Capillary Action and the Toothpick Star

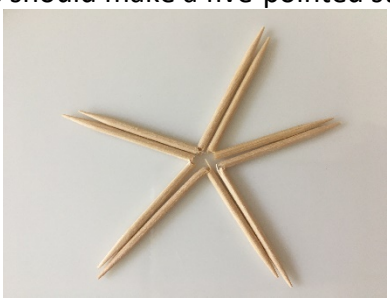
Supplies Needed:

- 5 wooden toothpicks
- Water
- Straw, eyedropper or fingertip to add water drops

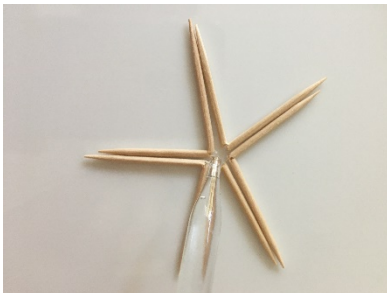
Procedure:

1. Carefully, without breaking them completely, bend each of your toothpicks in the middle so that they crack without breaking into two pieces.

2. Place the middle of your toothpicks (where the breaks are) together in the center of a plate. The five toothpicks should make a five-pointed star shape.



3. Carefully add several drops of water to the center of your toothpicks where the broken centers meet. You can do this using an eyedropper, pipette, straw, or your finger dipped into a glass of water. Note: You want to add just enough water such that all the broken centers of the toothpicks are soaked, but not so much water that any of the toothpicks start to float.



4. Watch and observe. Note: If you have added the correct amount of water, this won't take long (maybe a couple of seconds).

What's Happening:

Wooden toothpicks are made of dried wood, which when exposed to water, will absorb some of it. This absorption is due to microscopic openings in the wood that allow water to be drawn in, along the length of the toothpick. This process is known as capillary action. It is the same process that allows trees, flowers, and other plants to draw water up into their tissues. As the toothpicks absorb the water your placed in the center of the closed star, the wood expands, causing the bend you placed in each of the toothpicks to straighten a little bit. This is why you see the toothpicks moving to create an open star.

Capillary action is closely related to surface tension, which is the attraction of individual water molecules to each other. Water molecules have a slightly positive end and a slightly negative end. Similar to the way magnets attract, the positive end of one water molecule will attract the negative end of the molecule next to it. This phenomenon causes water to bead or dome. It also facilitates the movement of water through plants—the individual molecules pull at each other, helping to draw water throughout the structure of the plant.

Taking It Further:

- Try using hot or cold water. Does this change anything?
- What if you try a different liquid like saltwater, milk, or oil?

Want to see capillary action in action?

Place a white flower, like a carnation or rose, into a glass of water colored with food coloring. Observe for a few days. You will be able to see the colored water that has been drawn up the stem and accumulates in the petals, dying the veins of the petals with whatever color you made the water. If flowers are difficult to come by during stay-at-home orders, you can also try this with a fresh leaf of lettuce or a stalk of celery.

Walking Water Rainbow

Can you make a rainbow with just 3 primary colors & paper towels? The same process that gets water from the roots of trees to leaves will be what we use for this experiment. Paper towels, and the plants they are made of, consist of a sugar compound called ***cellulose***. Cellulose can resist gravity and pull water upwards through a process called ***capillary action.***

Supplies Needed:

- (6) clear jars or glasses
- Red, blue, and yellow food coloring
- Water
- (6) 1-2 inch strips of paper towels. Make sure they are long enough so that when they are looped over the lip of 2 jars, they reach at least ¾ of the way down the jar

Procedure:

1. Fill (3) jars nearly to the top with water
2. Add red food coloring to the 1st jar, blue to a 2nd, and yellow to the 3rd (***what color do you get when you mix red & yellow? Red & blue? Blue & yellow?***)
3. Arrange the 6 jars in a circle with an empty jar in between every filled jar (***what order will you put the jars in so that they are in rainbow order?***)
4. Add a strip of paper towel to each jar and loop it over the lip so it falls into the next jar. Each jar should have 2 paper towels in it that are going different directions.
5. Observe.
    a. What is happening in the clear jars?
    b. How is the water getting into the clear jars?
    c. What colors are being formed?
    d. How long did the process take?
    e. Will all of the water in the red/blue/yellow jars be moved to the clear jars or does that water stop moving at some point?
6. Remove the paper towel from in between the red and purple jars. Move the jars so that they are in a straight line and in rainbow order.

What's Happening:

When water molecules cling to a different substance — in this case, the paper towel — the process is called ***adhesion***. However, when water molecules cling to each other, the process is called ***cohesion***. Capillary action occurs when adhesion is stronger than cohesion. In this experiment, you saw the effects of adhesion overpowering cohesion when the water molecules became attracted to the paper towel's cellulose structure. When this occurred, the water and the added food dye, traveled up the paper towels and over to the next jar. Once the paper towels couldn't hold any more water, and adhesion is no longer stronger than cohesion, gravity took over and released the accumulated water into the empty jars. The primary colors then mixed to make the secondary colors. The water stabilizes and ends up at the same level in all the jars. Once the water level is the same in all the jars and the paper towels are all wet, the water stops moving from jar to jar. This is how the colors remain in primary and secondary colors, rather than continuously traveling from jar to jar, making a series of brown water jars. Now the next time you water a plant, you'll know exactly what's going on inside its leaves.

Pictures from:
https://www.steamsational.com/rainbow-walking-water-science/