Bay Area Scientists in Schools Presentation Plan

Lesson Name The Wonderful World of Water!

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Grade Level 5th Grade

Standards Connection(s) Properties of common molecules (specifically water); dependant and controlled variables, quantitative observations; making inferences; drawing conclusions

Next Generation Science Standards:
5-PS1-3. Make observations and measurements to identify materials based on their properties.
5-PS1-4, Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Ask questions about what would happen if a variable had changed. Use evidence to construct or support an explanation or design a solution to a problem. Analyzing and interpreting data (5-PS1-3)	5-PS1-3 Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.	**Structure and function:** Based on a material's properties, we can gather information on its structure and function. **Patterns:** We can make predictions based on observable patterns.

Common Core Standards:
ELA/Literacy
W.5.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
W.5.2D. Use precise language and domain-specific vocabulary to inform about or explain the topic.
SL.5.1D. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

Mathematics
5.MD.C.4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

Teaser:

Your opportunity to tell teachers and kids what's going to be fun and interesting about your visit!

As chemists we study how different chemicals and materials interact and what their special properties are and we try to use this knowledge to design new materials and chemicals to have different properties. We study and design new chemicals and materials for using and storing energy, like batteries and solar cells. The most common chemical in the world isn't a fancy material we've developed in lab, but rather it is water. Water has some super fascinating properties that we will look at in this module. We will observe how much water likes itself (cohesion), by competing to see who can put the most water on a penny. We will also look at how different liquids mix or don't mix (miscible / immiscible) with water, and use these properties to make a cool bookmark! Lastly, we will look at synthetic materials meant to store water (sponges and diapers], and we will determine which can actually store more!

Objective: *As a result of your lesson, what will students learn? What will they be able to do?*

Vocabulary/Definitions:
3 – 6 important (new) words

- Hydro – greek hydro, water
- Hydrophobic – hates water
- Hydrophilic – loves water
- Hydrogel – material swollen with water, like jellys, jello, hair gel
- Cohesion – sticking to yourself
- Adhesion – sticking to other things
- Absorption – picks up stuff
- Miscible – mixable
- Immiscible – doesn't mix

Materials:
What will you bring with you?

- Pennies
- Medicine droppers
- Nail Polish
- Permanent Markers
- Food Coloring
- Plastic Containers
- Paper towels
- Ziplock bags
- Sponges
- Diapers
- 100 ml beakers to hold water
- Black poster paper
- water resistant plates (2 for each student is plenty)

Classroom Set-up:
Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed
Please divide students and arrange the desks into 3 groups.

How many students total are in the class? Will there be access to water in the classroom? We will need 5-10 minutes to setup beforehand. Please provide the students with pencils.

Classroom Visit

1. **Personal Introduction:** **5 Minutes**
   Who are you? What do you want to share with students and why? How will you connect this with students' interests and experiences?
   Each person will briefly introduce themselves and mention their research.

   Topic Introduction: **10 Minutes**
   What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge…

   What is Chemistry / Materials Science? What are chemicals/materials we know about? What is the most common chemical out there? (water!) What has water in it? (oceans, animal cells, ice cream, plants etc… relate it to things they like ie beaches, water gun fights). Water is a molecule. What are the elements that water is made of (hydrogen, oxygen – show picture). What are the phases of water? Today we will talk about liquid water, and learn about things that love water (hydrophilic) and things that hate water (hydrophobic). Walk through the vocabulary sheet.

2. **Learning Experience(s):** **30 Minutes**
   What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring… Describe in order, including instructions to kids.

3 demonstrations, done sequentially at each table:

1. <u>Penny Challenge</u>
   Students will form pairs. Every pair will receive one penny and one medicine dropper. One student will add water to the penny dropwise until the water overflows. The other student will count how many drops were added and record this value, and encourage/coach the dropper. Suggest some healthy competition between teams.

   The graduate student will record every teams name and final drop count.

   After, all students have finished, discuss the ability of a penny to hold water (cohesion and adhesion). Then, ask why the students obtained different results, hoping to engage conversation about controlling variables in scientific experiments. Discussion should include:
   What side of the penny did each student pick?
   How dirty was the penny?
   Were all the drop sizes uniform?
   Where was the drop deposited (center, edges, other locations)?
   How fast was the water added?

   Ask what conclusions can and CANNOT be drawn from our small sample set?

2. Does it mix? Water, food coloring, and nail polish!
   Students will form pairs. Each pair will have 3 containers of water, 1 food coloring dropper, and 1 bottle of clear nail polish. Students will add a drop of food coloring to container A, and a drop of nail polish to container B. They will record their observations on the worksheet. Describe or draw a picture of what happens when water interacts with each of these liquids.

   The instructors will discuss the concepts of miscibility and immiscibility with the students. Can you think of a way to un-mix the food coloring from the water? How about the nail polish?

   Each student will decorate a strip of black paper with a permanent marker. In container C, one partner will hold the paper under water, while the second partner adds a drop of nail polish. By moving the paper under the film that forms, and lifting it out of the water, the thin film can be captured on the piece of paper. The partners can switch roles so that each can have a personalized bookmark to take home.

