 

| Investigating Material Properties |
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| Physical Science and Engineering, Grade 2  (Revised July 2018)  **Standards addressed in unit:**  **2-PS1-1.** Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.  **2-PS1-2.** Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.\* Clarification Statements: Examples of properties could include, color, flexibility, hardness, texture, and absorbency. Data should focus on qualitative and relative observations.  **2.K-2-ETS1-3**. Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.\* Clarification Statements: Data can include observations and be either quantitative or qualitative. Examples can include how different objects insulate cold water or how different types of grocery bags perform. |
| Students identify and classify materials based on properties such as color, strength, texture, hardness, flexibility, and absorbency. They use various objects for classification that help them understand how to classify and describe materials as well as how the properties of materials relate to their use in the designed world. Through scientific observation and writing students manipulate and observe the properties of different materials. They rate materials by testing properties and ultimately design and build a transport tool using their knowledge of material properties. Students use science notebooks to record and analyze their findings. |

*This Model Curriculum Unit is designed to illustrate effective curriculum that lead to expectations outlined in the 2016 Science and Technology/Engineering Curriculum Frameworks (*[*www.doe.mass.edu/STEM/STE*](http://www.doe.mass.edu/STEM/STE)*) as well as the MA Curriculum Frameworks for English Language Arts/Literacy and Mathematics. This unit includes lesson plans, a Curriculum Embedded Performance Assessment (CEPA), and related resources. In using this unit it is important to consider the variability of learners in your class and make adaptations as necessary.*

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Unit Assumptions and Comments on Sequence

**Sequence:**

This physical science unit emphasizes the science practices of observation and description, carrying out investigations, analyzing data and constructing explanations. By the end of the unit, students will understand that objects are made of different materials (i.e. wood, plastic, metal, cloth, and paper, etc); the difference between materials and properties, and that different properties (texture, color, strength, hardness, flexibility, and absorbency) can be used to compare objects. Throughout the unit, students carry out investigations in groups, produce data and analyze their findings. They also develop appropriate vocabulary to describe the observable properties through which materials are classified.

**Unit Assumptions:**

Before starting this unit, students should understand:

* The difference between human-made and natural objects.
* How to identify properties of objects and materials.
* A science journal is a place to document their work and ideas.

Students should also have the following skills to:

* Work cooperatively and collaboratively.
* Have academic science discussions.
* Have a working knowledge of a science journal/notebook.
* Be familiar with a data table.
* Write informational text.

See the strand map on the following page for an overview of the science standards that precede this unit and how the standards learned in this unit contribute to students learning in later grades.

Notes about the unit:

* Throughout the unit there are notes to the teachers to suggest ideas and strategies. They are noted as such and written in parentheses.
* All handouts are located at the end of the unit in the **Unit Resources** section.

Strand maps for standards 2.K-2-ETS1-3, 2-PS1-2, and 2-PS1-1.

2.K-2-ETS1-3
 - Prior standards - 1.K-2-ETS1-1
 - Following standards - 2PS1-2, 2-ESS2-1

2-PS1-2
 - Prior standards: 2.K-2-ETS1-3, 2-PS1-1
 - Following standards: 5.3-5ETS3-1(MA)

 2-PS1-1
 - Prior standards - PreK-PS2-1(MA), PreK-PS1-3(MA)
 - Following standards - 2-PS1-2, 5-PS1-3

2-PS1-1


|  | | |
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| Unit Plan  **Stage 1 Desired Results** | | |
| **ESTABLISHED GOALS G**  2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.  2-PS1-2. Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.\* Clarification Statements: Examples of properties could include, color, flexibility, hardness, texture, and absorbency. Data should focus on qualitative and relative observations.  2.K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.\* Clarification Statements: Data can include observations and be either quantitative or qualitative. Examples can include how different objects insulate cold water or how different types of grocery bags perform.  **ELA/Literacy Connections**  W-2.2. Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section. | ***Transfer*** | |
| ***Students will be able to independently use their learning to…* T**   * Use principles of the physical world to analyze and design products and systems to address social needs and wants. | |
| ***Meaning*** | |
| **UNDERSTANDINGS U**  ***Students will understand that…***  **U1** Matter can be described and classified by its observable properties.  **U2** Different properties are suited to different purposes.  **U3** A great variety of objects can be built up from a small set of pieces.  **U4** People can solve a problem through engineering and comparing/testing designs using their knowledge of the natural world.  **U5** Information from texts can be used to develop and write informational documents. | **ESSENTIAL QUESTIONS Q**  **Q1** How do you determine properties of materials?  **Q2** How do the properties of materials relate to their use in the designed world? |
| ***Acquisition*** | |
| ***Students will know…* K**  **K1** The basic observable properties for materials (color, texture, shape, size, weight, hardness).  **K2** The methods used to sort and classify materials based on their properties.  **K3** The simple tests used to investigate properties and categorize materials | ***Students will be skilled at…* S**  **S1** Observing and categorizing materials based on their basic properties.  **S2** Testing materials to observe and compare properties.  **S3** Analyzing data from tests of a tool to determine if it works as intended.  **S4** Making observations (firsthand) to construct an evidence-based account.  **S5** Writing informative/explanatory texts  **S6** Using the properties of materials to design and build a tool that will solve a problem.  **S7** Conducting a scientific observation (process and note-taking).  **S8** Constructing explanations and designing solutions; and obtaining, evaluating and communicating information.  **S9** Participating in group scientific discussions. |
| **Stage 2 - Evidence** | | |
| **Evaluative Criteria** | **Assessment Evidence** | |
| see CEPA Rubric | **CURRICULUM EMBEDDED PERFORMANCE ASSESSMENT (PERFORMANCE TASKS) PT**  **Goal:** Students demonstrate their understanding of properties of materials by applying those properties to a design task. They need to design, build and test a tool that can be used to pick up two different objects and move them from one point to another as efficiently as possible.    **Role:** Students are engineers on a construction site.  **Audience:** The foreman on the construction site who will be evaluating their tool design.  **Situation:**  Workers need to move two different objects from one area of the construction site to another area. The objects are blocking the area they need to build their building. The students (engineers) need to design and build a tool that will pick up the different objects. Their tool needs to keep the object “in” or “on” the tool in order to transport the item a standard distance. Students will try to move the objects over the distance. They then reflect on their tool designs.  **Product:** Students will design, build, and test a tool to move two different objects a standard distance, and write a report for the foreman about the effectiveness of their tool.  **Standards:** Students will be given a checklist beforehand to guide their tool design. This will be based on the rubric that the foreman will be using. | |
|  | **OTHER EVIDENCE: OE**  **Formative Assessments from lessons 1-3**   * Active, focused participation in whole-class and small-group discussions (asking and answering questions, making predictions and inferences, communicating data and results) about materials and properties of objects * Students’ ability to ask and answer questions about materials and properties * Written responses to questions that include supporting evidence from testing different properties * Analysis and discussion of data * Accuracy, relevance, and completion of individual science notebooks for recording investigations, data and ideas (drawings, tables, artifacts, writing) * Successful engagement in hands-on science and engineering investigations * Written informational paragraph on strength and real-life application of material properties | |
| **Stage 3 – Learning Plan** | | |
| **Summary of Key Learning Events and Instruction**  **Lesson 1: Exploring Materials (recommended time: 1 x 30-minute period)**  Students sort and classify everyday objects by their materials. They then describe the similarities and differences in the materials that are commonly used to make everyday objects and list their properties.  **Lesson 2: Exploring Material Properties (recommended time: 1 x) 30-minute period)**  Students review the objects they classified and sorted from the previous lesson. Students classify and sort the materials according to common observable properties. They describe the similarities and differences in their science notebook.  **Lesson 3: Testing and Rating Materials (recommended time: x 4) 30-minute periods)**  In a series of investigation stations, students test and rate observable properties (color, texture, hardness, strength, flexibly and absorbency) of materials. They use test results to determine which materials are best suited for a purpose and record their findings in their science notebook.  **Lesson 4: Testing Materials and Objects for a Purpose (recommended time: 2 x 30-minute periods)**  Students test different types of grocery bags to figure out what would be the best material to carry groceries. They test materials and their properties, analyze data and compare the strengths and weaknesses of each material. Students then write an informational paragraph justifying which material was best suited for holding groceries using evidence from their investigations.  **CEPA: Designing and Testing a Utensil to Move Various Items (recommended time: 3 x 30-minute periods)**  Students demonstrate their understanding of observable properties of materials by applying those properties to a design task. They design and build a tool (based on their knowledge of material properties) to move two different objects over a standard distance. They test their tool's function and efficiency. They present their findings and then write an informational paragraph describing and justifying their design choices. | | |
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Lesson 1: Exploring Types of Materials

