. Encourage a student to reach into the bag and describe what they feel. Then guess what the object might be.
Assessment 	**What Am I?** Draw, and color, a picture of an object on page 5 of your science notebook. Think of a few words to describe the object. Choose the most descriptive words and add them to page 4 in your science notebook. *If time allows, students could share --the description only—to see if others can guess the object described.* The performance rubric (in print masters) may be useful for tracking student progress.

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Sample Properties of Matter Chart

Color	Shape	Size	Heft	Strength/Flexibility	Texture
Blue	Pointy	Tiny	Light	Stiff	Slippery
Green	Round	Big	Heavy	Flexible	Bumpy
Yellow	Square	Little		Stretchy	Soft
Red	Rectangle	Humongous		Rigid	Hard
Silver	Flat	Medium		Strong	Squishy
Gray	Long			Weak	Rough
Purple	Short			Bendy	Smooth
Pink	Skinny				Sticky
Black					Fuzzy
Orange					Flakey
Brown					Sharp
					Rubbery
					Spongy

Other

Jingly, transparent, absorbent …

(In instances where a property category is not readily apparent the important part of the conversation is about which of the senses were used to make the observation)

Measurement/Weight

Introduce measurement tools, such as rulers or scales to help students gather and record different types of information about an object.

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Lesson 2	Treasures of Many Sorts
Overview Standard(s) & Objectives	**Overview** Students are called upon to help the classroom teacher with a challenging task. The teacher has been trying to find a way to organize numerous 'treasures' gifted to the classroom. The teacher has tried lots of different ways, but still cannot decide what might be the best approach to organize everything neatly so it can be used. During this lesson, students will observe, explore similarities and differences, and sort objects based on properties as they determine possible ways to classify them. **Building Toward** **2-PS1-1** Plan and carry out an investigation to describe and classify different kinds of materials by their observable properties. Crosscutting Concept • Patterns- patterns in the natural and human designed world can be observed. Pattern could include the similar properties that different objects share. Science and Engineering Practices • Plan and carry out investigations- plan and conduct investigation collaboratively to produce data to serve as the basis for evidence to answer a question. **Objectives** • Identify similarities and differences in order to sort a variety of objects based on their observable properties and patterns. • Analyze data in different ways to classify groups of objects. • Distinguish patterns in the observable properties of objects to complete a Venn diagram. • Collaboratively collect and record data.
Background Information	**Classifying** *Classifying* is organizing objects into groups based on their similarities. Defining rules for group membership is an aspect of classifying. **Comparing and Contrasting** Comparing and contrasting are ways of exploring the similarities and differences between two things. *Comparing* is identifying the similarities, and *contrasting* is identifying the differences between two things. The purpose for comparing and contrasting is to explain how these similarities and differences reveal something meaningful that is not apparent when either object stands alone.

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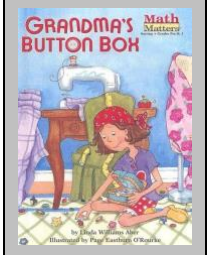
Materials	*For each student:* • Science notebook <u>*Part 1*</u> *For the teacher:* • Book- *Grandma's Button Box* by Linda Williams Aber • Chart paper and markers (or whiteboard) • Treasure Box *For each small group:* • Treasure to sort (from Treasure Box) <u>Part 2</u> *For the teacher:* • Variety of shapes • Sorting circles • Compare/contrast objects *For each pair:* • Compare/contrast cards
Prior Knowledge	Students should be able to use words that distinguish properties including, color, shape, size, and texture. Students should understand that properties describe how an object looks or feels.
Launch (10 minutes)	
Engagement and Communication of Student Expectations  	Students are called upon to help the classroom teacher with a challenging task. The teacher has been trying to find a way to organize numerous 'treasures' gifted to the classroom. The teacher has tried <u>lots</u> of different ways, but still cannot decide what might be the best approach to organize everything neatly. Explain that as you were trying different ways, it made you think of your grandmother's button box. **Read- *Grandma's Button Box* by Linda Williams Aber** • Ask students what the word ***sort*** means. (sort means to thoughtfully put certain items into groups.) • What are some ways that buttons were sorted in the story? (*shape, size, color*) • What are other things that might get sorted? (for example; socks, a rock collection, toys, books in a library, or food in a grocery store) • Ask if they know what the word ***classify*** means. (classify means organizing objects into groups based on their similarities. Defining rules for group membership is an aspect of classifying.) • How did the buttons get classified in the story? (round, square… small, *medium… round, small…red, blue..)* Write the terms *sort and classify* (with the definition) on chart paper or whiteboard.

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Explore (30 minutes)	
Procedure	**Part 1-Sort it out** **Small group (10 minutes)** • How can we sort these items into groups? Each small group of students will need: treasures to sort. 1. Working together, sort objects into groups. 2. Define rule for membership in the group (classify). For example, Objects that are red. 3. In your science notebook, on page 6 and 7, write the classification label for each of the groups you created. Then carefully count how many objects are in each group. Write that number in the appropriate box. 4. If time allows, try a different way. 5. Be prepared to explain to the class how you sorted/classified the objects and why. If students do not understand what to do, the teacher can model on chart paper. **Note:** Students may ask if every item must go into a group. It is okay if they have 'unsorted' items as long as they can explain why they do not fit into any of the other groups. It may be helpful to limit them to four categories to incorporate a math lesson later--making a bar graph of this data and to analyze the data. As the students work sorting and classifying objects, walk around and check for understanding by listening to the rationale of object placements and classifications. You should be able to determine if students truly have the concept of sorting/classifying or if they are simply guessing. **Whole Group (20 minutes)** • Ask each group to describe how they sorted their objects and why. Accept all groupings as long as students can justify them. • Ask if other groups used the same rule to classify their objects. Ask if anyone used a different rule. • As groups report out, create a word wall of classifications for reference. ○ What was your reasoning? ○ Is there a reason that you placed…..? Explain that ***reasoning*** is thinking about something in a logical, sensible way. ○ Can you describe any patterns you noticed? ○ Were any of the objects difficult to categorize? Why? (reasoning) Some objects may be more than one color, and this should promote discussion by the students to determine which color category the material should belong with. For example, "the button has more blue than red, so it should go in the blue category." Students may decide to have a multi-color category. **Small group (Optional)** • Draw a bar graph representing data collected during sorting.

Part 2- Similar and Different

Whole group (15 Minutes)

- Did you notice anything about the objects in each of the groups during the sorting activity? (*they have similar properties- they are similar in some way*)
- What if you had to sort objects into only 2 groups? (*for example, blue and not blue; or round and not round*) How do you think that might be different?

