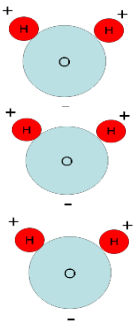
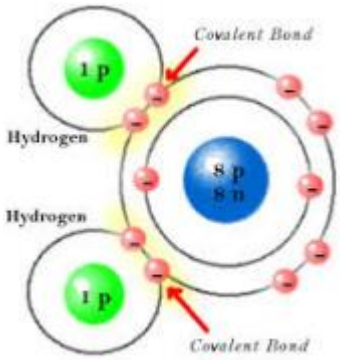
Name_____ per____ date_____ mailbox_____

Properties of Water Lab



Water's chemical formula is H_2O. As the diagram to the left shows, that is one atom of oxygen bonded to two atoms of hydrogen. The hydrogen atoms are "attached" to one side of the oxygen atom, resulting in a water molecule having a positive charge on the side where the hydrogens reside and a negative charge on the other side, where the oxygen atom resides. This separation of charge on opposite ends of the molecule is called **polarity**. Since opposite electrical charges are attracted to one another, water molecules tend to be attracted to each other. This makes water tend to be kind of "sticky." As the right-side diagram shows; the hydrogen end of the bottom water molecule's (positive charge) is attracted to the oxygen end of the above water molecule's (negative charge) and so on and so forth up the chain. This property of water is known as **cohesion**. All these water molecules attracting each other mean they tend to clump together. This is why water drops are, in fact drops! If it wasn't for gravity, these drops would be ball shaped or spherical as is the case aboard the International Space Station. Even if it doesn't form a perfect sphere on Earth, we ought to be happy water has the properties it does. Indeed without these properties we could not exist. For instance, for many of the same reasons water is "sticky" it is also known as the "Universal Solvent" because it dissolves perhaps more substances than any other liquid on Earth. This means that wherever water goes, either through the ground, our bodies, the sky or oceans it carries with it valuable chemicals, like minerals and nutrients.



Ever wonder, how a water strider walks across the surface of a pond without sinking? The surface water bears a remarkable property. On the molecular scale, it acts like a stretched elastic membrane or "skin." This property is referred to as **surface tension** and is largely due to cohesion between adjacent water molecules. It is caused by the attraction of the particles in the surface layer and the *bulking up* of the liquid below, tending to minimize surface area as molecules strive for the optimal pole to pole bonding arrangement. The whole effect causes tightness at the surface, which resists the step of a water strider's foot, supports a leaf temporarily and causes water to bead up on windows, certain clothing or a duck's back. It can slow the wetting process of certain fabrics and inhibit the cleaning process too.

Surface tension can however be reduced. Increase the water's temperature and kinetic energy starts to move molecules about again, while also promoting evaporation. The water vapor now above can linger in transition grabbing at remaining water molecules along the surface boundary and tugging at them from above. Bring water to a boil and surface tension is all but lost.

The addition of substances such as soap or detergent (known as **surfactants**) can reduce surface tension by increasing the spreading and wetting properties of water. Surfactant molecules look like tadpoles. The head is **hydrophilic** meaning attracted to water and typically soluble. Meanwhile, the tail of a surfactant is composed of fatty material that is insoluble in water and allows grease, oils or other fats to stick to it. This property of not dissolving in water makes it **hydrophobic**

meaning to repel water. Surfactant molecules break cohesion and surface tension allowing water to contact more dirt particles, making fabrics wetter and allowing materials to be cleaned.

Water striders can walk on the surface of water despite having a density themselves greater than that of water. Meaning they ought to sink if not for water's properties. However, surface tension and tiny hairs on their feet which are hydrophobic allow them to keep from getting wet and keeps them afloat.

1. Fill in the properties of water we investigate during this lab, from the reading above.

a. _____ relating to the separation of charges in a molecule
b. _____ meaning to repel water, literally "fear of water"
c. _____ term for a chemical which can break surface tension
d. _____ this term describes the ***force of attraction*** between adjacent water molecules.
e. _____ meaning attracted to water or literally "water loving"
f. _____ term describing the ***tensional force*** created by water at its boundary with air

2. _____What is the property of water that describes a water molecule's ***charge***?

a. polarity b. surface tension
c. cohesion d. surfactant

3. _____What is the property of water that describes the ***force of attraction*** between water molecules?

a. polarity b. hydrophobic
c. cohesion d. surfactant

4. _____What is the property of water that describes its ***tensional force*** at its boundary with air?

a. polarity b. surface tension
c. hydrophilic d. surfactant

5. Definitions: use the reading, use your text, use an online source

Define: polarity- _____
_____
_____

Define: cohesion- _____
_____
_____

Define: surface tension-_____
_____
_____

Water QUESTIONS

1. Explain why water is the universal solvent. Complete sentence, use the word **solubility or dissolve**

_____
_____
_____

2. What is a polar molecule? Explain. Use the words **positive, negative** and **charge**.

_____
_____
_____

3. Which end of the water molecule is negative? Which end is positive?

_____
_____

Fill in the blank:

Surface tension causes water to _____ on surface like glass.

