Bay Area Scientists in Schools Presentation Plan

Lesson Name Water you waiting for? Dive right into the wonders 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

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

As materials scientists we study how the structure of materials affect their properties and we try to use this knowledge to process materials to have different properties. We study and design everything from medical implants and dinosaur bones, to high tech materials for airplanes and batteries. The most common material 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 water behaves differently on various leaves and how certain leaves can be "self-cleaning" because of how they structure water. 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 hydor, 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

Materials:
What will you bring with you?

- Microscope images of leafs
- Pennies
- Medicine droppers
- Kale
- Chard
- Butter Lettuce
- Cocoa Powder
- Paper towels
- Ziplock bags
- Sponges
- Diapers
- 100 ml beakers to hold water
- 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 into groups of 4 and have desks pushed together in each of these 4 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?
We are women in the Materials Science and Engineering department at UC Berkeley. Each person will briefly introduce herself, and mention her research.

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

What is Materials Science? What are materials we know about? What is the most common material 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).

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. Penny Challenge
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. Water on different leaves and self cleaning, no roomba necessary!
Each student will have one plate and one medicine dropper. Rip a piece of Kale and hand it out to each student. Ask the students to put some drops of water on the kale and describe what they see and write it down/draw their observations. Repeat with Chard, and butter lettuce. Suggest that they check the backside of the leaf. Ask them to describe the similarities and differences in the behavior of water on all three leaves. Ask why the backside behavior is sometimes different.

Show microscope images of the three leaves and explain that structure of leaves is causing the surface to allow water to spread more or less. Explain in the context of hydrophilic/hydrophobic.

Provide the students with paper towels to thoroughly dry each leaf. Pour a few sprinkles of "dirt" (cocoa powder) onto each student's leaves. Ask them to drop water onto the leaf on the cocoa powder and describe what they see. Connect water shape with ability to "self-clean" and then hydrophobic/hydrophilic.

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 ziplock bag with a precut piece of sponge in it. Another student will be given a ziplock and the graduate student will open up a diaper and insert the correct volume of diaper material into that ziplock bag.

Ask students which can hold more water.

Start experiment by asking the third student in the group to add 100 ml water (prepoured into beaker by graudate student) into each ziplock bag. Have each student ziplock-holder slosh the water around until it is absorbed. Keep going until diaper is fully hydrated – this point may not be reached.

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 hydrophobic mean? Which leaf was most hydrophobic?
Why are some leaves hydrophobic and hydrophilic?
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?
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

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.