Wacky Water Name___________________________________

Station 1: Capillary Action

Observations and Questions:

1) Define *capillary action*.

2) Observe the capillary tubes. What is the relationship between the diameter of the tube and the height the water rises?

3) Observe the beakers of gravel. What distinguishes each beaker of gravel?

4) In which beaker did the water rise the greatest height? Least?

5) What can you conclude about the relationship between the spaces between the particles of gravel and the height the water rises?

Application*:*

1) Imagine that capillary action did not occur. What impact would this have on the Earth and/or soils?

   a. What would be the consequences for living organisms?

2) Plants move nutrients and water throughout their tissues using vessels called xylem and phloem.

   a. What process moves water from a tree's roots all the way to the top of its branches?

   b. What can you infer about the diameters of the vessels?

Station 2: Adhesion and Cohesion

Observations and Questions:

1) Define *cohesion*.

2) Define *adhesion.*

3) Gently place one drop of water on a clean, dry, glass slide.

   a) Observe the shape of the droplet. Using a camera, take a photograph of the droplet from the side, as shown in Figure 1.

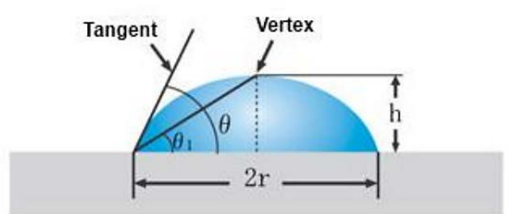
   b) Tilt the slide until the droplet moves. Record the behavior of the droplet here.

   c) Make a scaled, annotated drawing of the droplet from the photo in the box below. The annotations should include both angles, the radius, and the height, as shown in Figure 1.

   d) Find θ_1, then calculate θ. This angle represents the *contact angle*.

   e) How would you define the wettability?

Figure 1



Fine droplet shape can be assumed as part of a circle.
From the geometric theorem, $\theta = 2\theta_1$ holds.

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θ_1 =

θ =

4) Gently place a drop of water on the waxed paper.

   a) Record its shape, repeating the same procedure from question 3 a,c,d.

θ_1 = θ =

   b) Tilt the paper until the droplet moves. Record the behavior of the droplet here.

c) How would you define the wettability?

Application:

1. Do you think the droplet of water on the waxed paper experiences …?

    a. More adhesive forces compared to cohesive forces
    b. More cohesive forces compared to adhesive forces
    c. Similar amounts of cohesion and adhesion.

2. Provide evidence for your answer, citing the specific observations you made during the adhesion and cohesion station.

3. Do you think the droplet of water on the glass slide experiences…?

    a. More adhesive forces compared to cohesive forces
    b. More cohesive forces compared to adhesive forces
    c. Similar amounts of cohesion and adhesion.

4. Provide evidence for your answer, citing the specific observations you made during the adhesion and cohesion station.

Station 3: Investigation of Flowers and Leaves

<u>Task Overview</u>

Part 1: **Choose** flower petals and/or leaves to compare, as directed by the teacher. **Calculate** the contact angle (θ_c) of water on each material. **Record** the data in the *Contact Angle Data Table*.

Handle the samples by the edges, only, so you don't alter the surface.

Part 2: After finishing Part 1, gently **alter** the surface of the samples by abrading with a swab, or washing with soap. Place a drop of water on the sample and **determine** if the treatment causes a change in the contact angle. **Record** the results of the before and after treatment (B & A) in the data table.

Part 3: **Obtain** four different grits of **DRY** sandpaper. Place a drop of water on each sample and immediately **observe** the contact angle. **Sketch** the drops in the grit table.

1500 Grit	600 Grit	150 Grit	80 Grit

Contact Angle Data Table

Material 1:	**Material 2:**	**Material 3:**
$\theta_1 =$	$\theta_1 =$	$\theta_1 =$
$\theta_c =$	$\theta_c =$	$\theta_c =$
Wettablity:	Wettablity:	Wettablity:
B & A Observations	**B & A Observations**	**B & A Observations**

Final Conclusions:

Hints:

- Wax is a type of biologic molecule known as a *lipid* or fat, like oil, for example.
- In 1936, Wenzel created a formula for calculating contact angle: $\cos \theta_m = r \cos \theta_Y$

  θ_m is the actual, *measured contact angle*

θ_Y is the theoretical, *ideal contact angle*

r is the surface roughness

1. Define *hydrophobic.*

2. What do you think causes water to bead up on some surfaces? (Hint: there are 2 main factors.) Include 3 pieces of evidence to support your answer.

3. Identify 3 examples of how hydrophobic coatings could be used in real life. Make sure to describe the problem the application is solving.

Superhydro**philic**	Hydro**philic**	Hydro**phobic**	Superhydro**phobic**
$\theta c < 15°$	$\theta c < 90°$	$\theta c > 90°$	$\theta_c > 150°$

Figure 1 From Kyowa Interface Science Co., LTD
http://www.face-kyowa.co.jp/english/en_science/en_theory/en_what_contact_angle/