Teacher tip: encourage students to consider that sorting into multiple groups shows how objects are similar (comparing). However, the use of only 2 groups shows how objects are different (contrasting).

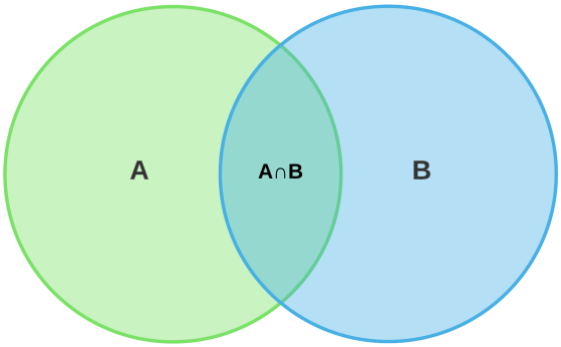
Use the bag with variety of shapes provided (Similar/different) to support the following group discussion. Use the sorting circles to help students visualize.

- Is it possible for two objects to be both similar and different?
- How is that possible? (*Big yellow circle, little yellow circle*)
- Ask students what the word ***compare*** means. (compare means to tell how two objects are similar.)
- Ask students what the word ***contrast*** means. (contrast means to tell how two objects are different.)

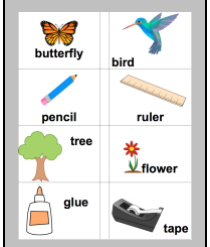
Write the terms *compare and contrast* (with definitions) on chart paper or whiteboard.

Show the class 2 objects and ask them to compare, and then contrast the objects.

Introduce a Venn diagram. Explain that this is another way to organize the information they are gathering and can help them explain similarities and differences between 2 objects. (Words that describe both objects belong in the middle where the circles overlap)



Small group (15 minutes)



Each pair (or small group) of students will need a set of cards to compare/contrast.

1. Discuss with your partner how Object A and Object B are similar (compare).
2. Discuss how they are different (contrast).
3. Turn to pages 8 and 9 in your science notebook. In the center, where the circles overlap describe how the objects are similar (both).
4. Next, add words that describe only Object A. Repeat for Object B.

If students do not understand what to do, the teacher can model on chart paper.

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<table>
<tr><td>Questions</td><td>Driving Question
How can different objects be compared to one another?
Probing Questions
What does it mean to sort matter?
How can matter be sorted?
Can you find a way to sort that is different from the book/other teams?
How does sorting matter make understanding it easier?
How are the objects similar? How are they different?
What patterns do you notice?
Why do you think properties are important?
How will the properties of … be determined?
How can you classify based on these properties?</td></tr>
<tr><td colspan="2">Summarize (10 minutes)</td></tr>
<tr><td>Communicate</td><td>Think, Pair, Share
Why do you think looking at similarities and differences is important?
Have students share some of their ideas with the class.

Discuss responses.
The purpose for comparing and contrasting is to explain how these similarities and differences reveal something meaningful that is not apparent when either object stands alone.
There is no one way to sort the items. There are a number of logical ways :0)
Whole group
Call on several students to explain how their objects are the same and how they are different. (compare/contrast) It might sound a little like this:

The pencil and ruler are similar because they are both long and made of wood. But they are different because the pencil is blue and the ruler is tan.

My objects are both green. But this one is a grasshopper and this one is a frog.

Both objects are round with a hole in the middle. You could eat the doughnut, but not the tire!
Why do you think it might be important that we tell one thing from another?
If they have trouble getting started on the discussion, remind them of the original task. Encourage students to think about how difficult it might be to make use of the gifted items if they cannot be organized in some way. (i.e. the jumbled button box)

Other suggestions might include: two things that look similar, but one is poisonous; adding salt instead of sugar to a recipe; or needing something to perform in a certain way.</td></tr>
</table>

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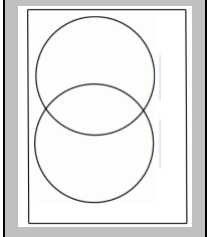
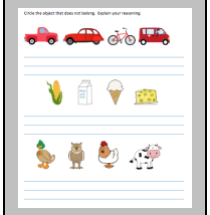
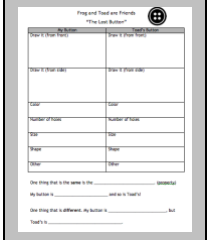
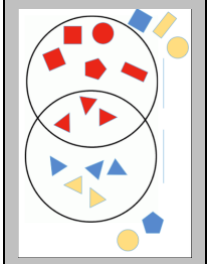
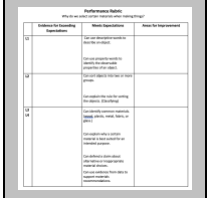
Terminology and Concepts to Solidify	**Analyze-** examine critically **Classify-** organize objects into groups based on their similarities. Defining rules for group membership is an aspect of classifying. **Compare**- to tell how two objects are similar **Contrast-** to tell how two objects are different **Object-** a thing that can be seen and touched **Pattern**- a particular way in which something is organized **Reasoning-** thinking about something in a logical, sensible way **Sort-** thoughtfully put certain items into groups **Venn diagram**- a visual representation that uses circles to show how two objects are similar and different (compare and contrast objects) Objects have properties that can be observed and used to describe similarities and differences. Sorting creates an order that makes understanding groups of objects easier. The purpose for comparing and contrasting is to explain how these similarities and differences reveal something meaningful that is not apparent when either object stands alone.
Connection to Big Ideas (Phenomena)	**Structures and properties of matter** Matter can be classified by its observable properties.
Follow Up/Practice 	**Venn diagram shape sorter** http://www.shodor.org/interactivate/activities/ShapeSorter/ **Compare and Contrast** A blank Venn diagram is included in the print masters if you wish to have students compare and contrast a set of objects you choose.

As a Matter of Fact

Assessment	
	**Which one of these is not like the others?** (In print masters) Additional images on USB drive can be projected for class discussion. *Accept all answers that students can support with reasonable justifications.
	**Frog and Toad- A Lost Button** (sheet in print masters) (story on USB drive) Students should complete the left side of the chart about “My button” before listening to the story. While listening to the story, students can add to the right side about “Toad’s Button” (you may need to pause while they write) Then, students will draw Toad’s button based on its description. Finally, students will identify similarities and differences.
	**What’s my rule?** (Look at sort and determine properties used) (In print masters)
	The performance rubric (in print masters) may be useful for tracking progress.

