Unit 2 (Materials):
Designing Experiments for Properties of Materials

Concept
Tests can be devised to determine properties of materials.

Content Objective
Teams use a design brief as they begin a design portfolio, and design a test to find materials that have certain properties.

Language Objective
Verbally describe a familiar test from home.
Evaluate the appropriateness of materials in writing using *coherent sentences* (evaluation and evidence match).
Sequence steps in design brief using sequencing words: *first, second, after that, next, then, last, finally.*

Standards
- **NGSS:**
  - **2-PS1-1.** Plan and investigate kinds of materials and their observable properties.
  - **2-PS1-2.** Analyze data from materials to determine which have best properties for an intended purpose.
  - **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define problem that can be solved with a new or improved object or tool.
  - **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses.
- **TEKS:**
  - **2C** collect data from observations using simple equipment such as hand lenses, primary balances, thermometers, and non-standard measurement tools (collect data with tools)
  - **2D** record and organize data using pictures, numbers, and words (organize data)
  - **2E** communicate observations and justify explanations using student-generated data from simple descriptive investigations (justify explanations of own data)
  - **2F** compare results of investigations with what students and scientists know about the world (compare with other findings)
  - **3A** identify and explain a problem in his/her own words and propose a task and solution for the problem such as lack of water in a habitat (explain prob and solution)
  - **3C** identify what a scientist is and explore what different scientists do (connect to adult scientists)
  - **4A** collect, record, and compare information using tools, including computers, hand lenses, rulers, primary balances, plastic beakers, magnets, collecting nets, notebooks, and safety goggles; timing devices, including clocks and stopwatches; weather instruments such as thermometers, wind vanes, and rain gauges; and materials to support observations of habitats of organisms such as terrariums and aquariums (use tools)
  - **5A** classify matter by physical properties, including shape, relative mass, relative temperature, texture, flexibility, and whether material is a solid or liquid (phy prop: shape, mass, temp, texture, flexibility, solid v. liquid)

- **5C** demonstrate that things can be done to materials to change their physical properties such as cutting, folding, sanding, and melting (phy changes in materials)

- **ELPS:**
  - **1A** use prior knowledge and experiences to understand meanings in English (prior knowledge)
  - **3G** express opinions, ideas, and feelings ranging from communicating single words and short phrases to participating in extended discussions on a variety of social and grade-appropriate academic topics (express opinions)
  - **4C** develop basic sight vocabulary, derive meaning of environmental print, and comprehend English vocabulary and language structures used routinely in written classroom materials (comprehend English vocabulary and structures in written materials)
  - **5F** write using a variety of grade-appropriate sentence lengths, patterns, and connecting words to combine phrases, clauses, and sentences in increasingly accurate ways as more English is acquired(write using a variety of patterns, connecting words, clauses)
  - **5G** narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired (narrate, describe, and explain)

Materials:
materials to be tested from recycleds and from around the room ; noodles ; paper; wood; plastic; Styrofoam; cloth ; manila folders or pocket folders for team portfolios ; butcher paper ; markers; copy of design brief on chart

Suggested Literature Connections
“First Day Jitters” by Julie Dannberg
“Iggy Peck Arcitect” by Andrea Beaty

Day 1: Engage Materials-Designing Experiments for Properties of Materials

Teacher Says/Does	Student Says/Does	Language requirements
1. Have students discuss how they get ready for school each morning using the sequence sentence stems in handout (**2.2.1**).	Student pairs discuss their morning routines at home.	Vocabulary: Design brief, product, material
2. Choose one student from each pair to share with the class, and record what s/he dictates. Number the steps and check the order with the student and class. Model the use of sequencing words like first, second, then, after that, etc.		first, second, after that, next, then, last, finally
3. Tell the students that a plan like this is a map for following directions, in engineering, we call these plans *design briefs*. *Design briefs* are very important for engineers, as they help them get their ideas together before they begin design work.	Student pairs discuss design brief.	
4. Remind students of the ways different materials stretched and compressed (Unit 1). Ask them how a design brief would help someone else repeat their test.		
5. Tell students different materials have different properties that make them better for a certain job or use. For the activity, each pair will receive copies of the material and product images from the handout (Materials Match **2.2.2**). [Note: Materials are represented in pictures. Products are written in words. You may want to review each material to be sure students know what each is.]	In pairs, students play the Materials Match activity using the sentence frames. Students chorally read sentence frames.	The product(s)_____ (can / cannot) be made with the material _____ because_____.
6. Model one or two matches and how to use of the sentence frames with the Materials Match cards.		
7. Observe students' language use and understanding while they play the Materials Match activity in pairs, and complete the sentence stems.		

