**Assessment Answer Key**

1. Using the concept of hydrogen bonds, explain…
   1. …why beads of water and oil are shaped differently and why water and oil behave differently when filled to the top of a cup.
   2. …how and why absorption of water and oil into a paper towel or capillary tube is different?
2. *Hydrogen bonds pull water molecules inwards at an outer edge or surface (e.g., towards the inside of the drop or downward from a surface of a cup) thus giving water a surface tension that is not present in oil.*
3. *Hydrogen bonds produce adhesive and cohesive forces that force water to rise. Oil does not have these forces between its molecules.*
4. How does water get to the tops of tall trees?

*Water enters trees at their root system in the ground and is transferred up to the rest of the tree by capillary action.*

1. Why does some water cling to the inside of a glass even if you empty it and try to shake out all of the remaining moisture?

*The water molecules are adhering (adhesion) to the glass, which also consists of polar molecules.*

1. How do you think the presence of hydrogen bonds might change the boiling point temperature of water compared to non-polar liquids? What about the melting point?

*Hydrogen bonds give extra “strength” to bonds between water molecules, thus it takes extra energy to pull water molecules apart from each other such as during a phase change. In other words, the melting and boiling points of water are unusually high when compared to other substances.*

1. Describe the difference between a hydrogen bond and a covalent bond. Which bond is weaker? Stronger?

*Covalent bonds form WITHIN WATER MOLECULES when electrons are shared between the oxygen and hydrogen atoms of water to form H2O. Hydrogen bonds form BETWEEN WATER MOLECULES as a result of water’s polar structure. Covalent bonds are about 10x stronger than hydrogen bonds.*

1. INVESTIGATE AT HOME: If we assume that many types of dirt are oil-based, and we know that oil and water are immiscible liquids, then placing a dirty object (such as a muddy soccer shirt) into water will not do much because the oil and water do not interact. However, the addition of soap changes things. Do a short investigation on how soap “works”. Pay particular attention to interactions between polar and non-polar substances.

*In the simplest sense soap molecules have two distinct “ends”, a polar (water-loving) end and a non-polar (water-fearing) end. The non-polar end of soap breaks-up the dirt/oil and surrounds it; the polar end is then flushed away with running water…taking the dirt trapped at the non-polar end along with it.*