PlantingScience – Agronomy Feeds the World

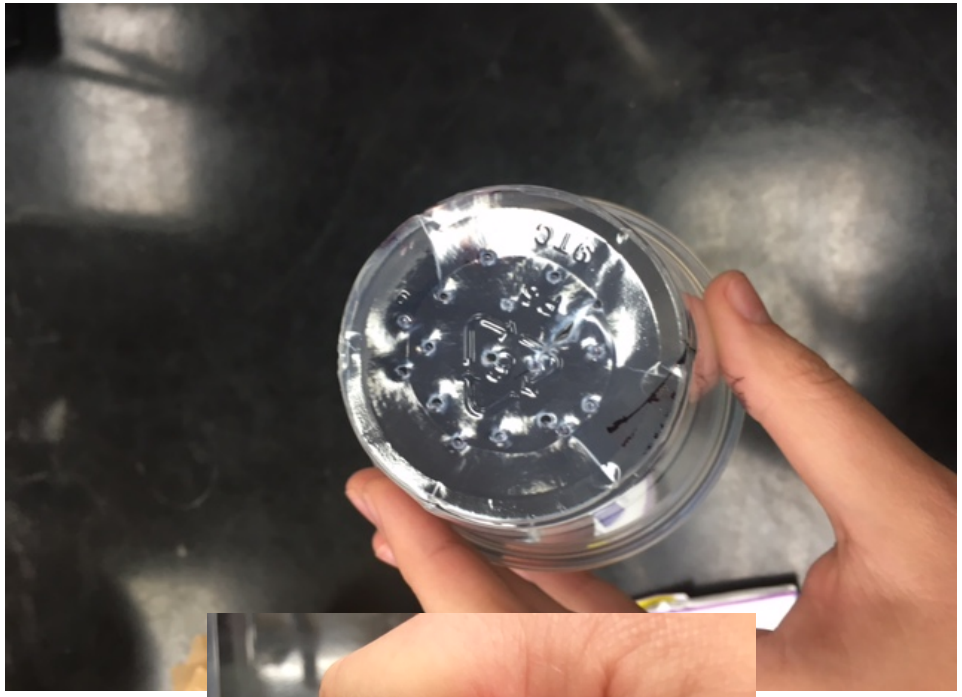
Experimental Design for Guided Inquiry – Teacher's Version

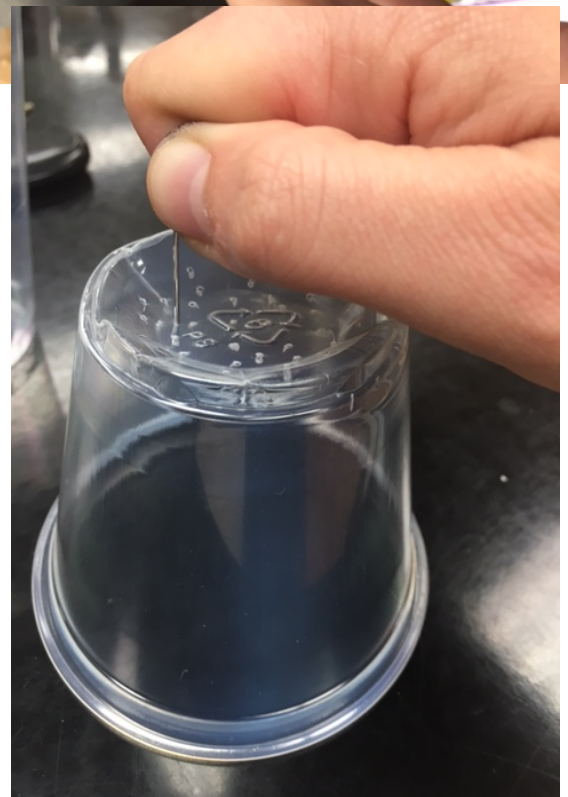
Notes:

- An alternative to soda bottles are clear plastic cups. The best design is to use one small 6 oz cup to fit into a larger 12 oz cup (see photos).
- There are two approaches to use with this guided inquiry; select the one that works best for your classroom. Or try both!