As a Matter of Fact

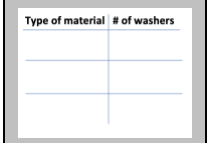
Lesson 3	What Matters Most?
Overview Standard(s) & Objectives	**Overview** Students learn something interesting about the person who has shared all the boxes. They are a materials scientist at the Sanford Underground Research Facility! What does it mean to be a materials scientist? Through observation and manipulation of various materials, students will recognize that properties can vary across different materials and begin to see their world as composed of a wide variety of materials with different properties that make them suited to different purposes. **Building Toward** **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.* Crosscutting Concept • Cause and Effect-simple tests can be designed to gather evidence to support or refute student ideas about causes. Science and Engineering Practices • Plan and carry out investigations- plan and conduct investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Analyzing and Interpreting Data- analyze data from tests of an object or tool to determine if it works as intended. **Objectives** Students • Identify and name a variety of common materials. (wood, plastic, metal, etc.) • Distinguish between an object and the material from which it is made. • Describe relationships between materials and their properties. • Describe relationships between properties of materials and potential uses. • Collect, record, and share observations. • Analyze the data obtained through observation and testing to determine which materials have the properties that are best suited for an intended purpose.
Background Information	**What are materials?** A material is a substance used to make things. The things in our world are made of many different materials, each having different properties. Some examples of materials include: metal, plastic, wood, glass, or fabric. If we look around, everything we see is made from a material, sometimes more than one!

As a Matter of Fact

	Properties and Uses Different kinds of materials have different properties. Some materials are rigid, others are flexible. Some are absorbent, others repel liquids. The properties of materials are more than how the object looks or what it feels like. The properties of materials determine how that material performs. Some materials have properties that make them better than others for making a particular thing. Why are saucepans made from metal? Which properties make it suitable for the use? Metal is a good conductor of heat, it does not melt with high temperatures, and it is strong. Of course, a saucepan could be made from glass, but that may limit some of its performance. **Materials scientists** Materials scientists test the properties of different materials to see how they perform, and decide which materials might be the best choice for a particular job. If you are building a rocket, for example, you need materials that are both light and strong. Materials scientists frequently work with engineers to decide which material is the best choice for an intended purpose. **Sanford Underground Research Facility--SURF** The Sanford Underground Research Facility (SURF) in Lead, South Dakota, is an underground science laboratory built in the former Homestake gold mine. SURF hosts a variety of science experiments. Some of the largest physics experiments, in dark matter and neutrino research, are located nearly one mile underground (4850 feet) to protect sensitive equipment from cosmic rays that can interfere with their results.
Materials	*For each student:* • Science notebook *For the teacher:* • Spoon Set- metal, plastic, wood • Chart paper and markers (or whiteboard) *For each small group:* • Testing supplies: variety of materials, ruler, spray bottle, washers, jumbo paper clips • Paper towel
Prior Knowledge	Students should have some familiarity with common materials, for example: wood, fabric, metal, plastic, or glass. *Students may consider size and shape as properties of objects and materials, but these are not properties of materials, only properties of objects.

As a Matter of Fact

Launch (10 minutes)	
Engagement and Communication of Student Expectations	Tell students that you learned something interesting about the person who shared all the boxes. They are a materials scientist at the Sanford Underground Research Facility (SURF)! • Ask students if they have ever heard of SURF. Explain that the Sanford Underground Research Facility (SURF) in Lead, South Dakota, is an underground science laboratory. https://vimeo.com/917557425 (*Optional, short video about SURF on USB drive*) • Ask students what the word **material** means. (*material* is what an object is made of) **Note:** Students may say that *material* is a type of cloth or fabric. If this is the case, the discussion might involve explaining that is one meaning of the word. However, in science the word material has a slightly different meaning (what the object is made of). The discussion then might include that cloth can be made from a variety of materials—cotton, wool, silk, etc. Show students the spoon set. • Ask students what materials the spoons are made from. Start a list of materials on chart paper, or the whiteboard. (metal, plastic, wood) Encourage students to look around the classroom. • What materials are used to make the things in the classroom? • Record observations on page 10 and 11 in science notebook. *The clothes we are wearing are made from cloth. The chairs are made from plastic. The windows are made from glass.* • Ask for examples, have the students identify the object and the material(s) used to make that object. • Ask students how they decided that a particular object was made from a particular material. • Discuss any 'difficult' objects (for example, plastic with a wood grain) You may wish to choose objects to discuss that will highlight that some objects are made of a single material, and some are made of many materials. • Ask students what they think a **materials scientist** does. (*materials scientists* test the properties of different materials to see how they perform, and decide which materials would be the best choice for a particular job.)

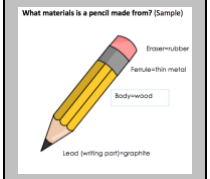
	Refer back to the spoon set. • What questions might a materials scientist ask about these spoons? (*What job will the spoon do? What is the best material for a spoon? Why?)* *Jobs for a spoon might include eating, serving, or stirring.* *Reasons for materials might include: plastic= lightweight or disposable. Metal=they don't stain, they are good for high temperatures, or can go in the dishwasher. Wood= won't scratch cookware.* Materials scientists plan and conduct tests to see how materials perform. • What kind of tests do you think they might use to determine if a material is strong? *(Students might say they could place weight on top of one of the materials and see how much it will hold before it breaks, or maybe measure how hard you have to pull on something before it breaks)* • What do you think they do with this information? (They record it in their science notebook!) Also encourage students to record any questions or ideas they have in their notebooks.
Explore (20 minutes)	
Procedure	**The best material for the job** When working underground, it is common to need some sort of bag to carry your stuff. After all, you are going to be there all day. Share pictures of people going to work with different bags. (on USB drive) 1. Ask students what sort of items they might take to work with them if they worked at a place like the Sanford Underground Research Facility *(lunch, laptop, camera, jacket, shoes, science notebook)* 2. What job would your bag need to do? What properties would you look for in a bag? How might you choose the best material for that job? 3. What tests might you perform to find out which bag material would be the best for this situation? (weight test, puncture test, wet test, stretch test, etc) • **See suggested investigations at end of lesson**  Students will work in small groups to <u>test materials</u>. Results should be recorded in their science notebook on pages 12 and 13. (words, numbers, diagrams, graphs) *You may wish to model how students should record data and graph results. *Students need time to explore! In the process they will build important math and science skills- observing, comparing, organizing (classifying), and communicating.* **Note:** Depending on the experience of the students, and the time available you may choose to extend this lesson over several sessions. (1 test each session) Another option might be to have different teams perform different tests during a single session and share results in a large class discussion.

