Soaps and Detergents Lesson

Grade Level: Third Grade

Stage I:

I. State and National Standards K-4

A. National Standards

1. Content Standard A: As a result of activities in grades K-4, all students should develop
-abilities necessary to do scientific inquiry
-understanding about scientific inquiry

2. Content Standard B: As a result of activities in grades k-4, all students should develop
-an understanding of properties of objects and materials

B. State Standards

3.1.4.E. Recognize change in natural and physical systems
-recognize change as fundamental to science and technology concepts
-examine and explain change by using time and measurement

3.2.4.A. Identify and use the nature of scientific technological knowledge
-distinguish between a scientific fact and a belief
-provide clear explanations that account for observations and results
-relate how new information can change existing perceptions

3.2.4.B. Describe objects in the world using the five sense
-recognize observational descriptors for each of the five senses (e.g. see-blue, feel- rough)
-use observations to develop a descriptive vocabulary

3.2.4.C. Recognize and use the elements of scientific inquiry to solve problems
-generate questions about objects, organisms, and/or events that can be answered through scientific investigations
-conduct an experiment
-state a conclusion that is consistent with the information

3.4.2.D. Recognize and use the technological design process to solve problems
-recognize and explain basic problems

3.4.4.A. Recognize basic concepts about the structure and properties of matter
-describe the properties of matter (e.g. hardness, reactions to simple chemical tests)
-know different material characteristics (e.g. texture, state of matter, solubility)

4.8.4.D. Know the importance of natural resources in daily life
-identify items used in daily life that come from natural resources

II. Enduring Understandings

-Soap and detergent are what oil or grease molecules need to help them to attach to water, because as the old expression goes, “oil and water don't mix”; one end of the soap or detergent molecules attach to the water and the other end attaches to the oil or grease, “hooking” them together, allowing for extra water to wash away the water/dirt/oil combination away

-When dirt of dust get on a surface, it can easily be cleaned off with water or a dry rag; if oil or grease gets mixed in with the dirt, however, water alone can't “hook” onto this oil or grease, instead sliding along it without being able to attach to it and wash it away

-Some variables in the experiment are the substance 'staining' the surface that is being cleaned, the surface used, the cleaning agent used, and how long the surface is rinsed with water after the cleaning agent is applied.

-A few variables that are controlled include the amount of the 'staining' substance on the surface, how much and for how long the cleaning agent is left on the surface, the amount of water and cleaning agent is placed in each cup, water pressure from the faucet during the rinsing period and for how long rinsing is occurring. Some uncontrollable variables include factors such as how each group exactly washes their wax paper (at what angle they place it under the faucet, etc.), how big the drops of their cleaning agents are that they place on the stain.

III. Essential Questions

How do different forms of soap (regular, dish detergent, shampoo, and laundry) work to clean a surface?

Why don't oil and water mix?

What is the most effective form of soap to clean a surface? Why? Does this change depending on the surface?

What are the variables in this experiment?

Why do the variables need to be controlled? Are there variables that are not controlled?

IV. Performance Standards

A. Students will know
-that oil and water can not mix on their own and that this is because their molecules are unable to attach to one another
-that soap is a cohesive substance that allows the water and oil molecules to bind together when mixed in with them, allowing this whole combination of substances to wash away when rinsed with additional water
-why having a control is important within an experiment
-how variables affect different aspects of an experiment

B. Students will be able to
-identify variables within an experiment, including independent and dependent variables

-identify the control within an experiment
-conduct their own experiment when prompted with an experimental framework
-explain and justify the conclusions of their experiments

Stage Two:

I. Pre-Assessment: Having the students complete the 'know' part of the KWL chart at the very beginning of the lesson. Write down abbreviated versions of all the answers that students give, even if their answers are not necessarily right or they have some misconceptions. This will allow the teacher to see what students solidly know before the lesson, what they partially know, and what big misconceptions or areas of confusion the students have about soap. By having students share all their ideas about soap, whether or not they are correct, allows the teacher to see not only what the students know but also specific areas concerning the topic of soap that need to be addresses and emphasized throughout the lesson so that students can re-frame their schemas about different aspects of this topic. Also, after watching the two youtube commercial clips, the teacher will inquire about similarities and differences between the two products highlighted in each commercial, as well as ask some follow-up questions about the students thoughts on this to conclude the pre-assessment.