**Brief Overview of the Lesson:** Students sort and classify everyday objects by their materials. They then describe the similarities and differences in the materials that are commonly used to make everyday objects and list their properties.

**Estimated Time:**approximately 1 x 30-minute period

**Standard(s)/Unit Goal(s) to be addressed in this lesson:**

* 2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.

**Essential Question(s) addressed in this lesson:**

* How do you determine properties of materials?

**Content Objective(s):**

* Students will be able to make observations in order to compare different properties of materials.
* Students will be able to use information from observations to explain how the same material can be used to make different objects.

**Language Objective(s):**

* Students will be able to use comparative language (on the other hand, more than, less than) in their discussion about the materials.

**Targeted Academic Language:**

* properties, material, human-made, natural, object, classify, describe, sort, similarities, differences

**What students should know and be able to do before starting this lesson:**

* Understand the difference between human-made and natural objects.
* Work in small groups collaboratively.
* Be familiar with grouping/sorting like items.

**Anticipated Student Preconceptions/Misconceptions:**

* Students may only think of materials as “earth materials.” They may not realize materials can be found everywhere.
* Students may not be aware of the range of materials’ texture, hardness, and color, etc.
* Students often consider size and shape as properties of objects and materials, but these are not properties of materials, only properties of objects.

**Instructional Materials/Resources/Tools:**

* Assortment of everyday objects - wood (i.e. ruler, pencil, chopstick), metal (i.e. spoon, can, aluminum foil, paperclip), plastic (i.e. utensil, bottle), rubber (i.e. eraser), fabric, paper, glass (i.e. marble, pair of old eye glasses), natural materials (i.e. leaves, rocks, clay) *Teacher Note: Pictures may be substituted for objects. Have enough variety of objects for students to work in small groups.*
* Trays/bins to hold objects
* Science notebook
* Chart paper
* Paper bag(s)
* Handout (can be copied and/or pasted into students’ notebooks)

**Instructional Tips/Strategies/Suggestions for Teacher:**

* This lesson also serves as a pre-assessment to determine what students already know about the properties of materials, as well as allowing misconceptions to begin to surface.
* Allow students to come up with their own vocabulary to name a property to assess prior knowledge. Lesson 2 defines the different types of common observable properties.
* Create a materials study center in a corner of the classroom where materials needed for investigations can be stored, and where children can work independently during center time.
* Have plenty of each type of material for groups to explore.
* Pictures may be substituted for objects.
* ESL Modification: Lower language level students may benefit from a word bank. Give an example to help them begin their task (i.e. object- eraser, material- rubber, property- flexible). Large Venn diagrams can be used as an alternative to writing/drawing in notebook. Students can place the objects onto the diagrams.

**Lesson Details:**

**Introduction: (5 min.)**

*Teacher Note: Optional: Students work in small groups instead of a large group. Prepare a few different bags filled with objects and have students work in small groups to discuss and/or write down the characteristics they feel.*

* Put an object in a bag ahead of time.
* Choose a student to reach into the bag and describe what they feel. The idea is not to identify the object, but to identify the properties that can be felt. Chart the characteristics. Have other students confirm the first student’s observations.
* Pull the object out of the bag and have students add to the list.
* Review the term, “material.” Explicitly define material:
  + **material**: anything used for building or making new things. Wood, metal, paint, and paper are examples of materials.

*They delivered the building materials to the construction site. I have to buy materials for my art class.*

* Explain that each material has “properties.” Explicitly define properties:
  + **properties:** characteristics of a material that you can figure out using your senses. Color, hardness, flexibility are examples of properties.
* Ask students which from the list is a property and what is a material.Point out that some materials come from the earth and others are made by humans. Ask them to give examples of human-made and natural materials. Explain that today we will be exploring all types of materials.

**Activity: (15 min.)**

*Teacher Note: Have various objects made of different materials available for students to sort, classify and describe.* *Pictures may be substituted for objects. Allow students to come up with their own vocabulary for types of properties. This will help assess prior knowledge. Lesson 2 defines vocabulary for the different types of common observable properties. Students are likely to classify objects by type of material and some may classify by property (i.e. blue, shiny, and transparent). Allow students to classify using either way.*

* Have an assortment of everyday objects in trays/bins on the tables.
* Split the students into small groups and ask them to sort, classify and describe the objects.
* Task 1: Each group discusses the objects and comes up with a way to classify them. They write/draw their groupings in their science notebook/handout.
* Task 2: Each group then describes 3 specific objects by their properties in their science notebook/handout. *Modification: Lower language level students may benefit from a word bank. Give an example to help them begin their task (i.e. object- eraser, material- rubber, property- flexible). Large Venn diagrams can be used as an alternative. Students can place the objects onto the diagrams.*
* Encourage students to comment or ask questions of each other in order to clarify ideas. Model appropriate science talk as needed.

**Closing: (10 min)**

* Each group of students shares a group of objects and how they classified them. Chart the student’s ideas. Ask students to say how they knew or what helped them to decide that a particular object is made of a particular material. Ask them to explain their classification of ‘difficult’ objects i.e. plastic with a wood grain. Have students identify which ones are classified by type of material and which one by property.
* Have students name a material and engage them in a discussion by asking why they think the manufacturer of each object decided to make it out of that particular material. Allow students to talk and respond to one another without commenting or correcting their ideas. Make note of the properties of materials that they mention. Students may note that some of the objects are sometimes made out of other materials. Spoons, for example, are often made of metal or plastic or wood.

*Optional:*

* Each group shares 1 material and describes its properties. Chart the student’s ideas.
* Review and write key vocabulary. Have a visual for each vocabulary term and use it in a sentence; ask students questions to relate to the language as necessary.