As a Matter of Fact

	Additional Note: students may ask for items to use to test their materials. These can be provided as appropriate.
Questions	**Driving Question** • How do the properties of materials relate to their use? Performance? **Probing Questions** • What kinds of materials is matter made from? • How do you determine properties of materials? • Why would you use one material instead of another? • What do you notice about the materials you are testing? • What do you think causes that to happen? • What properties matter most? • When might color matter? • Can you describe any patterns you noticed? • How does studying the properties of a material help you learn about how it might perform? • What materials do you think are used the most frequently to make the products/objects that you see every day?
Summarize (10 minutes)	
Communicate	Facilitate a quick sharing of test results and methods used across the class. • Can you describe any patterns you noticed? *Encourage students to describe relationships between materials and their properties. (fabric is absorbent, plastic is flexible, paper gets soggy, etc)* *Think cause and effect. What about the material causes the water to be absorbed/repelled? What causes it to be flexible?* • Which material do you think would be the best for a bag to take underground? Why? Facilitate a short student discussion about which type of material was the strongest, weakest, most flexible, etc. First have students discuss in small groups. Then facilitate a whole class discussion. Encourage students to identify the evidence students have to support their claim. *The best material to make the bag from is ____ because_____.* • What do you mean by best? (strongest, easiest to clean, repels water, etc) • Can you think of any problems with using this material to make a bag? • What other qualities are important when choosing a bag? • If you could choose an additional material to use for your personal bag, which material would you choose? Why?

	So many objects, so few materials! (Optional extension) I'm going to ask each of you, with a partner, to find an object in the room and identify the material or materials that object is made of, and then to discuss with your partner why you think that object is made of those materials. Why did the people who made this thing choose to make it from what they made it from and not something else? Record this information on page 14 and 15 of your science notebook. **Note:** You will likely hear a good deal of discussion about what constitutes "sameness." Are shiny metals and dull metals the same? Is the plastic spoon the same as the plastic bag, even though one object is rigid and one is floppy? Remain neutral on these matters; ask the students what they think. In lesson 4, students will think more about how materials are selected to meet a specific use. • What materials do you think are used the most to make the products/objects that you see? Why do you think that material is so popular? Facilitate the creation of a class tally of the different materials used in the classroom to help students determine and develop an evidenced based conclusion about which material(s) are used in most objects. (analyze and interpret data) • What does this tell us about ___? (*It can be used for lots of different products. Some materials have many uses*) • Why do you think ____ is used in so many objects? Think about the properties of this material that may make it useful for the other products. This may be a good time to discuss as a class the difference between man-made materials and naturally occurring materials. If you have time you may wish to point out that 100 years ago most toys were made of wood. (Plastic was not yet invented, it took a long time to create wooden toys and therefore they were expensive, and children did not have very many)
Terminology and Concepts to Solidify	**Absorb-** take in or soak up (energy, a liquid, or other substance) **Deconstruct-** break something down into its separate parts **Material**- what an object is made of (a substance used to make things) **Materials scientist-** person who tests the properties of different materials to see how they perform, and decide which materials would be the best choice for a particular job **Perform**- accomplish a task **Relationship-** the way in which two or more things are connected

As a Matter of Fact

	Repel- to keep (something) away **Suited-** appropriate for a particular purpose, or situation **Test-** a procedure to determine the quality, performance, or reliability of something Properties can be used to describe how an object looks, feels, or performs. *Students may consider size and shape as properties of objects and materials, but these are not properties of materials, only properties of objects. Certain materials have properties that are appropriate for specific uses and by comparing these; the idea is introduced that whilst some materials are reasonable for the use, others might do the job better.
Connection to Big Ideas (Phenomena)	**Structure and properties of matter** Different kinds of materials have different properties. Different properties are suited to different purposes. **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.
Follow Up/Practice	**Bring the Sanford Underground Research Facility into your school or classroom!** Invite an Education and Outreach team member to visit your school, they will talk about SURF, share pictures and video, as well as answer questions from students. Our programs are available to schools across South Dakota, free of charge. https://sanfordlab.org/education/field-trips-presentations Materials and Their Properties https://www.ecosystemforkids.com/games/2nd-grade/materials-and-properties/activity.html
Assessment  	Students diagram and label an object's materials and its properties and how these support the purpose of the product. ('Deconstruct' a product to identify its materials.) - Draw the product - Label materials used for the product - List properties of the materials - Explain how the materials' properties help the product do its job If students have difficulty choosing an object, you may offer some potential ideas…sample objects on USB drive. The performance rubric (in print masters) may be useful for tracking progress.

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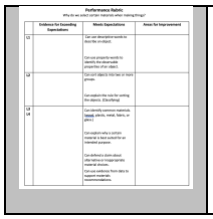
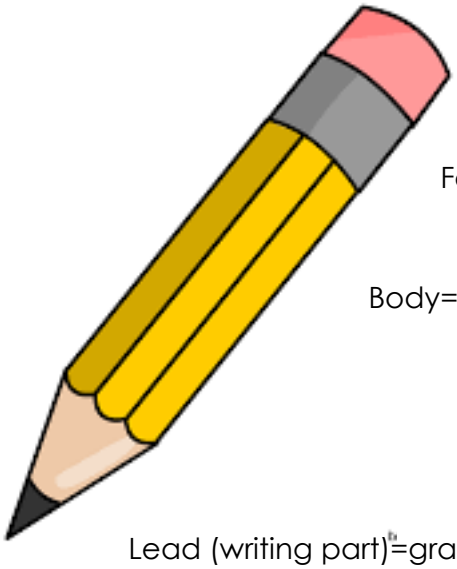


What materials is a pencil made from? (Sample)



Eraser=rubber

Ferrule=thin metal

Body=wood

Lead (writing part)=graphite

Rubber is soft and can erase pencil marks from paper without tearing it.

Thin metal is strong and flexible to attach eraser to pencil so it doesn't get lost.

Wood is hard enough to protect the graphite, and soft enough to be sharpened.

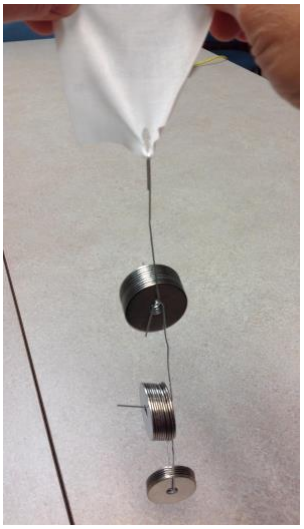
Graphite is soft and can leave dark marks on paper when writing. It won't dry out.

Lesson 3- Suggested Investigations

The Weight Test- Which material holds the most weight?