Water molecules are _____ to other water by a process called cohesion.

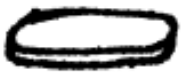
Surfactants are used to break cohesion between water molecules, making surfaces wetter and allowing water to _____ away dirt.

STATION 1: PENNY

1. Place a penny flat on the table near the edge of your lab station.
2. Hypothesize – how many drops of water do you think the penny could hold before water spills over the edge? Experiment with the Abe side verses the tails side of the coins.
3. Using a dropper, count how many drops the penny holds until it spills over. Draw how the water appeared on the penny right before it spilled off.

Hypothesis – Estimated # of drops → Heads _____ Tails _____

Drawing:



Record the actual # of drops _____

Next→

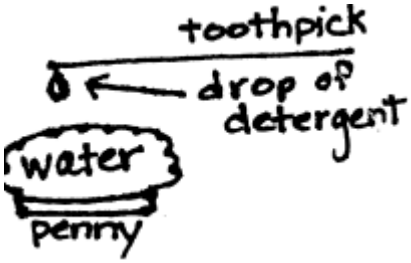
STATION 1: PENNY cont.

1. The forces of attraction between water molecules are _____.
2. Explain why the water molecules do not spill off the penny?

_____

_____

3. Repeat the above experiment, but stop right before the water spills off the penny.
4. Next using a toothpick, dab at the drop with tiniest bit of detergent. Try and touch only the soap to the droplet. **See image →**



5. Describe what happens to the droplet of water? Use the terms **surface tension** and **surfactant**

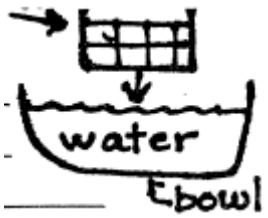
_____

_____

_____

CLEAN UP THE STATION – RINSE OFF PENNIES FOR NEXT GROUP

STATION 2: Netting Raft



1. Fill a pan with about 80% water from the sink. Very gently set the netting on the water. Be sure the net raft and pan have risked free of soap.
2. Gently lay 3 paper clips onto the netting.
3. Add soapy water a little at a time, at the bottom of the netting. Watch changes in the water's appearance above and below the raft and along the edges. Keep adding soap slowly until surface tension is broken.
4. How does soap effect the water molecules? Explain

_____

_____

5. How does soap make water "wetter"? Explain

_____

_____

CLEAN UP THE STATION – RINSE OFF SOAP FROM PAPER CLIPS, PAN AND NETTING

STATION 3: Wax Paper

1. Lay a piece of wax paper on a dry section of table. Place one drop of water on a glass slide and one drop of water on the wax paper.

SKETCH OBSERVATION HERE:	
Wax	Glass

2. Explain why the drop of water on the wax paper is "very round" in comparison to the drop on the glass is more "flat". Use the terms either **hydrophobic** or **hydrophilic**.

_____

_____

_____

3. Gently touch the tip of a <u>dry</u> toothpick to the drop of water on the wax paper
4. What do you observe?

_____

_____

_____

5. Now take a <u>wet</u> toothpick. Slowly and gently move a wet toothpick through the droplet on the wax paper.
6. What do you observe?

_____

_____

_____

7. Write if you **agree** or **disagree** with the following comment. "Water molecules are strongly attracted to each other, and they have little or no attraction for molecules of certain other substances." **Explain** why you **agree** or **disagree**.

_____

_____

_____

CLEAN UP THE STATION

STATION 4: Balloon and Faucet

1. Turn the water on to as low a pressure as you can, while maintaining a steady flow.
2. Build up a static electric charge by rubbing the balloon on a cloth surface.
3. Now move the balloon toward and away from the small but steady flow of water
4. Sketch the before and after of the water below

Before	After

5. Explain why it is that the water appears to bend in relation to the balloon. Use the terms **polarity,** and **static electric charge.**

_____

_____

_____

CLEAN UP THE STATION

Coolest experiments aboard the International Space Station
https://youtu.be/o8TssbmY-GM ←WATCH ME

Richard Hammond's Invisible Worlds - Water Strider
https://youtu.be/RphuMEUY3Og ←WATCH ME