**Assessment:**

* Gauge student understanding based on small and large group discussions and science notebook/handout collected.
  + Students sorted and classified objects types of materials.
  + Students compared and contrasted different materials.
  + Students identified common materials and that the same material is used to make different objects.
  + Students recorded detailed information in drawing and writing.

Lesson 2: Exploring Properties of Materials

**Brief Overview of the Lesson:** Students review the objects they classified and sorted from the previous lesson. Students classify and sort the materials according to common observable properties. They describe the similarities and differences in their science notebook.

**Estimated Time:**approximately 1 x 30-minute period

**Standard(s)/Unit Goal(s) to be addressed in this lesson:**

* 2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.

**Essential Question(s) addressed in this lesson:**

* How do you determine properties of materials?

**Content Objective(s):**

* Students will be able to compare and contrast different materials based upon their observable properties.
* Students will be able to generate multiple classifications of materials according to their observable properties (color, strength, flexibility, hardness, texture, and absorbency).

**Language Objective(s):**

* Students will be able to use comparative language (on the other hand, more than, less than) in their discussion about the materials.

**Targeted Academic Language:**

* Properties, material, human-made, natural, object, classify, describe, sort, similarities, differences, color, strength, flexibility, hardness, texture, absorbency

**What students should know and be able to do before starting this lesson:**

* Understand the difference between human-made and natural objects.
* Work in small groups collaboratively.
* Be familiar with grouping/sorting like items.

**Anticipated Student Preconceptions/Misconceptions:**

* Students may only think of materials as “Earth materials.” They may not realize materials can be found everywhere.
* Students may not be aware of the range of materials’ texture, hardness, and color, etc.
* Students often consider size and shape as properties of objects and materials, but these are not properties of materials, only properties of objects.

**Instructional Materials/Resources/Tools:**

* Assortment of everyday objects (made from wood, metal plastic, fabric, paper, glass, rock, clay, natural materials)

*Suggestion: Pictures may be substituted for objects. Have enough variety of objects for students to work in small groups.*

* Trays/bins
* Science notebook
* Chart paper
* Handout (can be copied and/or pasted into students’ notebooks)
* Book: *What if Rain Boots were Made of Paper?* By Kevin Beals and P. David Pearson, Illustrated by Tim Haggerty

**Instructional Tips/Strategies/Suggestions for Teacher:**

* Create a materials study center in a corner of the classroom where materials needed for investigations can be stored, and where children can work independently during center time.
* Use the same objects from the previous lesson.
* Have plenty of each type of material for groups to explore.
* Pictures may be substituted for objects.

**Lesson Details:**

**Introduction: (10 min.)**

*Teacher Note: Use the story of Cinderella and her glass slippers in replace of book.*

* Read the story: *What if Rain Boots were Made of Paper?* Have a discussion about the objects in the book (i.e. rain boots made of paper and frying pans made of rubber) in order to get them thinking about the relationship between objects, the materials used to make those objects, and the properties of those materials. *Optional: Ask students, “What if blankets were made of straw? What if baseballs were made of cotton?” Let students suggest a few more object/material combinations. Ask them to write about and illustrate the advantages and disadvantages they imagine would be encountered by making their object out of a different material.*
* Brainstorm a list of properties that need to be considered when making decisions about which material to use. This is a good time to introduce some of the terms used to describe physical properties that have not yet come up in discussion. Chart out the words used for the different properties. Introduce vocabulary (color, strength, flexibility, hardness, texture, absorbency) that the students did not come up with on their own. *Teacher Note:* *Suggestion: Create a word wall.*
* Explain that they will be observing the properties of the materials we explored yesterday.

**Activity: (15 min.)**

*Teacher Note: Use the same assortment of everyday objects from the previous lesson. The students will be testing the materials in Lesson 3. Remind students that materials can have multiple properties. Emphasize that they will be sorting are sorting by properties this time.*

* Split the students into small groups.
* Each group sorts and classifies the materials by their **observable properties** in their science notebook/handout. They also record their rules for sorting on the table below.
* After they have sorted one way, have them try again using a different sorting system.
* Encourage students to comment or ask questions of each other in order to clarify ideas. Model appropriate science talk as needed.

**Closing: (5 min)**

* Each group of students shares out and describes what properties they group withed what materials. (Check for accuracy and understanding). Chart the student’s ideas.
* Ask students to say how they knew or what helped them to decide why that material has a particular property.
* Review and write key vocabulary. Have a visual for each vocabulary term and use it in a sentence; ask students questions to relate to the language as necessary.

**Assessment:**

* Gauge student understanding based on small and large group discussions and science notebook/handout collected.
  + Students sorted and classified materials by their observable properties.
  + Students compared and contrasted different materials based upon their properties.
  + Students recorded detailed information in drawing and writing.
  + Students consider how the materials are used in life.

Lesson 3: Testing and Rating Materials

**Brief Overview of the Lesson:** In a series of investigation stations, students test and rate observable properties (color, texture, hardness, strength, flexibly and absorbency) of materials. They use test results to determine which materials are best suited for a purpose and record their findings in their science notebook.

**Estimated Time:**approximately 4 x 30-minute periods

**Standard(s)/Unit Goal(s) to be addressed in this lesson:**

* 2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.
* 2-PS1-2. Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.\* Clarification Statements: Examples of properties could include, color, flexibility, hardness, texture, and absorbency. Data should focus on qualitative and relative observations.

**Essential Question(s) addressed in this lesson:**

* How do you determine properties of materials?
* How do the properties of materials relate to their use in the designed world?

**Content Objective(s):**

* Students will be able to conduct an investigation to produce observations about materials according to common observable properties (color, texture, hardness, strength, flexibly and absorbency).
* Students will be able to analyze properties of materials and determine which are best suited for its intended purpose.

**Language Objective(s):**

* Students will be able to participate in collaborative conversations using their science notebook to support discussions.

**Targeted Academic Language:**

* color, light, medium, dark, flexibility/flexible, hardness, soft, texture, absorbency/ absorbent, nonabsorbent, texture, smooth, bumpy, rough, strength, weak, ratings/rate, tests, record

**What students should know and be able to do before starting this lesson:**

* Identify properties of materials.
* Work cooperatively and collaboratively in small groups.
* Have an academic science discussion during explorations.
* Working knowledge of a science journal/notebook.
* Be able to use a data table.

**Anticipated Student Preconceptions/Misconceptions:**

* Students may not be aware of the range of materials’ texture, hardness, absorbency, strength, flexibility and color.
* Students often consider size and shape as properties of objects and materials, but these are not properties of materials, only properties of objects.
* Students may have some confusion around the term “absorbency” (thinking of materials as wiping liquids away instead of soaking up the liquid).
* Students many not be aware that “hard” materials like wood and stone can absorb water.

