Bay Area Scientists In Schools Presentation Plan

Lesson Name: Properties of Materials
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Grade: 5 **Standards Connection(s):**

Next Generation Science Standards:

5-PS1-3. Make observations and measurements to identify materials based on their properties.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. **(5-PS1-1**) *Planning and Carrying Out Investigations* Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (**5-PS1-4**) Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (**5-PS1-3**)	*PS1.A: Structure and Properties of Matter* Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects. (**5-PS1-1**) The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (**5-PS1-2**) Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-	*Cause and Effect* Cause and effect relationships are routinely identified, tested, and used to explain change. (**5-PS1-4**) Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems. (**5-PS1-2**)

Common Core Standards:

ELA/Literacy:

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Mathematics:

MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.

FOSS Connections:

Grade 5 Module: *Mixtures and Solutions*
Investigation 4: *Elements*

Abstract:

Students will be given a chance to observe different materials, classify them based on their properties, and use those observations to solve a question posed to them at the beginning of the lesson. Students will also investigate the relationship between macroscopic properties and molecular structure.

Standards Connections:

Content Standards
Using Properties to Identify Compounds
Properties of Common Molecules
Experimentation Standards
Classify objects based on appropriate criteria
Plan and conduct a simple investigation based on student-developed questions
Record Data, draw conclusions, and write reports

Materials:

- Safety Materials
  Nitrile gloves (latex gloves can also be used but fewer people have nitrile allergies)
  Safety glasses

Experimental Materials
Styrofoam packing peanuts
Rubber bands
Copper wire
Glass slides
Common, non-hazardous, items needed for stations (e.g. nails, plastic milk jugs, ceramic bowl, sponge, etc.)

Wrap up Materials(SLIME!)
Borax solution
PVA solution
Cups
Spoons
Food dye

Plastic baggies

Vocab Words:

Hardness – a measure of how much the shape of a material changes when a force is applied

Hard solids – materials that are not easily broken or deformed when a force is applied

Soft solids – materials that are easily broken or deformed when a force is applied

Brittle – the ability to break cleanly without deforming

Flexible(ductile) – the ability to bend and deform without breaking

Classroom Visit

Concepts:

Materials can be hard and brittle (ceramics and glass), soft and brittle (Styrofoam), soft and plastic (rubber), or hard and plastic (metal wire or pipes)

A material's properties are based on its molecular structure

The same material can have different properties based on how it is treated when it is being made (will NOT go into specifics of the process, we only want them to see that the properties COULD be tailored based on the task for which it is needed)

Note for presenters:

This presentation is best done with at least five people—four to run the stations during the Topic Introduction and Learning Experience and one to prepare the slime during this time for the Wrap Up/Sharing Experiences. This will increase the efficiency of the latter, which can very easily become cumbersome.

1. **Personal Introduction** 5 minutes

Presenters introduce themselves to the students and tell them why they love science! Tell them that our job as chemists is to observe the properties of materials, explain them, and manipulate them

2. **Topic Introduction** 10 mins each = 40 mins

Students will break into groups (preferably four) and head to a learning station, each of which will discuss a different type of material (hard and brittle, soft and brittle, hard and flexible, soft and flexible)

Presenters will show students a common household item that fits the description of their station and ask the students to describe them in their own words

Presenters should encourage students to give any answer that they can think of; the goal being to get them to come up with as many words as possible to describe it. Then presenters can lead the students into talking about the hardness/softness and brittleness/flexibility of the material naturally by asking leading questions.

Teach them the new vocabulary words (defined above)

Hardness (contrast hard with soft)

Brittle

Flexible

Lead students into recognizing that properties are related to molecular structure

Models are a great way to simply explain the idea of molecular structure especially since 5th graders are only just now learning about atoms and molecules. To display the various types of materials, we used the following "models:"

Hard Materials: block of small beads glued together (to show that if one scrapes, they cannot take off top layer of "atoms")

Soft Materials: block of neodymium spherical magnets (to show that if one scrapes, they can take off top layer of "atoms")

Brittle Materials: molecular model with atoms held together by rigid K'nex connectors (to show that bending causes a fracture in the bonds)

Flexible Materials: molecular model with atoms held together by springs or rubber bands (to show that bending causes a deformation in the bonds)

Each group should explore each station for 10 minutes each, then rotate

After rotating groups, enforce what they learned at the previous station by asking what types of material they just learned about and to give an example of a common item that fits that description

3. **Learning Experience** 15 minutes

At the last station, each student will receive a worksheet from the presenter and be given and a task that needs to be completed along with a small box of possible materials to use **Presenters: see next page for worksheet**

Each station could have one task for whole group or break into smaller groups of a few students each with their own task

Students will work in small groups to determine what type of material is needed to complete that task (e.g. mailing a fragile package, building a table, making a key,finding a safety cover for fire extinguisher, making a sling shot, cleaning dirty dishes, etc.), express why this type of material would be suitable, and explain what the molecular structure might look like (either compared to another material or based on the models presented earlier)

Students will then be given a chance to present their findings to the class

Each presenter leading a group should pick one or two students to represent their group and share this information with the class

4. **Wrap up:Sharing Experiences** 10 mins

While still in small groups, students will—under very close supervision from teachers and presenters—be given materials to make slime (or play-dough)**Presenters: see next page for recipe of slime and play-dough**

During the Learning Experience one presenter was preparing the slime (or play-dough) by pouring appropriate amounts of the mixtures into separate cups and bringing the cups to each station

During the Wrap up/Sharing Experiences section, this presenter will then walk the students through making their slime (or play-dough)

Students should be able to use newly learned vocabulary words to describe the slime

Presenter can also relate how bonds must be forming to go from two liquids to a solid

5. Connections & Close 5 mins
   The presenters will thank the class and clean-up their supplies

TOTAL 75 mins

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to perform activities at each station. Read worksheet directions aloud. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students write down other examples of materials that have similar properties.