Day 2: Explore/Explain Materials-Designing Experiments for Properties of Materials

Teacher Says/Does	Student Says/Does	Language requirements
1. Show students the different design problems in handout (**2.2.3**). Let each team pick the problem they want to work on. 2. Teams work independently to create a design brief for the test they've chosen, then discuss and try out the materials test. Have each team name their test and write down the steps they use during their tests using the sentence frames on the same handout (**2.2.3**). 3. While the students are working, use the **collaborative dialogue template** (p. 32 in Teacher Handbook) to guide conversations and take a running record of students' progress on content and language objectives. 4. When teams are done, bring them together to talk about what "tests" or *pruebas* are. The children know about math and reading tests, but did they know that scientists and engineers are always doing tests as part of their jobs? 5. Ask students to explain if they have seen their parents (or anyone else) ever test something. For example, when a company wants to make a new type of chewing gum, they have to find ways to test it to make sure that people will buy it. They need to find out if it's chewy and if it tastes good, properties they want the gum to have.	Student pairs discuss which challenge they will complete. Students write down the steps of their tests and perform the tests. Student pairs discuss how their parents test things out.	Vocabulary: first, second, after that, next, then, last, finally

Day 3: Elaborate/Evaluate Materials-Designing Experiments for Properties of Materials

Teacher Says/Does	Student Says/Does	Language requirements
1. Tell the students they will now exchange design briefs with the other teams to see if the other team can repeat the test. 2. Using the doc cam or projector, model the processing of filling out the feedback sheet (**2.2.4**). Emphasize the importance of respectful and constructive comments that help the team improve their plans. 3. Have the students exchange plans and circulate around the room while they are working to perform another team's test. 4. When the teams are ready, have each one share a 'glow' (a positive aspect) and 'grow' (something to improve) about the other team's design brief, and return feedback forms to the team. 5. Tell the students that they will have a chance in the next class to make changes to their plans based on their peers' feedback. 6. Ask students to discuss in pairs what makes a good design brief. 7. Allow student pairs to contribute ideas to the whole group, record the students' ideas about the criteria for quality design briefs. Tell them that you will use their ideas to develop the rubric for their final design briefs. Possible criteria include: • Includes appropriate sequence of steps • Uses of sequence words • Is easy to follow • Works to test the specific property	Student teams read another team's design brief and perform the test. Students write feedback using the sentence stems. Student pairs discuss qualities of a good design brief.	One thing that we liked was _____ __. One thing that you could improve is _____.

Day 4: Evaluate Materials-Designing Experiments for Properties of Materials

Teacher Says/Does	Student Says/Does	Language requirements
1. Before the lesson, modify the unit rubric based on the students' ideas from the previous session. 2. Have students work in teams to revise their design briefs based on peer feedback. In addition to the map, have students use sentence stems from handout (**2.2.5**) to answer the following questions: • *What materials and objects did you find that passed your test?* • *What materials were especially interesting?* • *Could you build a structure like a house out of your material?* 3. When the students are ready, have them share one important thing that they learned from the unit.	Student teams create a revised design brief and write their responses to the evaluation questions.	Vocabulary: first, second, after that, next, then, last, finally The _____ passed our test. We were especially interested in the _____ because _____. One important thing that we learned was _____.

Name: _____ Date: _____

Getting ready for school.

I want to explain _____.