**Instructional Materials/Resources/Tools:**

* Science notebook
* Data table handout (can be copied or pasted into student notebook)
* Paper plates, mats, cups or trays (for sorting, holding and displaying materials)
* Color Station (this station is used as an example that whole group does together)
  + Pieces of cloth, crayons, colored pencils, paint sample swatch cards, construction paper, etc.
* Texture Station (this station is used as an example that whole group does together)
  + Pieces of bubble wrap, sand paper, clothes/fabric, stuffed animals, etc.
* Absorbency Station
  + Container of water for each group
  + Small pieces of material (cork, wood, metal and plastic, sponge, paper towel, rubber, pencil, sheet of paper, etc.)
  + Droppers/pipettes
  + Plastic cups/bowls
  + Stop watch
* Strength Station
  + Cardboard, metal (ruler or dowel), wood, plastic (All materials should be about same size.)
* Flexibility Station
  + Erasers, plastic items, various springs, pipe cleaners, elastic bands, aluminum foil, string, fabric, cardboard, pencil, metal spoon, etc.
* Hardness Station
  + Nail or coin to use scratch the materials (one at each station to perform scratch test for hardness)
  + Foods, rocks, pieces of wood, pieces of metal, sticks, pencil, plastic ruler, metal ruler, can, rubber, plant pot, etc.
* Large group data table on white/blackboard or chart paper
* Sticky notes

**Instructional Tips/Strategies/Suggestions for Teacher:**

* Complete this lesson sequence over four days—two stations per day and one day for data analysis and science discussion.
* Take enough time to go over key vocabulary needed to record observations.
* Give enough time for debrief and wrap up of the lesson.
* Station rotations
  + Create instructions for each station to place at stations
  + Each group of students rotates through all the stations over three days.
  + Set up stations around the room ahead of time or have materials separated in bins for students to set-up at tables.
  + As students rotate to a new station provide station modeling as needed.
  + Have plenty of each type of material to resupply stations as some will be damaged during explorations.
  + Teachers may pick any three or more materials for the stations. The presented materials are just suggestions. Make sure the materials represent a variety of types (i.e. not just earth materials or all manufactured materials).

**Lesson Details:**

**Day 1- Introduction: (10 min.)**

* Ask students, “How we can test properties of materials?” Guide conversation as needed. Allow time for students to respond and quickly chart ideas for testing materials.
* Explain that they will be conducting a scientific investigation testing material properties (color, texture, hardness, strength, flexibly and absorbency) explored in the previous lesson.
* Explain and discuss that they will be using a data table to write down their predictions and observations. *Teacher Note: Use data table in handout section or have students create one or paste it in their science notebook.*
* Set expectations for stations and group work.

**Activity: Testing for Color and Texture (20 min.)**

**Materials Exploration:**

*Teacher note: The first two stations are designed for the entire class to do together. Model as needed how to fill out the data table and any directions for how you would like students to test the materials.*

**Color**

* + Hold up a black piece of construction paper and a white one. Ask for the difference. When color is offered, push for how would you describe the white one? (light) How would you describe the black one? (dark) Hold up a gray one. (medium) Practice rating color using the terms: **light, medium and dark.**
  + Show various shades of blue (or any color can work) paper. Ask the students to rate the colors according to light, medium, dark. *Suggestion: Paint sample swatch cards work well. Cut them up to challenge students to put them in order from lightest to darkest.*
  + Have the students turn and talk.
  + Encourage students to comment or ask questions of each other in order to clarify ideas. Model appropriate science talk as needed
  + Share out responses and have students record their ratings in their data table.

**Texture**

* + Pass out materials that have different textures (i.e. bubble wrap, sand paper, clothes/fabric, stuffed animals, etc.)
  + Have the students work in groups to rate the textures (i.e. **rough, smooth, bumpy**, etc.) based on their sense of touch.
  + Have the students turn and talk.
* Encourage students to comment or ask questions of each other in order to clarify ideas. Model appropriate science talk as needed.
  + Share out responses and have students record their ratings in their data table.

**Days 2 & 3: Station Rotations**

**Day 2: Testing for Absorbency and Strength (30 min.)**

**Introduction: (5 min.)**

*Teacher Note: Provide directions for each station for students to refer to. Provide sentence frames on the board to facilitate conversations at the stations: “I notice that \_\_\_\_\_\_.” “Why is \_\_\_\_\_\_\_\_\_ happening?” “I think that \_\_\_\_\_\_.”* *These sentence frames are suggestions to get conversation started at each station and help students fill out their data table. Remind students of classroom expectations around participating in collaborative conversations (use your usual structure for this—accountable talk, etc.). Circulate through the stations and assist as needed. Ask probing questions to help students access the concepts and transfer their understandings on a greater scale.*

* Explain that each group is going to plan and carry out investigations today and tomorrow. They will visit each station (4 in total) for 10 minutes each.
* Review how to use the data table. *Teacher Note: Data table is located in handout section or have students create one or paste it in their science notebook.*
* Divide the class into small groups. Review expectations for working in groups at scientific exploration stations.
* Pass out materials and have students rotate to their first station.

**Station 1: Testing for Absorbency (10 min.)**

*Teacher Note: Circulate through the stations and assist as needed. Ask probing questions to help students access the concepts and transfer their understandings. Encourage students to comment or ask questions of each other in order to clarify ideas. Model appropriate science talk as needed.*

* Students will be testing different materials to see which will absorb water the fastest.
* Station Directions:
* You are going to investigate the absorbency of different materials. Absorbent means to take in or soak up.
* Make a prediction: Which material absorbs water the fastest for cleaning up a spill?
* Test your materials:
  + Use a dropper and put 5 drops into each bowl.
  + Place each material in its own bowl and watch to see if it absorbs the water. Watch what happens for 10 seconds using the stopwatch, then again for 30 seconds and 1 minute.
  + Take your material out of the water and see if there is water left in the bowl.
  + Rate your materials on your data table - **nonabsorbent, a little absorbent or very absorbent**
  + Extension: If you have another idea to test for absorbency, share it with your group.

**Station 2:** **Testing for** **Strength (10 min.)**

* Students will be testing different materials to see which is the strongest.
* Station Directions:
* You are going to investigate the strength of different materials. Strength means how much an object resists being damaged or broken.
* Make a prediction: Which material is the strongest?
* Test your materials:
  + Try to bend the different materials. Which ones can you bend easily? Which ones are the hardest to bend?
  + Rate your materials on your data table - **weak, strong or very strong.**
* Extension: If you have another idea to test for strength, share it with your group.

**Closing: (5 min)**

* Ask the students to define *strength*. Have students share out different materials that **weak, strong or very strong.**
* Ask students to define *absorbency.* Have students share out their predictions and results for their test using the terms: **nonabsorbent, a little absorbent or very absorbent.**
* Facilitate a discussion of any contradictory results (i.e. one group says wood is very absorbent and the other group say it is nonabsorbent). Ask probing questions; “Why did you rate this material this way on this property? How do you know?”
* Prepare students for next day’s stations.

**Day 3: Flexibility and Hardness (30 min.)**

**Introduction: (2 min.)**

*Teacher Note: Remind students of classroom expectations around participating in collaborative conversations (use your usual structure for this—accountable talk, etc.). Encourage students to comment or ask questions of each other in order to clarify ideas. Model appropriate science talk as needed.*

* Split students up into small groups. Pass out materials and have students rotate to their first station and begin explorations.

**Station 3: Testing for Flexibility (10 minutes)**

*Teacher Note: Circulate through the stations and assist as needed. Ask probing questions to help students access the concepts and transfer their understandings on a greater scale.*

* Students will be testing different materials to see which is the most flexible.
* Station Directions:
  + You are going to investigate the flexibility of different materials. Flexibility means how much the object will bend without breaking.
* Make a prediction: Which material is the most flexible?
* Test your materials:
  + Try to bend the different materials. Which ones can you bend easily?
  + Rate your materials on your data table- **very flexible, flexible or not flexible.**
* Extension: If you have another idea to test for flexibility, share it with your group.

