**How many drops fit on a penny?**

**Introduction**

Although a water molecule has an overall *neutral charge,* the shape of a water molecule makes it a **polar molecule** (it has a positive end and a negative end). The two hydrogen are slightly positive, and the oxygen is slightly negative. These different charged ends cause a *weak attraction* between an H from one water molecule to the Oxygen of a neighbouring water molecule. This attraction is called a **hydrogen bond**.

The process of hydrogen bonds making water molecules “stick” together is called **cohesion**. Cohesion results in **surface tension on the** surface of a body of water, forming a surface “film” or “skin.” This is why some insects like water striders can walk on water.

Some substances, such as soap, may reduce the cohesive force of water, which will reduce the surface tension of the water

Different liquids have different surface tensions due to their different molecular structures and therefore different intermolecular forces (attractions).

Because water molecules at the surface of the water puddle are attracted more to each other than to the air molecules above them, they cling together and form a dome shape on the coin. Surface tension prevents the water molecules from falling out and spilling. You can keep adding water drops until the surface tension is not strong enough to counter the gravitational pull on the water.

**What To Do**

1. Rinse a penny in tap water. Dry it completely with a paper towel.
2. Examine the penny and consider how many water drops you think will fit on the penny. **Write down your prediction: \_\_\_\_\_\_\_\_\_\_ drops.**
3. Place the penny on a flat surface that can get wet.
4. Fill a small beaker with water.
5. Draw water up SLOWLY into the dropper.
6. Keeping the dropper VERTICAL (pointing straight down, and not at an angle or sideways), do a few practice drops on the counter to get CONISTENT drops.
7. Now add drops to the penny while partner counts. Make sure not to touch the tip of the pipette to the penny when dropping water onto it.
8. Add drops until water runs over the edge of the penny.
9. Repeat the experiment with a different liquid like alcohol. Pay attention to the shape of the liquid puddle on the penny and the number of drops before it spills over. **Prediction: \_\_\_\_\_\_\_\_\_ drops**.
10. Repeat the experiment with water but add a drop of soap/detergent to the beaker of water you use. **Prediction: \_\_\_\_\_\_\_\_\_\_\_ drops**.

**Extension:** Start with a full glass of plain water (with a dry rim to prevent the water from dripping down the side of the glass). How many coins can we add to the water without the glass overflowing?

Gently add coins one by one. Because of surface tension, the water will rise above the rim of the glass before it spills (just like the initial experiment). Compare your original prediction with the number of coins you were able to add.

**HOW MANY DROPS FIT ON A PENNY? Name: \_\_\_\_\_\_\_\_**

**Observations:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Liquid** | **Prediction** | **Trial 1** | **Trial 2** | **Trial 3** | **Average** |
| **Tap Water** |  |  |  |  |  |
| **Alcohol** |  |  |  |  |  |
| **Soap + Water** |  |  |  |  |  |

**Questions**

1. Were your predictions correct? Extension: By what percentage were you off?
2. Why was it necessary to perform multiple trials on the same liquid?
3. It was important to keep the dropper vertical when dropping the liquid. Why do you think it was important?
4. What are the variables in this experiment?

Independent Variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Dependent Variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Controlled Variables: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Explain in your own words, using scientific terms how it is possible to get so many water drops on a coin. (Read the intro again if you are not sure).
2. Would a dime (10 cents) hold more or less drops? Why?
3. Does it matter if the coin is heads or tails? Why do you think this?
4. Explain in your own words and using scientific terms why the alcohol held more/less drops than water. (Read the intro again if you are not sure).
5. Did you encounter any problems in your trials? What would account for the variation in your trials?