First, _____

_____.

Second, _____

_____.

Then, _____

_____.

After that, _____

_____.

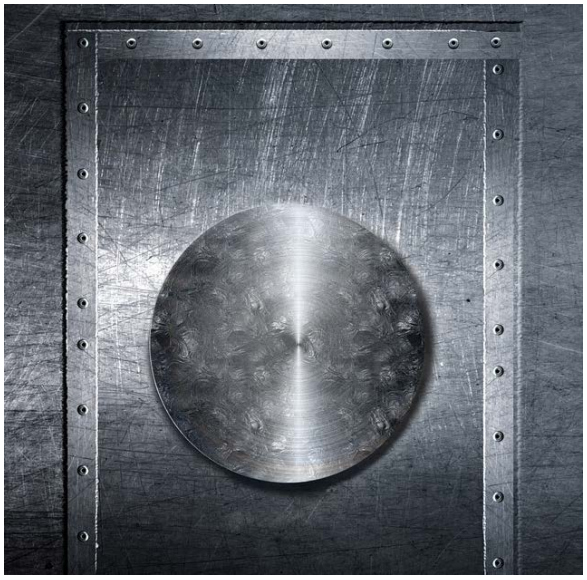
Finally, _____

_____.

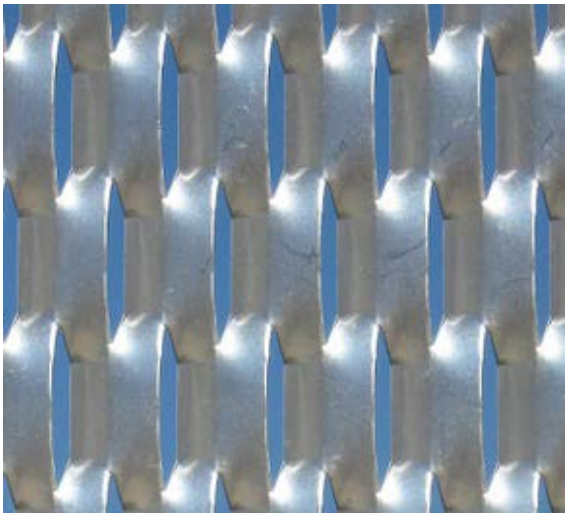
Name: _____ Date: _____

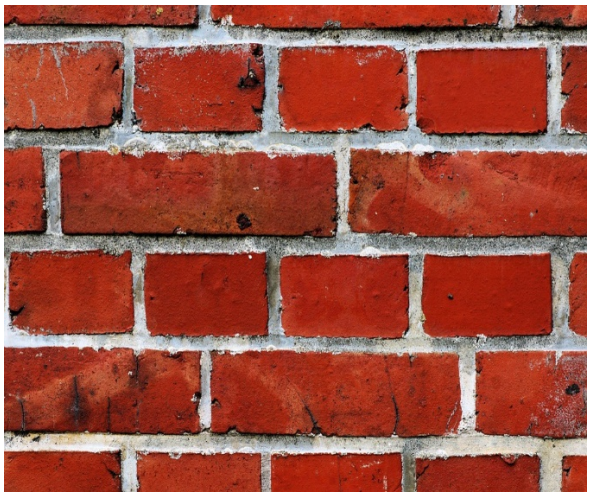
Name: _____ Date: _____

Materials Match



Name: _____ Date: _____





Name: _____ Date: _____

House or apartment building	**Car**
Teddy bear	**Soccer ball**
Straw	**Jeans**

Name: _____ Date: _____

Swimming suit	**Playground equipment**
Roads	**School building**
Pillow	**Spoon**

Name: _____ Date: _____

Can I use *this* to make *that*?

The product(s) _____ (can / cannot) be made with the material _____ because _____.

The product(s) _____ (can / cannot) be made with the material _____ because _____.

The product(s) _____ (can / cannot) be made with the material _____ because _____.

Name: _____ Date: _____

Name: _____ Date: _____

Design Brief: Experiments for Properties of Materials

Design Problem	Words to Remember/ Palabras para recordar
Design a way to find a material that is the most elastic. [OR] **Design a way to find a material that has the most shear strength.** [OR] **Design a way to find the best material that can be compressed without breaking.** [OR] **Design a way to find the best material that can be stretched without breaking.**	

Drawing or Model of Our Plan (You can use the back of the page, too!):

Steps	
Task	**Person Responsible**

Name: _____ Date: _____

Testing properties of materials.

For this experiment, we want to test _____.

To do this, we first need to_____

_____.

Second, _____

_____.

Then, _____

_____.

After that, _____

_____.

Finally, _____

_____.

Feedback Sheet

For Group: _____

From Group: _____

Instructions: Use this sheet to give respectful and helpful feedback about another team's design brief. Make an "*X*" on each line in the place showing how much you agree or disagree with each sentence.

1) We knew what we were supposed to test.

Strongly Disagree **Neutral** **Strongly Agree**

2) It was easy to follow your test.

Strongly Disagree **Neutral** **Strongly Agree**

3) We understood the different steps.

Strongly Disagree **Neutral** **Strongly Agree**

4) We got different results each time we tried your test.

Strongly Disagree **Neutral** **Strongly Agree**

5) One thing that we really liked was _____.

6) One thing that you could improve is _____.

Name: _____ Date: _____

Last remarks

The _____ (passed / did not pass) our test.

We were especially interested in the material _____

because _____.

One important thing that we learned about testing materials

was _____.