**Station 4: Testing for Hardness (10 min.)**

*Teacher Note: Give students only one type of scratching tool so results are consistent.*

* Students will be testing different materials for hardness.
* Station Directions:
  + You are going to investigate the hardness of different materials. Hardness means how firm an object is, and how easily it is scratched
  + Make a prediction: Which material is the hardest?
  + Test your materials:
    - You will need to scratch each material using a coin or a screw and measure how easy it was to scratch.
    - Rate your materials on your data table **soft, hard or very hard.**
  + Extension: If you have another idea to test for hardness, share it with your group.

**Closing: (8 min)**

* Ask the students to defineflexibility. Have students share out different materials that are **very flexible, flexible or not flexible weak.**
* Ask students to define *hardness.* Have students share out different materials that are **soft, hard or very hard**.Discuss difference between hard and very hard.
* Facilitate a discussion of any contradictory results (i.e. one group says wood is very absorbent and the other group say it is nonabsorbent). Ask probing questions; “Why did you rate this material this way on this property? How do you know?”
* Encourage students to comment or ask questions of each other in order to clarify ideas. Model appropriate science talk as needed.
* Prepare students for next day’s data analysis and reflection.

**Day 4 - Data Analysis and Reflection: (30 min.)**

**Introduction: (5 min)**

* Review properties and tests from the previous days.
* Split students up into small groups. The groups can be the same or different as the station groups.
* Begin a discussion of how these properties could help decide when and how to use which materials.
  + How would rating properties of materials be useful in life?
  + Are there jobs that you’d need this skill for or times when you’d have to choose one material over another?
  + What materials have the properties that are best suited for…. picking up spills? being visible for people to see? standing on? keeping you from slipping?

**Data Analysis and Reflection: (20 min)**

*Teacher Note: Have large group data table ready for group analysis.*

* Student Group Activity (10 min.)
  + Students will work in small groups to compare their findings on each test (from the past three days of explorations).
  + Students use sticky notes to decide as a group which materials would be best suited for picking up spills? being visible for people to see? standing on? keeping you from slipping? etc.
  + Students write one material on each sticky note (i.e. sponge) and then place that material on the large group data table in the appropriate column (i.e. the sponge sticky note would be placed in the best for….. column.)
* Large Group Activity (10 min)
  + Once students have completed their task, come back together as a large group.
  + Work through a discussion of which materials were best suited for the different tasks. Ask for the evidence they have to back up their ratings. Move sticky notes as necessary.
  + Have the class agree on a final list. *Optional: Have students record the class’s findings in their science notebook and/or have them edit their initial results based on the class discussion.*
  + Suggested Conversation Prompts:
    - How did you choose which material was suited best for that task? Why?
    - What surprises did you find during your explorations of each material?
    - Are there any further tests you’d do to determine the properties?

**Closing: (5 min.)**

* End with a discussion of how these properties could help decide when and how to use which materials.
  + Why are those materials best suited for that purpose?
  + Are there jobs that you’d need this skill for or times when you’d have to choose one material over another?
* Chart responses.

**Assessment:**

* Gauge student understanding based on small and large group investigations discussions and data collected.
  + Students observed a variety of properties (color, flexibility, hardness, texture, absorbency).
  + Students tested and rated a variety of materials for their properties (color, flexibility, hardness, texture, absorbency).
  + Students recorded detailed and accurate information in their notebook.
  + Students described properties and characteristics in phrases.

Lesson 4: Testing Materials and Objects for a Purpose

**Brief Overview of the Lesson:** Students test different types of grocery bags to figure out what would be the best material to carry groceries. They test materials and their properties, analyze data and compare the strengths and weaknesses of each material. Students then write an informational paragraph justifying which material was best suited for holding groceries using evidence from their investigations.

**Estimated Time:**approximately 2 x 30-minute periods

**Standard(s)/Unit Goal(s) to be addressed in this lesson:**

* 2-PS1-2. Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.\* Clarification Statements: Examples of properties could include, color, flexibility, hardness, texture, and absorbency. Data should focus on qualitative and relative observations.
* 2.K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.\* Clarification Statements: Data can include observations and be either quantitative or qualitative. Examples can include how different objects insulate cold water or how different types of grocery bags perform.
* W.2.2. Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

**Essential Question(s) addressed in this lesson:**

* How do the properties of materials relate to their use in the designed world?

**Content Objective(s):**

* Students will be able to conduct an investigation to produce data to compare properties of different materials for use in specific applications.
* Students will be able to construct written explanations based on evidence from their investigations.

**Language Objective(s):**

* Students will be able to participate in collaborative conversations using their science notebooks to support discussions.

**Targeted Academic Language:**

* test, discuss, notice, record, predict, investigate, repel, weight, suited

**What students should know and be able to do before starting this lesson:**

* Identify and test properties of materials.
* Work cooperatively and collaboratively in small groups.
* Have an academic science discussion during explorations.
* Have working knowledge of a science journal/notebook.
* Be able to use a data table.
* Write informational text.

**Anticipated Student Preconceptions/Misconceptions:**

* Students often consider size and shape as properties of objects and materials, but these are not properties of materials, only properties of objects.

**Instructional Materials/Resources/Tools:**

* Science notebook
* Testing Materials handout (can be copied or pasted into student notebook)
* Large chart paper or white/blackboard
* Paper and plastic grocery bags (optional: add a reusable bag). Enough for each station to test bags.
* Heavy items (i.e. books, bricks, cans, etc.)
* Spray bottle with water
* Air pillows or balloons
* Optional: scale

**Instructional Tips/Strategies/Suggestions for Teacher:**

* Teacher may need to review structure of informational writing (introduction, facts, details, and conclusion) and model an example.
* Have enough materials for each group to perform their investigation at the same time.
* Use same type of bags and “heavy” materials for each test for consistency.

**Lesson Details:**

**Day 1: Testing Materials**

**Introduction: (5 min.)**

* Ask students, “Have you ever been carrying a bag of groceries and had the bag break or tear on you? Do some grocery bags hold up better than others do? What properties are important in a grocery bag?”
* Allow time for students to turn and talk to a partner. Chart their ideas.
* Explain the task that they will be working in small groups testing and comparing types of grocery bags and their properties to determine which is the best suited to carry groceries. Discuss how to use the data table. *Teacher Note: Data table is located in handout section or have students create one or paste into science notebook.*
* Split the students into small groups.
* *Teacher Notes:**Additional prompts to activate student’s prior knowledge or to be used during investigation as needed.*
  + *What properties would you look for in a bag?*
  + *What properties would you test for? Strength, flexibility, absorbency, texture, color, hardness?*
  + *Choose 3 different properties to test for. What would they be?*
  + *How will you test them?*
  + *What do we have to consider?*
  + *What do we mean by the best? The strongest?*

**Writing Instruction: (5 min.)**

* Ask students what makes a good informational statement? (i.e. When writing or answering why they think something will work). They should be descriptive and use evidence from experience or knowledge (not personal opinion, i.e. *It looks strong* or heresy *“Sally said so”*).
* Chart responses or model an example as needed.
* Create an example as a class together to be put up on board for students to refer back too during lessons.