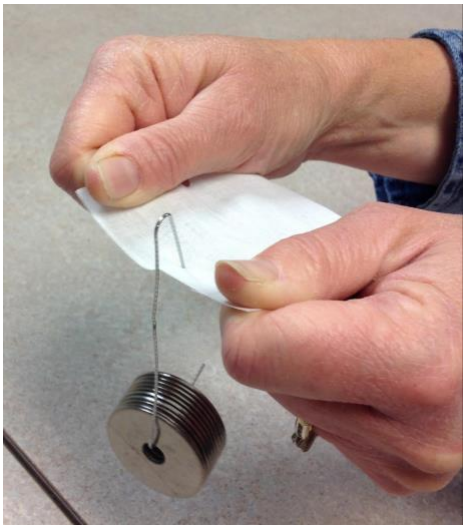
- Insert a jumbo paperclip hook into the hole to act as a hanger for the washers.
- While one student holds the material vertically, another student will add washers until the fabric rips, or they have depleted the supply of washers.
- Record observations and results- (number of washers held.)

*The muslin will support a substantial amount of weight before ripping. If time allows, students may add chains of washers from multiple teams to see if they can find the limit.



Puncture Test- Which material resists the paperclip pushing through the material?

- While one student holds the material horizontally (both hands), another student will put the tip of the unbent paperclip on the material.
- Add washers until the material is punctured.
- Record observations and results- (number of washers needed).



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The Wet Test- Does the material repel or absorb water?

- Place paper towel on working surface.
- While one student holds the material vertically, another student will spray the material with water (one pump).
- Was the water absorbed or repelled? What's your evidence?
- While one student holds the material vertically, another student will spray the material with water a second time (one pump).
- While one student holds the material vertically, another student will spray the material with water a third time (one pump).
- Record results- (Water did/did not run off).

The Stretch Test- Does the material stretch or rip?

- Lay material next to a ruler.
- Hold the left side at the zero mark of your ruler and measure original length.
- Stretch the fabric along the ruler until it resists being stretched anymore.
- Write down the amount it stretched beyond the original length.
- Record observations and results- (amount it stretched beyond the original length.)

Lesson 4	Engineering a Solution
Overview Standard(s) & Objectives	**Overview** In this lesson, students think about materials in terms of their usefulness in objects and the way those objects function. First, they consider what materials are appropriate for certain objects. Then they brainstorm some materials that would be wildly wrong. Finally, they will ask questions, make observations, and gather information about a simple problem that can be solved through the development of an improved object. Then make a recommendation to SURF engineers about which materials they consider to be the best fit for the job and why. **Building Toward** K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. Crosscutting Concept Structure and Function- The functioning of natural and built systems alike depends on the shapes and relationships of certain key parts as well as on the properties of the materials from which they are made. Science and Engineering Practices • Asking Questions and Defining Problems- Define a simple problem that can be solved through the development of a new or improved object or tool. **Objectives** Students • Discuss strengths and weaknesses of different materials in specific situations. • Gather information to support (or refute) ideas about which materials and properties allow an object to be well suited for its intended purpose. • Ask questions and make observations to clearly understand a problem. • Recommend a design solution.
Background Information	**Finding the best solution** Certain materials have properties that are best suited for an intended purpose. However, occasionally materials that are better in some ways (such as stronger or cheaper) may be worse in other ways (heavier or harder to cut). Thus, the idea is introduced that whilst some materials are reasonable for the use, others might do the job better. **Engineering Design** Engineering design is an iterative process (EDP) that engineers use to identify and solve problems. It's important to note that the EDP is flexible- meaning the *steps* should be *repeated* as many times as needed until the problem has been solved.

As a Matter of Fact

	The engineering design process can be extremely useful to any individual trying to solve a problem. But engineering design is ordinarily done in teams. Each team member brings different knowledge and experience to the process, which usually improves the results. **What makes rope so special?** Ropes can be made from a variety of materials, but the one thing that all ropes have in common is that they are made up of multiple strands of whatever material. Each strand by itself is strong, but its strength is multiplied greatly when those strands come together to form a rope. Some ropes have a solid cord in the middle to provide even more strength. Needless to say, a good rope is essential for many tasks.
Materials	*For each student:* • Science notebook *For the teacher:* • Chart paper and markers (or whiteboard) • Yates Rope *For each pair:* • Paracord • Toothpick
Prior Knowledge	Different kinds of materials have different properties Different properties are suited to different purposes. The properties of a material often determine how they are used to make things.
Launch (10 minutes)	
Engagement and Communication of Student Expectations	Every day we use things without thinking very much about them. Take a look at the shoes on your feet. When you put them on this morning, did you think about what materials they were made from? Did you think about the job those shoes were designed for? (*rubber boots to keep your feet dry, tennis shoes for traction, furry shoes to keep your feet warm, etc*) To make a useful object, you have to choose your materials carefully. Today you will consider some objects and think about what materials work well for them. You will also think about materials that would not work well for those objects and why. • What if you were in charge of making (designing) a useful object? • How would you decide which materials to use? **Listen for responses that indicate students understand the relationships between a material, its properties, and an object's function.* • Imagine what would happen if you tried to build an airplane--not a toy airplane-- out of cardboard. (*It's lightweight*) • What would happen as you tried to load it with passengers? (take someone's answer before continuing).

- What would happen if it started to rain? (Again, call on a student to tell us what would happen.)

Act as recorder to document the discussion of strengths and weaknesses of materials choices. (Example below)

Airplane 

Material	Properties (strengths)	Properties (weaknesses)
Cardboard	Lightweight	Not very strong
	Inexpensive	Should not get wet
Metal	Strong	Heavy
	Can get wet	Expensive
?		

The best solution (compromise)

Facilitate a class discussion that encourages students to consider materials that would be good (and not so good) to build with. Discuss considerations for choosing certain materials when designing a useful object.

> *Occasionally materials that are better in some ways (such as stronger or cheaper) may be worse in other ways (heavier or harder to cut).*

As time allows, or if students need more practice talking about the strengths and weaknesses of certain materials, you might also propose the following:

- What if you built a bed out of stone?
- What if you made tennis shoes out of metal?

You could make tennis shoes out of super-strong steel. They would last a long time, but they would be too heavy to walk in, or they might rust if they got wet.

Explore (30 minutes)

Procedure

Understanding the Details-Part 1

Our friends at SURF would like our help. A team of engineers is contemplating ways to improve a rope that does a very important job. This rope is responsible for lifting and lowering the cage that takes people to and from work. It needs to be strong, but the current design is incredibly heavy!

- What do engineers do? (design and build things to solve problems)
- What is the cage? (a compartment for people traveling underground and back to the surface. It is attached to a rope and operates like a very primitive elevator.)

1. Show video of people loading the Yates Cage, then descending 4850 feet underground. (on USB drive)

In real life this trip takes ~12 minutes. The video shows the trip in 2 minutes :0)

- What might a rope designed to do this job look like? (turn and tell a neighbor before a larger group share)

- What materials do you think it's made from?
- What questions do you have?