   Instructors will discuss why the thin film of nail polish forms, as well as what gives rise to the thin film's iridescence. Materials engineering / processing should also be discussed: we take advantage of the immiscibility of the two liquids in order to create the film and float it onto a substrate.

   Source:
   http://www.nisenet.org/sites/default/files/catalog/uploads/5398/materialsfilm_guide_15nov10_0.pdf

3. Hydrogels (diaper vs. sponge)
   We will compare how much water a sponge and a diaper of the SAME volume can hold. The results may surprise you!

   Split student duties according to how many students are in the group. 3-4 students per group works best. One student will be given a Ziploc bag with a precut piece of sponge in it. Another student will be given a ziploc and the graduate student will open up a diaper and insert the correct volume of diaper material into that ziploc bag.

   Ask students which can hold more water.

   Start experiment by asking the third student in the group to add a dropperful of water into each ziploc bag. Have each student ziploc-holder slosh the water around until it is absorbed. Add more droppersful of water until diaper is fully hydrated – this point may not be reached. Record the number of droppers each material can absorb.

   Discuss how a hydrogel can hold over 1000 times its weight in water. Compare that with their weight. Tell them they already are a hydrogel!
   Name common hydrogels (jello, hair gel, etc…)

3. **Wrap-up: Sharing Experiences** **10 Minutes**

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

Pull all the groups together. What was highest value each of the 4 groups got for penny experiments? Ask again: why were the values were different?
Ask: what does miscibility mean? Immiscibility?
Why do some liquids mix with water, and some not? Hydrophilic and hydrophobic?
Which held more water, the sponge or the diaper? What changes did they notice in the sponge and diaper material as more water was added?

4. **Connections & Close:** **5 Minutes**

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

Getting excited about science is seeing it all around you. Learning about water makes this easy, especially in the Bay Area. When it's raining, look on the road to see the gasoline or watch water run off or into different surfaces.

Things to think about at home or share with the class after doing at home: think of other substances that are hydrophobic (for example oil, gasoline, silicon spoons, wax – candles, plastic). Some of these things can be used to hold water, which ones?

Total 60 Minutes

Follow-up – After Presentation

Suggest students write a letter explaining "How we learned about _____?"
List or attach examples of activities, websites, connections for additional learning.
Attach worksheets, hand-outs, visuals used in classroom presentation.

Can do this if time permits, or allow students to do on their own.
Magic Sand Demo:

Magic sand is sand with a hydrophobic coating. Sand is usually hydrophilic, so water acts as glue between sand particles when sand is wet. Hydrophobic sand, in contrast repels water, so it stays dry when put into water.

http://www.stevespanglerscience.com/product/1331
See video at that link for a great demonstration, and the site also sells magic sand.
Students can figure out how much water jello can hold. They first should weigh the jello powder and then weigh the water that is added.

If students want to learn more about materials science, NOVA did a series on it called Making-Stuff.

http://www.pbs.org/wgbh/nova/tech/making-stuff.html

Wonderful World of Water

Vocabulary Sheet

Hydro_____

_____

Hydrophilic_____

_____

Hydrophobic_____

_____

Hydrogel_____

_____

Cohesion_____

_____

Adhesion_____

_____

Absorption_____

_____

Miscible_____

_____

Immiscible_____

_____

Penny Challenge

Making Observations:

How many drops of water fit on your team's penny?

Tally up the number in the box below.

Number of drops: _____

What was the largest number of drops for a team in your group? _____

What was the smallest? _____

Why do you think each team had a different number of drops?

_____

_____

_____

_____

_____

_____

Diaper vs. Sponge Challenge

Make a prediction:
Which do you think could hold more water: a diaper or a sponge?

Material	How many droppers of water did you add? Tally them below.
Sponge	
Diaper	

Which held more water: the sponge or the diaper?

_____

Does this match your prediction?

_____

Nail Polish Challenge

Use the interaction of water with another liquid to make a cool bookmark!

1. Write your name or draw a picture on a strip of black paper.

2. Find a partner to work with!

3. In water container A, drop some food coloring into the water and observe what happens. Do you think you can get the food coloring back out of the water?

Describe or draw a picture of the food coloring / water mixture.

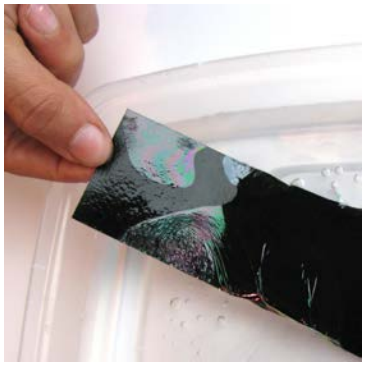
4. In water container B, use the brush to let a drop of nail polish fall into the water and observe what happens. Do you think you can get the nail polish back out of the water?

Describe or draw a picture of the nail polish / water.

5. Partner #1 should hold their paper under the water in the container B. Make sure to keep holding it down flat on the bottom with one finger and move it over to one side of the container.

6. Have Partner #2 use the brush to drip one drop of nail polish onto the surface of the water.

7. Partner #1 is now going to "catch" the film with the paper: hold one end of the paper like it shows in the picture and lift it up out of the water. The film of nail polish will stick to the paper.



What does the nail polish look like on the paper?