**Exploration: (15 min.)**

*Teacher Note: Have enough materials for each group to perform their investigations at the same time. Use same type of bags and “heavy” materials for each test for consistency.*

* In small groups students should review types of bags at their table first and write down their predictions of which will be the best for carrying groceries and why?
* Groups will test the materials and record their answers.
* Investigation Directions
  + The Weight Test- Which type of bag holds the most weight? Which is the strongest?

*Teacher note: choose one type of object for students to test for consistency. (i.e. The entire class should all use books to test the strength of their bags.)*

* + - While one student holds the paper bag up, place books, bricks or other heavy objects into the bag one at a time until it breaks or tears.
    - Repeat with a plastic bag.
    - Record results (i.e. # of books).
    - Scale optional
  + The Wet Test- Does your bag absorb or repel water? Is it absorbent or nonabsorbent?
    - Spray a paper bag with water and to see if it absorbs or repels water.
    - Repeat with a plastic bag.
    - Record observations and results.
  + The Stretchy Test- Is your bag flexible? Does the material stretch or tear?
    - While one student holds paper bag up, place airfilled balloons or air pillows used for packing into bag one at a time until the bag is full or it tears.
    - Repeat with a plastic bag.
    - Record observations and results.

**Extensions:**

* Add other types of bags to testing process (i.e. reusable, cloth, etc.)
* Students choose and design two additional tests (i.e. for color and texture) to conduct and compare.
* Students contact area grocery stores and request information on amount of paper and plastic bags used in a week.

**Closing: (5 min.)**

* Have students discuss their results in small groups. Make sure each student has recorded the group’s results into their notebook or handout. Have them brainstorm other uses for the bags.

**Day 2: Writing a Conclusion (30 min.)**

**Write your Claim: (15 min.)**

*Teacher Note: Teacher may need to review structure of informational writing (introduction, facts, details, and conclusion) and model an example. As students are writing, circle around room to check for quality of writing. Pick a few exemplary examples to share with class.*

* Work through a short discussion of which type of bag was the strongest, weakest, most flexible, etc. Talk about the evidence they have to support their ratings. *Optional: Chart ideas.*
* Give students time to write a response to the question, *The best material to make the bag from is \_\_\_\_ because \_\_\_\_\_\_,* on the handout.
* Have a few students share out their claims and evidence.
* Lead a discussion based off their answers and come to a group decision on which materials were the strongest and weakest. *Teacher Note: Discussions can be done in small groups or through turn and talks first and then move to large group discussions.*
  + Points to discuss during debrief:
    - Which type of bag performs better? Is this the bag that you regularly choose?
    - What other qualities are important when choosing between paper and plastic bags?
    - What other information or issues influence consumers’ choices of bags?
    - Are there any problems with this material?
    - What other properties would you test for?

**Brainstorm Other Uses for Bags: (5 min.)**

* Ask students for examples from the previous day for other uses for bags. What properties would they look for in that bag?
* Lead a short discussion of how these properties could help decide when and how to use which material for that the new purpose.

**Write an Additional Use for your Bag: (10 min.)**

* Give students time to write a response to the question, *Choose an additional use for your bag. Which material would you choose based for your personal use? Why?*
* Have a few students share out their claims and evidence.
* Teacher collects for assessment purposes.

**Assessment:**

* Gauge student understanding based on small and large group discussions and written responses.

Curriculum Embedded Performance Assessment (CEPA)

**Designing and Testing a Utensil to Move Various Items**

**Brief Overview of the Lesson:** Students demonstrate their understanding of observable properties of materials by applying those properties to a design task. They design and build a tool (based on their knowledge of material properties) to move two different objects over a standard distance. They test their tool's function and efficiency. They present their findings and then write an informational paragraph describing and justifying their design choices.

**Goal:** Students demonstrate their understanding of properties of materials by applying those properties to a design task. They need to design, build and test a tool that can be used to pick up two different objects and move the materials from one point to another as efficiently as possible.

**Role:** Students are engineers on a construction site.

**Audience:** The foreman on the construction site who will be evaluating their tool design.

**Situation:**  Workers need to move two different objects from one area of the construction site to another area. The objects are blocking the area they need to build their building. The students (engineers) need to design and build a tool that will pick up the different objects. Their tool needs to keep the object “in” or “on” the tool in order to transport the item a standard distance. Students will try to move the objects over the distance. They then reflect on their tool designs.

**Product:** Students will design, build, and test a tool to move two different objects a standard distance, and write a report for the foreman about the effectiveness of their tool.

**Standards:** Students will be given a checklist beforehand to guide their tool design. This will be based on the rubric that the foreman will be using.

**Estimated Time:** approximately 3 x 30-minute periods

**Standard(s)/Unit Goal(s) to be assessed in this lesson:**

* 2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.
* 2-PS1-2. Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.\* Clarification Statements: Examples of properties could include, color, flexibility, hardness, texture, and absorbency. Data should focus on qualitative and relative observations.
* W.2.2. Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

**What students should know and be able to do before starting this lesson:**

* Identify and understand that materials have basic observable properties.
* Materials can be tested to observe and compare properties.
* Understand how to use a data table and analyze the data from it.
* Work cooperatively and collaboratively in small groups.
* Have an academic science discussion during explorations.
* Working knowledge of a science journal/notebook.
* Make observations (firsthand) to construct an evidence-based account.
* Write informational text.

**Instructional Materials/Resources/Tools:**

* Items to move (brick or rocks, “glass” or clear plastic, cotton balls, erasers, etc.—teacher chooses 2 types for whole class)
* Tool-building materials (plastic utensils, popsicle sticks, sponges, straws, string, tape, etc)
* 2 bins per group or masking tape squares on table (Point A and Point B—teacher make sure to mark off standard distance between two bins or place masking tape boxes on the table a standard distance apart)
* Bins for students to place their materials in
* Chart paper or black/white board
* Handouts:
  + Day 1-Tool Design: Moving Items Using Various Materials
  + Day 2 - Tool Building and Testing
  + Day 3- Final Reflection
  + Day 3- Comparison of Groups Tools Table
  + Student Tool Checklist for Tool Design, Testing, and Analyzing
  + Tool Design: Moving Items Using Different Materials (CEPA Rubric)

**Instructional Tips/Strategies/Suggestions for Teacher:**

* Before starting the lesson,
  + Determine ahead of time how far the tool should travel from point A to point B. Make sure to mark off a standard distance between two bins or place masking tape boxes on the table a standard distance apart.
  + Any materials available can be used for CEPA.
  + Suggestion of having students use maximum of three materials for building their tool.
  + Choose two items for class to move (i.e. heavy –brick, delicate- “glass”). Choose items that have different properties.
  + Set up stations around the room ahead of time or have materials separated in bins for students to use at tables.
  + Prepare the Day 3 Comparison of Groups Tools Table handout before the last session on board/projector or on large paper. Adapt the table as needed for your purposes.
  + Create a word wall of property terms that students can refer to (if not created earlier)
* Suggested 3-4 students per group.

**Assessment:**

* Use the rubric to evaluate student work based on CEPA worksheets collected and group presentations.