The facilitator should act as recorder. Keep a record of student ideas/questions on chart paper or the whiteboard.

If we are going to share our ideas with the engineers, we should talk more about ropes!

- What do you know about ropes?
- How could we define rope? (*a cord that is made of strands of various materials that are twisted (or braided) together into a larger and stronger form.*)
- What are ropes used for? Where might you find one being used?
- Has anyone ever taken a rope apart?

2. Hand out paracord and toothpick. Allow pairs of students to deconstruct the cord.

   Teacher Tip: this can go on for a long time. It is not necessary for the pair to take apart every strand. Rather the goal is to notice the design/structure of the cord.

   - What is it made from? (*lots of strands of nylon*)
   - How is it designed? (*a braided outside cover and the twisted 'guts'*)
   - What properties do you think it has? (*lightweight, flexible, strong, inexpensive*)

Tell the class that paracord is considered to be a very useful type of nylon rope. It is lightweight, flexible, and strong enough to be used for parachutes!

3. Ask students to think about people who might have developed ropes long before machines made them, or you could buy them in a store.
   (Students may consider ancient civilizations or prehistoric times, they may consider more local groups like the American Indians or the early pioneers)
   - What do you think the rope might have been needed for? *(fastening, dragging, lifting, or climbing)*
   - What materials do you think were used? *(grass, reeds, vines, leather, animal hair)*
   - How do you think the ropes were made?
     (strands of material were twisted or braided together)

Encourage students to discuss the ingenuity required to make rope out of materials that are readily available.

Making Rope from grass
https://thekidshouldseethis.com/post/how-to-make-rope-from-grass

Other optional videos include:

Yarn
https://babbledabbledo.com/yarn-craft-idea-make-yarn-rope/

Plastic bags
https://www.1millionwomen.com.au/blog/turn-plastic-bags-usable-rope-super-easy-diy/

Part 2- Engineer a Solution

1. Show videos of the Yates Hoist- the machine that winds and unwinds the rope attached to the cage (on USB drive)
   - What are some useful properties for the rope at SURF? (*strong, affordable, durable, etc*)
   - What materials would be good choices for this rope? Why?
   - Can the rope be made from more than one material? (*it could be more than one material, or it could be multiple strands of the same material*)

Return to the list of ideas/questions. Ask students if they have any items they would like to add or revise.

FYI- In real life the rope for the cage is about 6,ooo feet long!

Yates Cage Capacitates

10,000 pounds

36 people

500 ft /minute (speed)

2. Ask the class if they would be interested in seeing the rope that is currently used for raising and lowering the cage at SURF. Pass around a section of the Yates rope.
   - What materials were used to create this rope? (*twisted metal outside, a natural fiber rope in the center*)
   - What properties do those materials have? (*strong, durable, slightly flexible*)
   - Did anything about this rope surprise you? Why? Why not?
   - What problem does this rope solve?
   - What are some strengths and weakness of this design? (*metal strong, but heavy- if gets wet, might rust. The fiber core can be oiled to help protect metal surrounding it- it might not be strong on its own*)

Small Group

3. Students should work in small groups to brainstorm potential improved rope materials. As students consider different types of materials, they can record their ideas on pg 16 in their science notebooks.

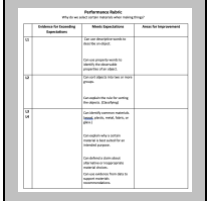
As students work, circulate first to address any procedural questions and then to listen to what students are talking about and to ask probing questions (see below) to further their thinking.

	4. Time to make a recommendation! Discuss as a team, ideas for the improved rope design. 5. On pg 17 in your science notebook describe the desired features of your improved rope. Explain what problems it solves, which material(s) you suggest and why. Share any other important design details. Students can add drawings or other visual displays to their work, when appropriate, to help clarify their thinking.
Questions	**Driving Question** • How can materials be used in different ways to solve different problems? **Probing Questions** • How did you decide which material(s) was best suited for the rope? • Did your team consider any material compromises? Explain. • How does the material an object is made from affect the use of the object? • How does the material an object is made from help the object to work properly? • What materials might be invented in the future? • Can you think of situations when you'd have to choose one material over another? • What is your recommendation for the design?
Summarize (10 minutes)	
Communicate	Ask each team to report. Students should be able to provide justifications for their recommendations. Depending on their responses, you may wish to dig a little deeper into student thinking about the materials, their properties, and the function of the rope. **What are your recommendations for the new and improved rope?** • Which materials do you consider to be the best fit for the job? Why? • What will it look like? (Design- twisted, braided, knotted, woven? Color? Diameter? Etc? • What problem(s) does it solve? **Facilitated Group Discussion** • Did all members propose using the same material(s)? • How did you decide which material(s) was best suited for the rope? • Did your team consider any material compromises? Explain. **Finding the best solution** Solutions have different strengths and weaknesses and must stay within certain constraints. Engineers have to choose the solution that provides the most desired features with the fewest negatives. That's why engineering is often called "design under constraint".

As a Matter of Fact

	Potential Constraints ✓ Cost? ✓ Availability? ✓ Easy to work with? ✓ Long lasting?
Terminology and Concepts to Solidify	**Analyze**- examine in detail **Compromise**- a situation in which people accept something slightly different from what they really want, because of certain constraints **Constraint**- a limitation or restriction **Engineer**- a person who designs and builds things to solve problems **Recommendation**- a suggestion or proposal as to the best (something) **Rope**- a cord that is made of strands of various materials that are twisted (or braided) together into a larger and stronger form. All objects and materials are described based on properties and characteristics. Different properties are suited to different purposes. Certain materials have properties that are appropriate for specific uses and by comparing these; the idea is introduced that whilst some materials are reasonable for the use, others might do the job better.
Connection to Big Ideas (Phenomena)	**Engineering Design** Materials can be used in different ways to solve different problems. There may be more than one possible solution to a problem.
Follow Up/Practice	**Read the book- *What if Rain Boots were Made of Paper*?** http://online.pubhtml5.com/kyrh/zndh/ Use this as a fun way to get students talking about the relationships between the materials used to make objects and the properties of those materials. **Additional literature connections:** - *The Three Little Pigs* (there are many variations) Students could read the story from a materials scientist point of view and make recommendations why they should build their house from….straw, sticks, or bricks? -*Goldilocks and the Three Bears* (also many variations) Students might use a variety of teacher supplied materials to design beds (too, hard, too soft, just right)