Follow-up Possibilities

ELA Activity:
Suggest students write a letter/report of the findings.

Letters can be addressed to:
Properties of Materials Group
c/o Community Resources for Science
1611 San Pablo Ave Suite 10 B
Berkeley, CA 94702

Reading Connections:

- Janice VanCleave's Molecules by Janice VanCleave – (Children ages 8-12) Includes 20 simple and fun experiments that allow you to discover the answers to these and other fascinating questions about molecules, plus dozens of additional suggestions for developing your own science fair projects. Learn about the structure of molecules with a simple experiment using gum drops and toothpicks; about molecular motion with a glass, a cup, and food coloring; about crystals using Epsom salts, a soap dish, and a paint brush; and much more. All experiments use inexpensive household materials and involve a minimum of preparation and clean up. http://www.amazon.com/Janice-VanCleaves-Molecules-VanCleave/dp/047155054X/

Mathematics Activity:
Students can create a graph showing the number of different objects based on their similar properties. Also, students can write and solve word problems that involve various materials with similar properties.

Other:

Chemistry of Green Lesson:
This is an activity (located on page 3 of PDF) about composites, materials made of 2 or more different components. Learners will be challenged to build the best mud bricks, one of the earliest examples of composites. From a supply of various building components, which the learners will examine for their different properties, they will build mud bricks, then dry them and put them through several tests. *Bricks must bake in the sun for 2-3 days prior to testing. Resource contains information about how this activity relates to carbon nanotubes and links to video, DragonflyTV Nano: Hockey Sticks.
http://pbskids.org/dragonflytv/web_assets/pdf/dftv_nanoedguide_hockeysticks.pdf#page=3

Properties of Materials Worksheet

What is the task that you need to complete? _____

_____

_

What are the materials available to you?

1. _____

2. _____

3. _____

4. _____

Which is the most appropriate to complete the given task? _____

What properties does this material have that make it appropriate? _____

_____

_

How do you think these atoms/molecules are arranged and connected that might lead to its properties?

_____

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_____

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_____

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Recipes and Instructions

SLIME

Most of the ingredients in this recipe can actually be purchased at stores if you know where to look. Borax is a soap that can usually be found in the cleaning aisle of a grocery store. PVA typically comes as a powder (unless you buy it already in glue form), which can usually be found in arts and craft stores and sometimes in home improvement stores. Then the only other things you need are food dye and water!

If you've never made this before, it might be fun to try it ahead of time with a scaled down version. The recipe here should make more than enough for 25 kids in a classroom!

To be prepared ahead of time:

PVA (poly-vinyl alcohol) solution:

Pour 1125 mL of H_2O into a 2000 mL beaker, bring to a boil, and cool to 90 °C
Sprinkle 45 g PVA (MW 120000 – 130000) portion-wise into beaker while stirring slowly to avoid clumping. Make sure first portion dissolves completely before adding more PVA
When all PVA has been added, cool to RT and store in a large plastic bottle with appropriate label

Sodium Tetraborate (Borax) solution:

Dissolve 8 g of sodium tetraborate in 200 mL of hot H_2O
Cool to room temperature and store in a stoppered Erlenmeyer flask with appropriate label

To be prepared during Learning Experience:

One presenter should spend time setting up two sets of small plastic cups—one set that contains ~90 mL of the PVA solution in each cup and one set that contains ~8 mL of the borax solution in each cup. If you want to be really efficient, you can add the food coloring to the PVA solution during this time or let the students choose their own color.

To be performed during Wrap Up/Sharing Experiences:

Tell students to pour the borax solution into the cup with the colored PVA solution and stir with a spoon until of proper consistency (you know… slimy)
If students would like to keep their slime, give them a (closeable) baggie in which to put it and ask them to place the slime in their back pack (so as not to distract them from their lessons later in the day).
I would suggest putting a small note of instructions in the bag, so that the parents know what they are dealing with. This slime is perfectly fine to handle (students should wash their hands after playing with it), but it is NOT edible. It is non-toxic however; so there is no need to call the poison hot line if a student accidentally swallows a small amount

Recipes and Instructions (Continued)

PLAY-DOUGH

To be prepared ahead of time:

Ingredients:

Measure out appropriate amount of flour, salt, and water for the number of students in the class in a 2:1:1 ratio, respectively.

Place each ingredient in a separate container labeled with its contents

To be prepared during Learning Experience:

One presenter should spend time setting up two sets of small plastic cups—one set that contains the correct ratio of dry ingredients in each cup and one set that contains the water in each cup. Also, even though there is no harm in the edible ingredients, as scientists we should mention that it is not proper scientific technique to taste chemicals as you can never be completely sure of what you are putting in your mouth, so please don't eat the play-dough.

To be performed during Wrap Up/Sharing Experiences:

Tell students to pour the water into the cup with the flour and salt and stir with a spoon until of proper consistency (you know… play-doughy)

They should then take the dough and make a small bowl in which to put the food dye.

Once the dye is placed in the bowl, they can kneed the color into the dough

If students would like to keep their play-dough, give them a (closeable) baggie in which to put it and ask them to place the slime in their back pack (so as not to distract them from their lessons later in the day).

I would suggest putting a small note of instructions in the bag, so that the parents know what they are dealing with. This play-dough is perfectly fine to handle (though the dye may come out and stain their clothes), and because it's made with edible ingredients, it's totally fine if a student accidentally swallows some.

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