**Day 1: Tool Design and Building**

**Introduction: (5 min.)**

*Teacher Note: Suggested 3-4 students per group.*

* Explain the scenario: The foreman at a nearby construction site needs help from engineers (the students). The foreman needs to move two different objects from one area of the construction site to another area. The objects are blocking the area they need to build their building.
* Explain to students that each small group/partnership will create a tool that allows them to move the two different objects from one place to another (show objects that students need to move—i.e. cotton balls, paper clips, erasers). *Teacher Note: Choose objects that have different properties (i.e. heavy –brick, delicate- “glass”).*
* Explain to students that their tools must be built out of materials provided by the foreman (teacher) and that in order to choose the best materials for their tool they will have to figure out the material properties through questioning, observing, describing, measuring, comparing, classifying, recording data and findings.
* Explain to students that the success of their tools will be determined by how well they explain their choices when designing their tool and how they used the material properties.

**Tool Design and Document Choices: (20 min.)**

*Teacher Note: Review structure of informational writing (introduction, facts, details, and conclusion) and model an example, as needed.*

* Review the guidelines for the tool creation task. Break the students into small groups and pass out the task description worksheet and checklist. Have materials available for students to review what is available to them for designing purposes.
* Tell students they must decide what materials to use, the properties to investigate, how to build their tool and move the items from Point A to Point B. Students must justify their material choices through informational writing.
* Allow students about 10 minutes to talk and plan and 10 minutes to write with their partners as you circulate around the room. Decide whether students will need additional time or support, and plan for this the following day.

**Gather & Analyze Materials: (5 min.)**

* Set up an area where students who have finished planning can gather the materials needed for their tool. Provide a small tray or another container where students can organize these materials. Once they have organized their materials, they can begin to build if time allows.

**Day 2: Building and Testing**

**Introduction: (5 min.)**

* Review expectations for the CEPA Project and allow students time for final questions/organizing their materials. Remind students that they will present these tools to the class and justify the materials chosen to make their tool on Day 3.

**Build and Test Tool, Begin to Prepare Presentation: (20 min.)**

* Students start/continue to build and test their tool’s ability to move objects from Point A to Point B. When they have finished their “test runs” they should prepare their presentation in which they will discuss the materials and their properties they used and justify why they picked those over others.
* Have students write their responses on their worksheets.

**Day 3: Time Tools & Presenting Investigations (30 min.)**

**Presentations: (20 min.)**

* Give students a few minutes to make final preparations for their group presentations.
* Students present their tools. Each student team should have about 5 minutes to show and tell about their tools. *(Teacher Note: Student presentations can be presented over several days. Take advantage of times such as morning meeting, shared reading, and transitions for presentations.)*
* Teacher charts each group’s tools and the properties taken into consideration when building their tool. Use the Day 3 Comparison of Groups Tools Table in handouts section as example while students are presenting their investigations. Use this table on the board/projector. (*Teacher Note: adapt this table for your class’ purposes.)* For example, Group 1 considered color, texture, and strength for their materials/design. Teacher charts this information for comparisons/discussions.
* Once all groups have presented their tools, teacher will lead discussion on strengths and weaknesses of each design and how that relates to the properties of the materials used. For example, Group 1 considered color but not flexibility. Group 2 considered flexibility and texture, but not strength. What could each group do to improve their design/tool in the future?

**Writing Reflection: (10 min.)**

* Explain to students that they need to compare their tool to the other group’s tool in writing. They will write a short paragraph explaining what tool they would choose for moving items on a construction site. They have to justify their reasoning with facts and information from their investigations and presentations.
* Before students turn in their worksheets, have them revisit the checklist to review they have completed all of the tasks. Teacher collects CEPA worksheets for assessment purposes.

Unit Resources

**Lesson 1:**

* Exploring Types of Materials- Task 1
* Exploring Types of Materials- Task 2

**Lesson 2:**

* Exploring Properties of Materials

**Lesson 3:**

* Testing and Rating Materials Based upon Properties Data Table

**Lesson 4:**

* Testing Materials and Objects for a Purpose

**CEPA:**

* + Day 1-Tool Design: Moving Items Using Various Materials
  + Day 2 - Tool Building and Testing
  + Day 3- Final Reflection
  + Day 3- Comparison of Groups Tools Table
  + Student Tool Checklist for Tool Design, Testing, and Analyzing
  + Tool Design: Moving Items Using Different Materials (CEPA Rubric)

**Additional Unit Resources**

* Websites and supplemental lesson plans and information

**Lesson 1: Exploring Types of Materials- Task 1**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

| **Draw and label the objects that are similar.** | **How are these objects similar?** |
| --- | --- |
|  |  |
|  |  |
|  |  |

**Lesson 1: Exploring Types of Materials- Task 2**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |
| --- | --- | --- |
| **Object** | **Type of Material** | **Properties** |
|  |  |  |
|  |  |  |
|  |  |  |

**Lesson 2- Exploring Properties of Materials**

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| Common Properties | Material |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Lesson 3: Testing and Rating Materials Based upon Properties Data Table**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

| **Property** |  |  |  |
| --- | --- | --- | --- |
| **Color** | light | medium | dark |
| **Texture** | smooth | bumpy | rough |
| **Strength** | weak | strong | very strong |
| **Flexibility** | not flexible | flexible | very flexible |
| **Absorbency** | nonabsorbent | absorbent | very absorbent |
| **Hardness** | soft | hard | very hard |

**Lesson 4: Testing Materials and Objects for a Purpose**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Prediction:**

I think that the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bag will be the best suited for carrying groceries because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Paper and Plastic Bag testing- Record your results from your investigation.**

|  |  |  |
| --- | --- | --- |
| **Property** | **Paper Bag** | **Plastic Bag** |
| Strength |  |  |
| Absorbency |  |  |
| Flexibility |  |  |

List other uses for these materials.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Conclusion**

Provide evidence of why you think one bag is better suited than the other for carrying groceries. Explain your answer in the space below.

Think about ...Which type of bag performed better? What other qualities are important when choosing between paper and plastic bags?

The best material to make the bag from is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Choose an additional use for your bag. Which material would you choose for your personal use? Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CEPA: Day 1- Tool Design: Moving Items Using Various Materials**

**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Directions: Design a tool that allows people to move an item from one point to another. Things to consider when creating your tool**

* + - * What properties does each material have?
      * How can that material help you carry the two items?

List the materials used and draw a diagram (with labels!) to help people understand your tool. Make sure to give your tool an exciting name! Use the data table below and your science partner to help you.

Name of your Tool Design: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |
| --- | --- | --- |
| **Materials:** | **Properties:** | **How does this property help your tool?** |
|  | 1.  2.  3. |  |
|  | 1.  2.  3. |  |

1. Why are the materials you chose the best to move an object from one place to another?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What properties do those materials have that made you choose them for your tool design? Explain.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**CEPA: Day 2- Tool Building and Testing**

**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

In the space below draw a diagram of your tool (make sure to label the materials!).

Practice testing your tool! Record how it worked. Draw or write any changes you made to the tool.