As a Matter of Fact

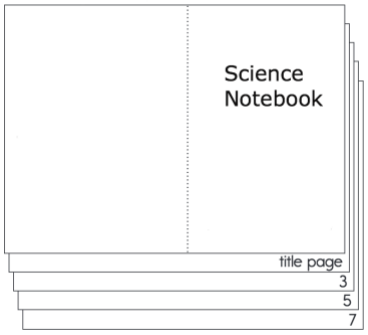
	Career exploration During this unit, students learned about the work of a materials engineer and made a recommendation about materials to an engineer in charge of designing and building the rope. • What is the difference between a materials engineer and an engineer? How do they work together? (optional videos on USB drive) • Can you think of other jobs that you'd need this skill for or times when you'd have to choose one material over another?
Assessment  	**Back to bird nests** Using bird nest pictures from Lesson 1, ask students the following questions: • What words might you use to describe the nest to someone who is far away? • What materials are these nests made from? • Why do you think a bird would use that material to build a nest? • Why do you think people select certain materials when making things? • If something is unfamiliar to us, how do we decide if it might work? • How does the material an object is made from help the object to work properly? • As an engineer, what advice would you give this bird? What problem would that help solve? As the students respond, check for understanding by listening to their descriptions and rationale. You should be able to determine if students really have a grasp of the unit concepts or if they are simply guessing. The performance rubric (in print masters) may be useful for tracking progress. **Alternative Assessment** Have students defend their claims about alternative or inappropriate materials. Ask students, "What if pillows were made of stone?" or "What if scarves were made of sandpaper?" or "What if tables were made of foam?" Provide the following sentence starters if needed. • Yes, [material] would work in [object] because it is……. • No, [material] will not work in [object] because it is….. • Maybe, [material] will work, but [material] might be a better choice because….

Print Masters

Printing Science Notebooks

Use the pdf file 'PropertiesNotebook' located on the USB drive

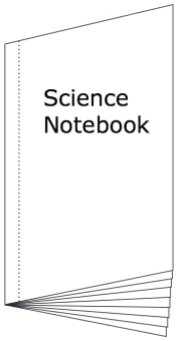
Paper size 8.5-by-11-inches



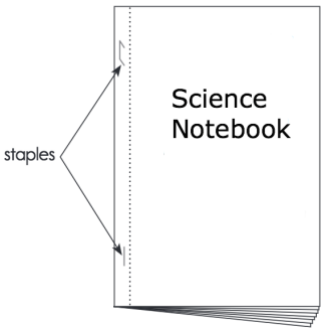
Layout is landscape

Print 2-sided

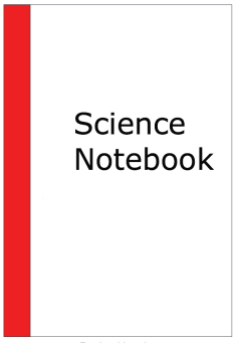
Flip pages on short side (short-edged binding)



Fold stack of pages in half, taking care to line up the corners



Staple two times along left edge of front cover



(Optional) Place a strip of 1-inch tape along the left side, covering the staples on the front and wrapping to the back of the notebook.

As a Matter of Fact

Frog and Toad are Friends

"The Lost Button"

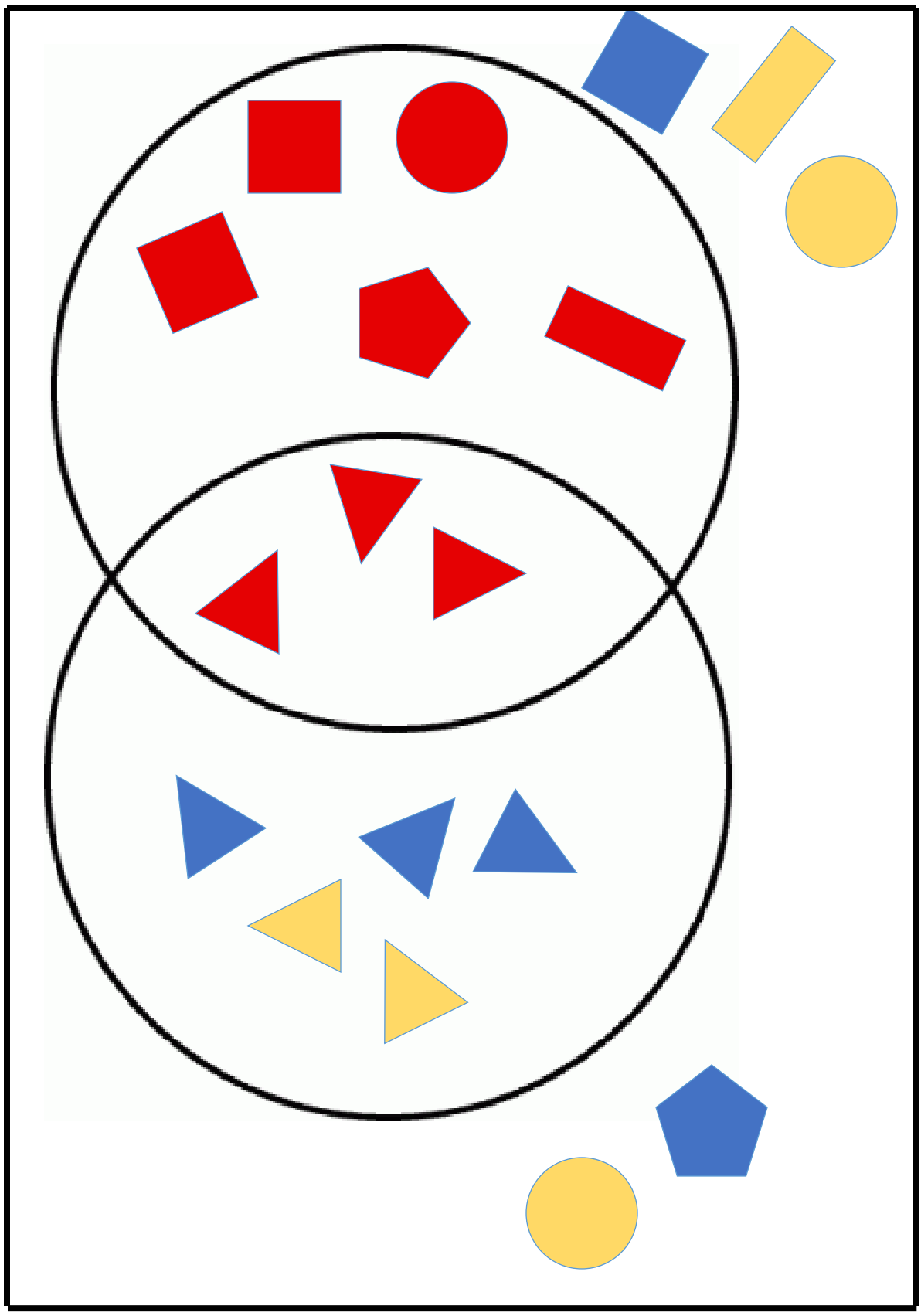
My Button	Toad's Button
Draw it (from front)	Draw it (from front)
Draw it (from side)	Draw it (from side)
Color	Color
Number of holes	Number of holes
Size	Size
Shape	Shape
Other	Other

One thing that is the **same** is the _____. (property)

My button is _____ and so is Toad's!

