

Classical Conversations – Wallowa County  
Cycle 2 Science Tutor Prep  
**Week 14b – Pepper Run (VanCleave's #171)**

Prep Notes	
Materials	Black pepper 2-quart bowl of water Few drops of liquid detergent in small saucer Toothpicks
Teacher Background	Water molecules loosely bond to one another. This bond is called a “Hydrogen bond” - the slightly “positive” Hydrogen end is attracted to the slightly “negative” Oxygen end of H <sub>2</sub> O. This bond accounts for surface tension, which we see in action when a water drop on the table “beads” up, rather than spreading thin or breaking to pieces. Surface tension holds, unnoticed, in balance until a <u>surfactant</u> like detergent is introduced, which weakens and breaks those bonds. In this project, the detergent weakens bonds in the middle of the water, allowing the still-strong bonds on the outer edge to “pull” water (and the pepper on it) toward the edges.
Opener Ideas	<ul style="list-style-type: none"> <li>• What kinds of things float? What sinks? (Dense objects sink; objects that are “porous” or that don't break the water's surface tension don't.) Will pepper float?</li> <li>• Have you noticed how water “beads up” and “holds tightly together in droplets”?</li> </ul>
Grammar	<ul style="list-style-type: none"> <li>• <b>Hydrogen bond:</b> an attractive force between Hydrogen (slightly positive) and Oxygen (or Nitrogen or Flourine)</li> <li>• <b>Surface tension:</b> the “skin” water makes on its surface by lining up into Hydrogen bonds</li> <li>• <i>Surfactant:</i> something that weakens the surface tension in a fluid</li> </ul>
<b>Scientific Method</b>	
Observations	...about the bowl of water – anything interesting? Then add the pepper (below) – anything interesting to observe....?
Question	Does soap break the surface tension of water?
Hypotheses	“Yes” or “no”
Experiment (Procedure)	<ul style="list-style-type: none"> <li>• Sprinkle the pepper onto the surface of the water in the bowl</li> <li>• Dip a toothpick into the saucer of detergent</li> <li>• Insert the toothpick into the center of the pepper-water bowl</li> </ul>
Results	The pepper rapidly moves to the edges of the bowl
Conclusions	Soap is breaking the surface tension of water, from the center outward. When the outer tension is still high, and the inner is broken, the outer tension “pulls” the water surface (and pepper on it) toward the edges.
<b>More</b>	
	<ul style="list-style-type: none"> <li>• You could investigate other materials – e.g., does it matter that it's pepper? (would paprika do the same thing?) Does the detergent/soap brand/type matter?</li> <li>• Note that the breaking of the surface tension does not cause the pepper to sink (usually). Investigating the density of pepper or measuring the remaining surface tension of soapy water would be a natural next steps.</li> </ul>