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Research Based Lesson

**Topic:** The Water Race

**National Science Education Standards:** Science as inquiry/ Physical Science

**MS Science Frameworks:** Bonding/Gas laws and states of matter/Solutions

**Objectives:**

- Compare the properties of compounds according to their type of bonding. (DOK 1)
  - Covalent and ionic bonding, polar and non-polar interactions
- Explain the thermodynamics associated with physical and chemical concepts. (DOK 2)
  - Surface tension, hydrophobic, hydrophilic
- Describe and identify factors affecting the solution process. (DOK 2)
  - Solubility, solute, solvent
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
  - Cleaning Compounds and Dirty Surfaces (previous experiment)

**Engage**

Students were given six different commercial products (rain-x, shampoo, water repellent, and 3 different types of mascara) that possessed hydrophobic or hydrophilic properties. They were asked the following questions during this phase:

Can you explain the purpose of this product?

How does it work? Provide a hypothesis about how it works?

Can you name products with a similar application?

*Scenario:*

I need your help identifying 2 unknown liquids that I have with me. My friend accidentally mixed the vials and I need to identify which liquid is which before my boss discovers the mix-up. This

is very important!!! The only way I can distinguish between the two is by their physical characteristics. Before I give you the unknowns, I need you to prove you can identify specific physical characteristics.

Given six different products and a clean surface, please determine if they are hydrophobic or hydrophilic.

### **Explore**

The students tested the surface tension of their substrate (plastic lid). After determining the surface tension of their substrate, they determined the surface tension of each product. Prior to their exploration, the experimental procedure was demonstrated. At this time, they described their observations as a bead of water or spread of water.

#### *Objectives:*

Identify the surface tension of the substrate (obtain a background)

Identify the surface tension of each product given

Record observations

Review hypothesis

#### *Materials:*

Rain -X

Shampoo

Water Repellant

Mascara\_ water soluble, fibers, waterproof

Q-tips

Cotton Swabs

Water

Beakers

Weigh boats

Pipettes

#### *Procedure:*

Each station was given the materials needed prior to the arrival of the students.

1. Using a pipette, transfer a drop of water onto the substrate to test the surface.
2. Record observation
3. Using a Q-tip, apply a small amount of product onto a small surface of your lid.
4. Using a marker, circle and label that area.
5. Using a pipette, transfer a drop of water onto the area with *product* to test the surface.

6. Record observation
7. Repeat for the remaining products

\*Use a different Q-tip for each product

\* Use the same number of drops of water during each test.

### **Explain**

During this time, we briefly discussed the application of each product using vocabulary terms such as, covalent bonding, ionic bonding, polar bonding, and non-polar bonding.

We discussed why they observed a particular surface tension for each product. We also compared their hypothesis with the results obtained. Hydrophobic/Hydrophilic interactions were discussed at this time.

### **Elaboration**

Students were given the unknowns at this time. Dodecanethiol and BYK-191 surfactant was the unknowns assigned. The students were able to immediately distinguish that the two liquids differed in viscosity and smell. They recorded this observation. They were given an aluminum q-panel and instructed to test the substrate. After evaluating the substrate the unknowns were applied in two different areas. A pipette was used to apply the water droplet needed to test the surface tension of the unknowns.

### **Evaluation**

The students recorded their information in their data chart. They were asked to provide facts regarding the surface tension observed for their unknown. The name of each unknown was provided and the students were able to make a hypothesis regarding the composition of each unknown, in addition to naming similar products. The students were able to connect the self-cleaning concept with surface tension.