II. Formative Assessment: Asking questions that ask students to clarify and elaborate upon the statements they are making throughout each mini-discussion we have in the lesson. Checking in with each group to see what variables they want to test in their own personal experiments, and what variables will therefor change or stay the same as a result.

III. Summative Assessment: Having the students share their personal group experiments with the class including what variables they changed, what were controlled, their independent and dependent variables, the outcome of their experiment, and the conclusion(s) they came to about this outcome. Also, having a wrap-up discussion at the end of the lesson while simultaneously filling out the 'L' column of the KWL chart allows groups of students to share a big idea they learned and a question they have for further exploration.

IV. Adaptations: Thinking about the strengths and needs of the students, I will create the experiment groups with these factors in mind, placing students accordingly. The 'create your own' experiment part of the lesson can be more or less structured depending on how well the students are grasping the material and essential 'running with it'. The teacher can provide more suggestions for this or allow students to change more variables than just the surface they are using and substance to be cleaned. Also, additional time can be provided to allow the students to do some personal research to get ideas before they conduct their own experiments if they are really stuck on what they want to do.

Stage Three:

I. Materials

-big pad of paper on an easel
-big markers to write on the pad of paper-enough sheets of white unlined paper for each group of 3 to 4 students
-lipstick
-masking tape, scissors, ruler, pencils (enough of for each group)
-food grater
-q-tips (enough for each group)
-soap
-dish detergent
-laundry detergent
-shampoo
-measuring cups for each group
-measuring spoons for each group
-plastic cups (five per group)
-wax paper
-napkins
-lego pieces (two flat lego boards, one two by six lego piece)

II. Procedures

Engage: 1, 2, 3, 5

1. Have the students sit together on the rug in a circle in front of an easel with a pad of paper. Pose the question “Does anyone know anything soap or detergent” (more specifically how they work and what they are used for)? Have the students volunteer their answers and write them down on the big pad of paper. You as a teacher will be make a KWL chart, with columns for what the students know, want to know, and have learned. This will be filled out at different points throughout the lesson. Be sure to let the students know that they should share all their ideas about soap even if they are not sure whether they are right or not. What is does, different kinds, how we use it, how it's made, etc. You will be filling this out under the “K” section of the chart (know). Leave room for the 'W' and 'L' sections of the chart for use later on in the lesson.

2. Show the children two Palmolive soap commercials on http://www.youtube.com. The students will already be seated in a circle so all will be able to see. Ask the students to look for any similarities and differences they see between the two products shown in the two commercials. Proceed to show:

   http://www.youtube.com/watch?v=qMWF-cKNCdk

   and

   http://www.youtube.com/watch?v=_bEkq7JCbik

3. Ask students to share some similarities or differences between the two products they saw in the commercials that they observed. Some examples of similarities might be they both are advertising products from the same brand, they're both used for cleaning, they both make bubbles, or they're both a form of soap (this is an especially important similarity, so if not said by one of the students make sure to come back to it and emphasize it in the discussion). Some differences might be one is a bar of soap and the other is dish detergent, one was being used for a shower while the other was used to wash hands at a nail salon, one is a liquid and the other is a solid, etc.

4. Once it is established that both products are types of soap, ask some followup questions to continue the pre-assessment:

   Which soap do you think cleans better? Why?
   Do you think it matters what type of soap you use depending on the surface?

5. Announce that we will be testing out different types of soap products to determine which cleans a lipstick stain the best off of a wax paper surface. We will be testing the effectiveness of regular bar of soap, dish detergent, shampoo, and laundry detergent, and lastly water. Introduce two new concepts: variables and what it means to have a control control. This is important because it is laying the foundation for some of what students will need to know in order to conduct their science fair experiments later in the year.