One thing that is **different.** My button is _____, but

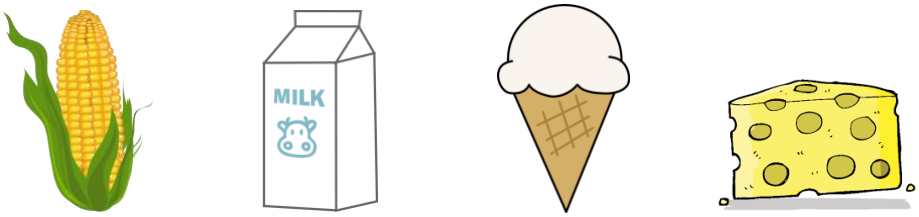
Toad's is _____.

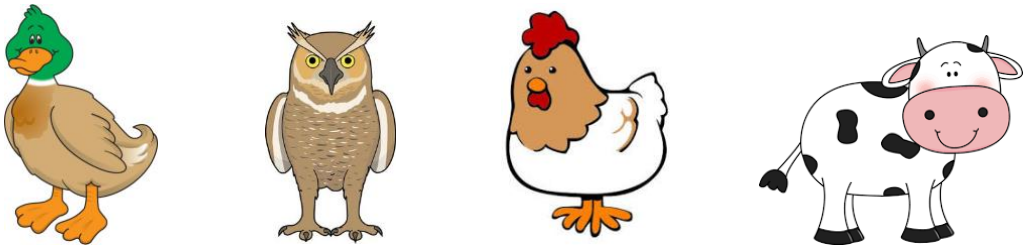


What's My Rule?

As a Matter of Fact

Circle the object that does not belong. Explain your reasoning.



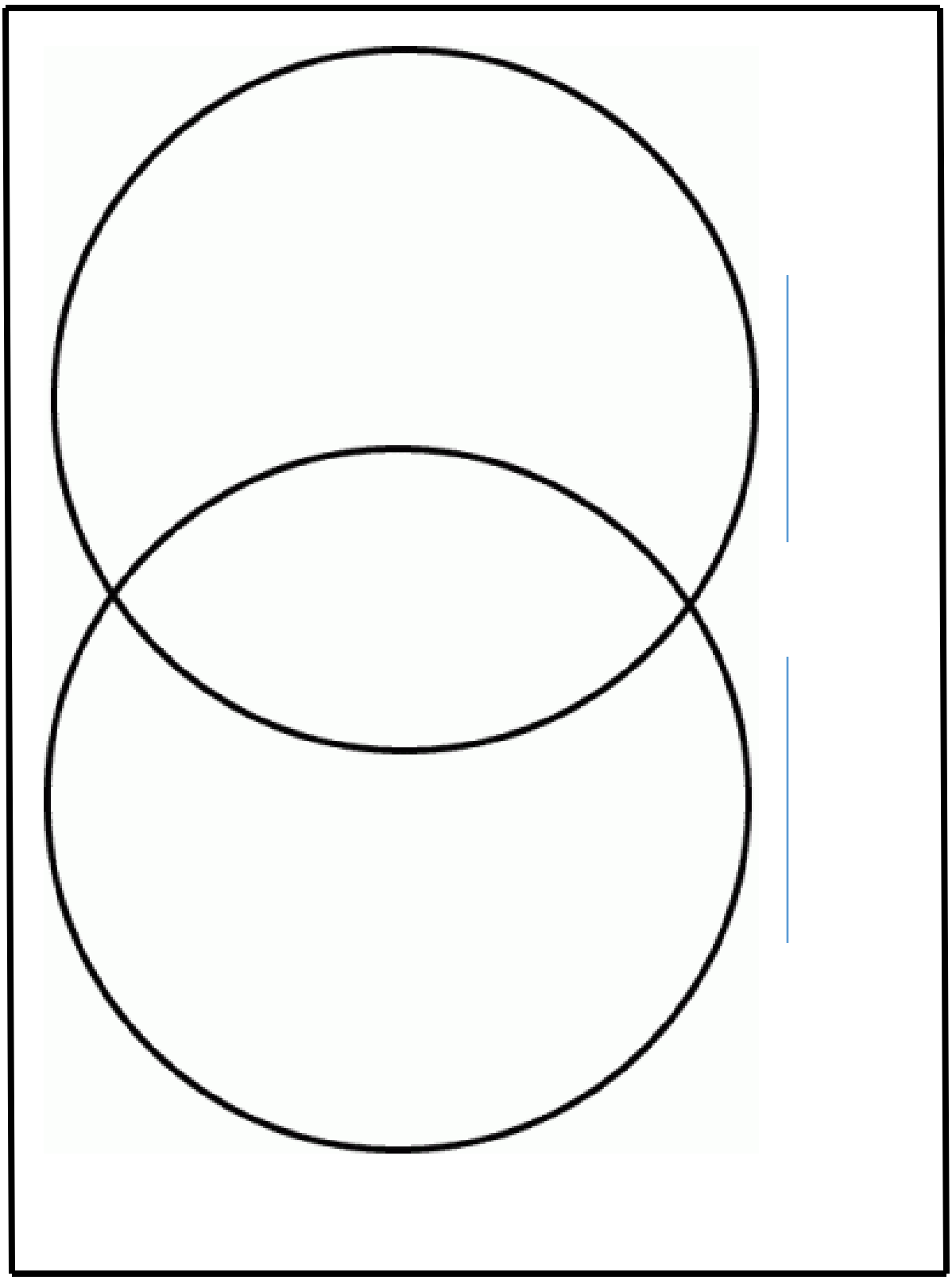


As a Matter of Fact

Performance Rubric

Why do we select certain materials when making things?

	Evidence for Exceeding Expectations	Meets Expectations	Areas for Improvement
L1		Can use descriptive words to describe an object. Can use property words to identify the observable properties of an object.	
L2		Can sort objects into two or more groups. Can explain the rule for sorting the objects. (Classifying)	
L3 **L4**		Can identify common materials. (wood, plastic, metal, fabric, or glass.) Can explain why a certain material is best suited for an intended purpose. Can defend a claim about alternative or inappropriate material choices. Can use evidence from data to support materials recommendations.	



Compare and Contrast