**CEPA: Day 3-Final Reflection**

**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Which tool would you choose for moving items on the construction site? Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**CEPA: Day 3 Comparison of Groups Tools Table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Color** | **Flexibility** | **Hardness** | **Texture** | **Absorbency** | **Strength** |
| **Tool Design #1** |  |  |  |  |  |  |
| **Tool Design #2** |  |  |  |  |  |  |
| **Tool Design #3** |  |  |  |  |  |  |
| **Tool Design #4** |  |  |  |  |  |  |
| **Tool Design #5** |  |  |  |  |  |  |

**CEPA: Student Tool Checklist for Tool Design, Testing, and Analyzing**

**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Please check off on this list as you complete the task for your tool design.**

|  |  |
| --- | --- |
|  | My group named our tool design. |
|  | I listed at least 3 properties for each material on my data table. |
|  | I identified properties of each material and wrote why those properties are helpful for our tool. |
|  | I answered the two questions from Day 1 worksheet. |
|  | I drew a diagram of our tool and labeled the materials. |
|  | I ran practice tests of our tool and recorded information about how well our tool moved items from one point to another. |
|  | I answered the final question from the Day 3 worksheet. My written response has an introduction sentence, a least 3 facts and a concluding sentence. I have at least 5 sentences in my paragraph. |
|  | My group is prepared to present our tool to the group. |

**Tool Design: Moving Items Using Different Materials (CEPA Rubric)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **4- Exceeds Expectations** | **3- Meets Expectations** | **2- Developing** | **1- Emerging** |
| Properties  Investigated | Each material includes 3 or more properties to be observed and described. | Each material includes 2-3 unique properties to be observed and described. | Each material includes 1-2 properties to be observed and described. | Each material includes only 1 property to be observed and described. |
| Diagram | Diagram has all parts labeled and clearly conveys each material. | Diagram has most parts labeled and clearly conveys most materials. | Diagram has some parts labeled or incorrectly labeled parts and conveys some materials. | Diagram without labels or incorrect labels are provided. |
| Tool Efficiency /Testing | The variety of materials used provides a basis for multiple and unique ways of efficiently transporting an item from one point to another. All materials fit the task. | The variety of materials used allows several different ways to efficiently transport an item from one point to another. Some materials may not be a best fit for the task. | The materials chosen limits transportation of an item from one point to another. Some materials do not fit the task. | Materials are not appropriate or sufficient to complete the task. |
| Properties of Materials | The group used 3 or more different properties of materials to create their tool. | The group used at least 3 different properties of materials to create their tool. | The group used 2 different properties of materials to create their tool. | The group used 1 property of materials to create their tool. |
| Informational Writing | Written explanation introduces the topic, uses more than three facts and property definitions to strengthen justifications. Provides a concluding statement. | Written explanation introduces the topic, uses three facts and property definitions to strengthen justifications. Provides a concluding statement. | Written explanation introduces the topic, uses two facts and property definitions to strengthen justifications. Provides a concluding statement. (It may not include a topic and/or concluding statement.) | Written explanation introduces the topic, uses one or no facts and property definitions to strengthen justifications. (It may not include a topic and/or concluding statement.) |
| Group Presentation- Content | Presentation explains which materials were used and why. Gives information about choice of materials. | Presentation explains which materials were used and why. Gives some information about choice of materials. | Presentation somewhat explains which materials were used and why. Gives some information about choice of materials. | Presentation does not explain which materials were used and why. No information about choice of materials is given. |
| Group  Presentation | Clearly and effectively structured. Students take turns speaking; they speak clearly, and address the audience. The flow of the presentation is orderly and the sequence of evidence supports their claim. | Clearly and mostly effectively structured. Students mostly take turns speaking; they address the audience. The flow of the presentation is orderly and the sequence of evidence supports their claim. | Presentation is not clearly structured. Students mostly take turns speaking; they address the audience. The flow of the presentation is out of order and the sequence of evidence supports their claim. | Presentation is not clearly structured. Students do not take turns speaking; they address the audience. The flow of the presentation is out of order and the sequence of evidence does not support their claim. |

**Additional Unit Resources:**

|  |  |
| --- | --- |
| **Resource/Website** | **Possible Uses** |
| BBC series called Bitesize:  <http://www.bbc.co.uk/schools/scienceclips/ages/5_6/sorting_using_mate_fs.shtml>  <http://www.bbc.co.uk/schools/scienceclips/ages/7_8/characteristics_materials_fs.shtml>  <http://www.bbc.co.uk/bitesize/ks2/science/materials/>  <http://www.bbc.co.uk/bitesize/ks2/science/materials/material_properties/read/2/> | BBC activity website. Uses the language “characteristics” instead of “properties.” This site may be useful for differentiation purposes or teacher information.  Sorting Materials (first link)  Characteristics of Materials (second link)  Material Properties game (third link)  Material Properties Information for students, included quizzes (4th link) |
| <http://www.youtube.com/watch?v=xOKr462HLc0> | “3C Materials Song” Could be used as a hook, closing or introduction to the CEPA. Catchy little tune to get students thinking about the uses of materials. |
| PBS Learning Media- Materials Lab <http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfw.bbmatrls/materials-lab/> | Materials lab (intended for 3rd grade and up), may be useful for teacher background knowledge building or advanced students to explore. |
| Great! Schools:  <http://www.greatschools.org/worksheets-activities/6067-bend-it-stretch-it-squash-it.gs> | “Bend It! Stretch It! Squash It!” free printable PDF worksheet. Could be used as morning work, center work or homework. |
| Book: *What if Rainboots Were Made of Paper*  <http://store.amplify.com/designing-mixtures-student-book---what-if-rain-boots-were-made-of-paper-pk-of-6-p155.aspx#.UP7sAMnZf1A.pinterest>  <http://lawrencehallofscience.stores.yahoo.net/whifrabowema.html> | *What if Rainboots Were Made of Paper*  A story that explores different items made out of unusual materials and what might happen if they were really made out of those materials. This is a link to buy the book, but could be possible to find a local copy or purchase for read aloud extension. |
| Primary Source UK:  <http://www.primaryresources.co.uk/science/science3a.htm>    <http://www.primaryresources.co.uk/science/pdfs/rsc_tc_nc1.pdf> | Materials and their Properties lesson plans and background information. (First link)  “Properties of Everyday Materials” includes background information and extension activities that go along with unit. (Second link) |
| Discover Primary Science: <http://www.primaryscience.ie/media/pdfs/col/Paper_Strength_Activity.pdf> | Which paper has the greatest tearing-strength activity? Activity could be used for a supplement or additional activity for unit. |
| NOVA- PBS Series:  <http://www-tc.pbs.org/wgbh/nova/assets/education/making-stuff/making-stuff-activity-guide.pdf> | PBS- Making Stuff Activity Guide. Intended for older students, but has good background information and ideas for other activities. |
| Wordsmyth- Educational Dictionary and Thesaurus:  <http://www.wordsmyth.net> | Student-friendly definitions of terms |
| <http://www.teacherspayteachers.com/Product/2nd-grade-NGSS-Describe-and-Classify-Different-Kinds-of-Materials-944122>  <http://www.teacherspayteachers.com/Product/NGSS-2-PS1-2-Materials-Best-Suited-For-An-Intended-Purpose-1297361> | Teachers Pay Teachers Worksheets (could be used for centers or homework). Must be purchased or could be re-created by classroom teacher. |
| <http://www.ctsciencecenter.org/documents/PD/ODNU/Standard-3.1-Properties-Of-Matter.pdf> | Connecticut Science – Properties Of Matter Teacher guide |