   Definitions: *Variables- can be independent (what you want to change) or dependent (what is observed as a result of that change); a controlled variable is what is kept the same -ask students for some examples of independent, dependent, and controlled variables in the experiment they are about to do; for example, an independent variable would be using the cleaning agents to see how well each individually cleans the lipstick stain, and a dependent variable would be the effect of each cleaning agent on the lipstick stain, and an example of a dependent variable would be how well each cleaning agent works to clean off the lipstick stain; the controlled variable is the water because it should have no effect on the lipstick stain, and there is an equal amount of water mixed in with every cleaning agent.

   Explore: 1, 2, 3, 5

6. Read out the assigned groups of three or four students and have them return to their tables. Pass out the materials needed (the cups with the cleaning agents & the control, the labeled wax/ unlined paper combination sheets with the lipstick, the q-tips, napkins) and explain how students will be using the q-tips to put one drop of each liquid on the lipstick in each different space (making sure that, will doing this, that they don't touch

the q-tip to the lipstick directly at any time). Ask the students “Why is it important that we don't touch the q-tip to the lipstick when we are doing this experiment?” (The lipstick has been spread across each labeled space on the sheet of paper that the wax paper is covering as equally as possible; touching the q-tip to the lipstick directly could cause some to rub off on it and compromise the final results of the experiment).

7. Wait 3-5 minutes and while your waiting with the students, ask them to make predictions about what they think will happen when they rinse the wax paper. Ask questions such as :
   Which cleaning agent will do you think will work the best in this instance? Why?
   Have you ever had any experiences with using these cleaning agents before? What are they typically used for?
   Have you ever used any of them cleaning agents for to clean something other than their specified purpose?

8. After about five minutes, turn the facet on at the sink so a thin stream of water flows out. Then, have the students take turns going to the sink and rinsing their squares on the wax paper that have the different cleaning agents and the control. Tell the students not to change the amount of water coming from the faucet, and to only rinse their wax paper for about five seconds, making sure to rinse every square.

9. Have the students discuss in their small groups which cleaning agent or agent(s) seemed to work best according to their experiment. Which ones didn't work as effectively? What about the control (the square with just the water)? Come back together as a class and discuss all the groups results as a whole. Were there any similarities? Any differences? What could have accounted for these differences? Were there any uncontrollable variables that could have caused these within the experiments?

   Explain: 1, 2, 3 , 4, 5

10. One conclusion that the students should eventually reach is that the cleaning agents as a whole work significantly better at cleaning the lipstick stain off the wax paper than the control (the water alone) does. Ask the students why this is the case, and have students volunteer a few thoughts about this. Then, show a demonstration using the lego pieces to explain this question. Have one lego piece color represent oil and the other represent water and the other color represent oil. First, take the two flat lego pieces and slide over the other. Explain how when oil mixes with dirt, it is impossible to wash it away with just water because oil and water molecules don't mix together. Water basically just slides over the oil (or grease) and is unable to attach to it and wash it away. Then, use the two by six lego piece (representing the soap or detergent) to connect the two flat lego

boards. Explain how the soap or detergent molecules are able to have one end that attaches to the water and another that attaches to the oil, “hooking” the two together. Once this has happened, additional water can wash the oil/water/soap combination away.

11. Address the “want to know” section of the KWL chart. Now that the students have a basic understanding of why we use soap and detergent as cleaning agents, what new questions have emerged for them?

    Elaborate: 1, 2, 3, 4, 5

12. Prompt the students to think in their small groups how they would change the experiment if they could to test cleaning a different substance and/ or on a different surface. Have them come up with ideas of what they want to test in their small groups; let them know they must agree on what they want to do as a group and that what they use (as far as substances and surfaces) must be approved by the teacher and ensured that it is available for their use.

13. Once the students have come up with what variables they would like to change in their groups experiments, have them make predictions about how they think this will affect the outcome of their experiments in comparison with the first collective experiment that the class did as a whole. Have the discuss these in their groups, and then pass out the materials they need that are specific to what they are planning on testing. Also, be sure to go over the general preparation process that you as a teacher did to prepare for the first experiment, including labeling the cups, measuring out the right amount of cleaning agent for each cup (an a consistent amount of water to mix this with), labeling and dividing up different but equally sized sections of their surface, and placing an equal amount of substance to be cleaned on each section of this surface.

