Name_____ Date_____ Biology 513

Properties of Water

Properties of Water

The following properties of water are possible because water is a polar molecule and can form hydrogen bonds with other water molecules.

1) **Cohesion** – an attraction between the same substances, for example, between a water molecule and another water molecule.
2) **Adhesion** – an attraction between different substances, for example, between a water molecule and the cellulose of plant cell walls.
3) **High Surface Tension** – is a measure of how hard it is to break the surface of a liquid. Water has a high surface tension. Surface tension is related to cohesion.
4) **High Specific Heat** – The **specific heat** of a substance is the amount of heat that must be absorbed or lost for 1 g of that substance to change its temperature by 1ºC. Water has a very high specific heat.
5) **High Heat of Vaporization** – Heat of vaporization is the heat a liquid must absorb for 1 g to be converted to gas. Water has a high heat of vaporization.
6) **Ice floats** – Ice is less dense than liquid water and thus floats.
7) **Good solvent** – Water is a versatile solvent (can dissolve many substances) due to its polarity, which allows it to form hydrogen bonds easily.

Station 1 – Two Glass Slides and Water

Part A – Dry Glass Slides

1) Completely dry with paper towel both sides of two glass slides.
2) Put one glass slide directly on top of the other.
3) Try to "pull" the glass slides apart from each other. (Do not try to "slide" them apart from each other). Record your observations. How difficult was it to pull them apart?

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Part B – Wet Glass Slides

4) Place one drop of water on top of a dry glass slide.
5) Place another dry glass slide on top of the drop of water so that the two glass slides make a "water sandwich".
6) Try to "pull" the glass slides apart from each other. (Do not try to "slide" them apart from each other). Record your observations. How difficult was it to pull them apart?

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Part C – Compare Dry Glass Slides with Wet Glass Slides

7) Compare the difficulty level of pulling apart dry glass slides with pulling apart wet glass slides. Explain your results in terms of **cohesion** and **adhesion.**

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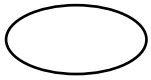
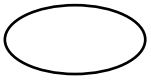
Station 2 – Water and a Penny

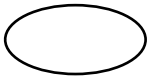
1) First make a prediction: how many drops of water do you think can fit on the top surface of a penny? _____
2) Make sure that both sides of the penny and table are completely dry.
3) Add one drop of water on top of a dry penny. After seeing how much room it takes, do you want to rethink your first prediction? New prediction _____
4) Continue carefully adding drops of water onto the penny, keeping careful count of each drop until the water spills off the penny. Try this three times, recording the number of drops each time, and then find the average number of drops that can fit.

	Number of Drops of Water
Trial 1	
Trial 2	
Trial 3	
Average	

5) Draw a diagram below (side view) showing the shape of the water on the penny after one drop, when the penny is about half full, and just before it overflows.


Single drop


Half Full (_____ drops)


Near Overflowing (_____ drops)

6) How did your data compare with your prediction? Many students will be surprised by the data. What were they surprised about?

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7) Try to explain scientifically why a penny can hold so many drops of water before it spills over. Explain your results in terms of **cohesion** and **adhesion.**

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Station 3 – Graduated Cylinders and The Meniscus

1) Obtain three different sized graduated cylinders: 10 ml, 50 ml and 100 ml.
2) Fill each graduated cylinder half full of water.
3) Observe the meniscus of each one.
4) Explain why a meniscus forms in each graduated cylinder in terms of **cohesion** and **adhesion**. Draw a diagram and explain it. Where are the cohesive and adhesive forces found?

Labeled Drawing	Explanation:

5) Compare each meniscus with each other. How does the meniscus differ as the size of the graduated cylinder changes? Draw a diagram and explain it.

Labeled Drawing	Explanation:

6) Explain why the meniscus changes as the graduated cylinder changes in terms of **cohesion** and **adhesion**.

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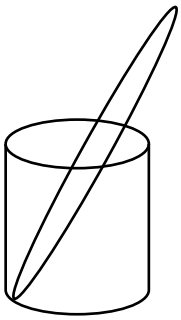
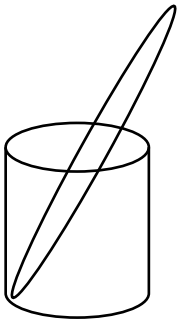
Station 4 – Narrow glass capillary tube and water

1) Obtain a small beaker of water and a dry, narrow glass capillary tube. The glass capillary tube is **VERY** fragile, so handle it carefully. If there is liquid in the capillary tube, draw it out with paper towel.
2) You will be placing the dry, narrow glass capillary tube inside the beaker of water. In the diagram below, draw the water level in the beaker **and** predict where you think the water level in the glass capillary tube will be.



Prediction



Observed Results

3) Place the capillary tube in the water. In the diagram above for "observed results", draw where the water level is in both the beaker and in the glass capillary tube.
4) What did you observe?

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5) Explain what you observed in terms of **cohesion** and **adhesion**.

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6) Using the same concepts, can you explain why water travels up a plant from the soil against gravity within xylem tissues? Again, explain in terms of **cohesion** and **adhesion**.

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Station 5 – Paper clip and water

1) Start with a beaker of water and some paperclips. Do you think a paperclip will float in the water? Drop one dry paper clip in the beaker to find out. Since the paperclip is denser than the water, it will sink to the bottom of the beaker.
2) Now find out if you can float the paperclip. Instead of dropping the paperclip into the beaker, gently lay it flat on the surface of the water. (This is tricky – it may help to place a piece of paper towel slightly bigger than the paperclip in the water. Then lay the paperclip on top of it. In a minute or so, the paper towel will sink, leaving the paperclip floating on top of the water.)
3) Explain why a paper clip can float on top of water in terms of **surface tension**.

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Station 6 – Drop Shape on Glass and Wax Paper

1) What will be the shape of a drop of water on (a) a piece of wax paper and (b) a glass slide? Draw the shape (side view) of the drop you expect on each surface:

_____	_____
Wax paper	Glass Slide

2) Why did you predict as you did? What assumptions are guiding your thinking?

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3) Perform the experiment. Place several drops of water on each dry surface and draw (side view) the results below.

_____	_____
Wax paper	Glass Slide

4) Compare your predictions with your observations and explain.

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5) Can you explain the differences in drop shape in terms of **adhesion** and **cohesion**?

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Questions

Direction: For each description below, identify the property or properties of water that best explains it.

1) Sweating cools you down.

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2) The temperature of coastal regions does not fluctuate as much as inland/landlocked regions.

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3) A basilisk lizard can "run" on water away from a predator.

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4) The water at the beach in June is cold but the water at the beach in September is warm (even though the air temperature in September is colder than in June).

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5) A bug can float on water and not sink.

_____

6) Animals like fish that live in the water do not become frozen and freeze to death.

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7) Blood is made of water and contains many dissolved substances such as salt and glucose.

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8) Provide an example not found in this lab that shows a property of water. What property of water does it demonstrate?

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