    Evaluate: 2, 3, 4, 5

14. Allow students to conduct their group experiments using the same general procedure they used for the first experiment .

15. Give each group time to come up to the front of the class and explain their variables and present their results to the class.

16. Conduct a wrap-up conversation about key concepts that students have learned throughout the lesson; add to the 'learned' section of the KWL chart. Ask that each group think of at least one (they can contribute more once every group has shared) big

idea they have learned or discovered and one question that they have for further exploration.

How the lesson aligns with the 5e Model:
Engage- Students were asked to recall what they knew or thought they knew about soap and how it works. Show the two soap commercial clips on youtube.com and discuss the similarities and differences between the two products shown.

Explore- Having the students do the 'If cleaning is urgent, use soap or detergent' modified lesson in groups of three or four; allowing them to go through the experiment and then discuss in their groups their results and what they think this means.

Explain- Discussing the results of the experiment, doing the lego demonstration of how oil and water naturally interact and how soap or detergent changes those interactions; adding to what students want to know in the KWL chart

Elaborate- Having students design their own experiments in their groups testing how water, shampoo, laundry detergent, regular soap, and dish detergent work to clean a certain substance off of a certain surface; having students come up with a new surface to use and or/ substance to put on that surface to do the cleaning test. Having the students come to some big conclusions about their experiments in their groups.

Evaluate- Having students share their own personal group experiments (i.e. what variables they changed, the outcomes) and then having a wrap-up discussion to identify and re-enforce key concepts, including filling out the “learned” part of our KWL chart. During this, have each group come up with something they learned and a question they have for further exploration.

Reaction:

One of the first changes I made to this lesson was during the first experiment, when are students had the same variables and were doing the same procedure, was to provide students with part of the materials already set up at ready to do the experiment. This included giving them label cups with the water and substance such as the soap or detergent already added, a pre-made wax and unlined paper sheet taped together and labeled, with the substance being cleaned (the lipstick streak) already drawn onto the paper. I made this decision so that students could jump right into the experiment, intending to allow them to do a similar set up process independently when they came up with their own experiment in their small groups; I didn't think having students do the same set-up twice would be beneficial and setting up the experiment for them beforehand would save some time in class. “How much guidance does a teacher decide how to provide in inquiry? In making this decision, a key element is the intended learning outcomes. Whether the teacher wants students to learn a particular science concept, acquire certain inquiry abilities, or develop understandings about scientific inquiry (or some

combination) influences the nature of inquiry" (National Research Council, 2000, p. 30). To make this lesson as inquiry-based as possible, my "intended outcomes" couldn't happen unless we were able to get to the personal group experiment portion of the lesson. About half of the steps from the original procedures for the 'If cleaning is urgent, use soap or detergent' lesson which I was adapting (American Chemical Society, American Institute of Physics, & American Mathematical Society, 2000) for my lesson involved set-up of the experiment. To reach the objectives I wanted to focus on, the "whys" and "hows", I decided that doing these steps myself and then giving the students the opportunities to take part in set-up later on during their personal group experiments was what needed to be done. During the explain portion of the lesson, I wanted to do more than just explain verbally why oil and water do not mix. This is why I choose to add in the lego demonstration, research by Carolyn Evans shows how she successfully allowed her students to take advantage of a number of different tools and techniques to explain the different gas laws (Evans, 2004, p. 30). Also, the original experiment suggested that students try this experiment again on just a plain piece of paper (without wax paper attached over it) and then on their skin using the same substance as the subject for cleaning, the lipstick. I wanted to allow the students some creativity while still staying in the general framework of the experiment we had just done, by allowing them to change two aspects of the experiment, the surface being cleaned and the substance that we wanted to test with the different cleaning agents. "A good activity for a starting point should also offer promising opportunities for productive exploration within the constraints of the classroom environment" (Huber & Moore, 2001, p. 34). I wanted to be able to give students the opportunity to be creative with their experiments and explore questions about variables they had while at the same time being practical about the resources available for use to do this in the classroom.

References

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