Approach #1:

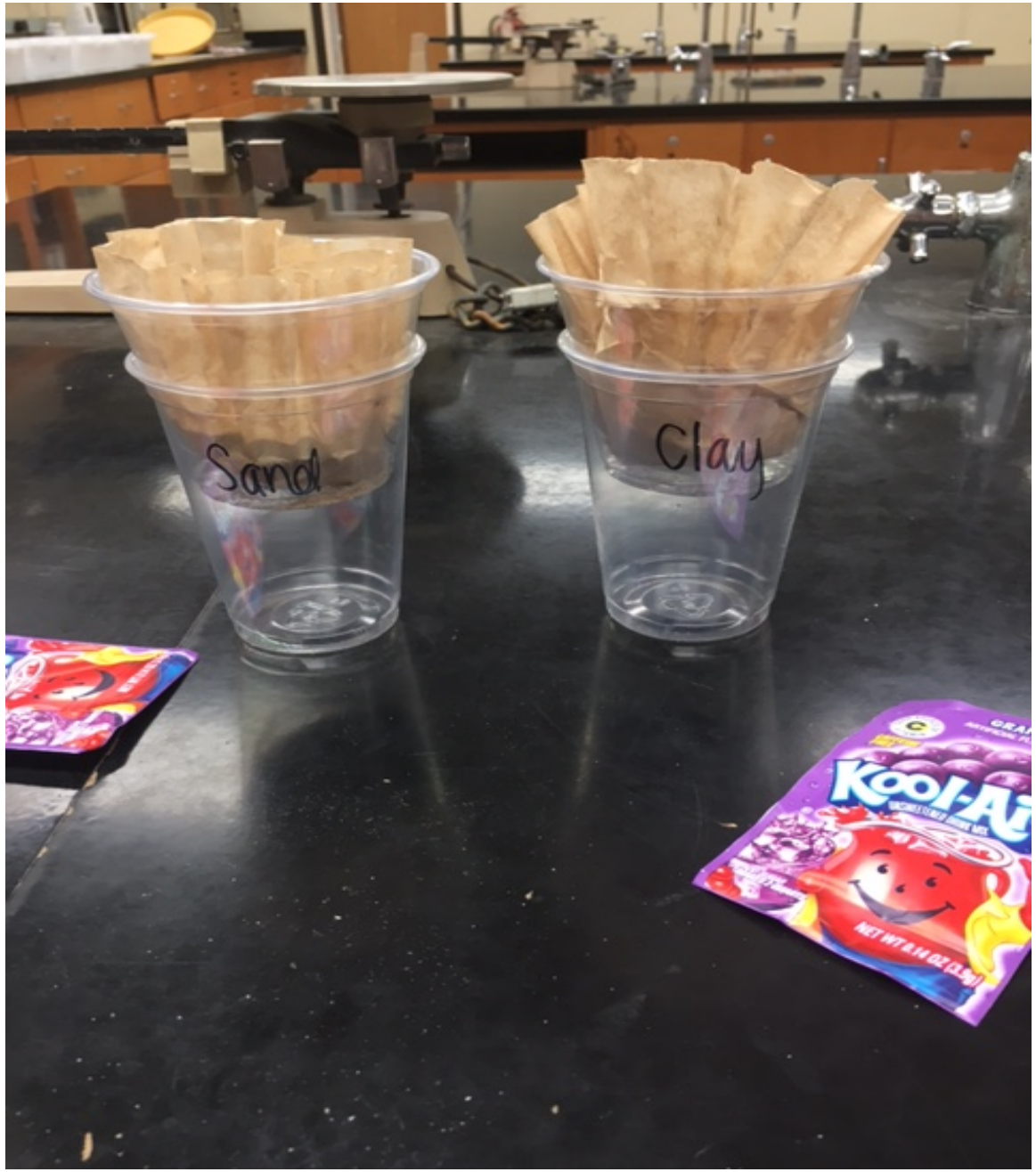
1) Punch holes into the bottom of the smaller cup. This is where the soil and filter will be put. A paper clip works to punch the holes, but figure out what works best for you!





Approach #1

2) Add the coffee filter as shown and fill the cup about 1/3 full with soil. This is where you can experiment with different kinds of soil. Sand vs clay, sand vs home soil vs clay, etc.



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Approach #1

3) Add a half of a purple Kool-Aid® packet to each soil and add 100 ml of water.

With this, there will be a slight difference in the leachate color. There was also blue dye attached to the soil. Explain to students that the Kool-Aid® is a nitrogen fertilizer being added to the soil. The blue dye of the Kool-Aid® will be ammonium (NH_4^+).

From previous exercises, students will know that soil has a negative charge, and because ammonium is positively charged it will attach to the soil particles. Because clay has a larger surface area, and therefore more negative charges, it will retain more ammonium.

Students will be able to see this when looking at the soil in the filter. See photos below- The soil used in this demo was a fine sand (normally used in golf courses) and pure Kaolinite 1:1 clay mineral.

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Approach #1

- Mix Kool Aid® powder into each soil.
- OR
- Sprinkle Kool Aid® powder on top of the soil – test to see which gives the clearest results for you.

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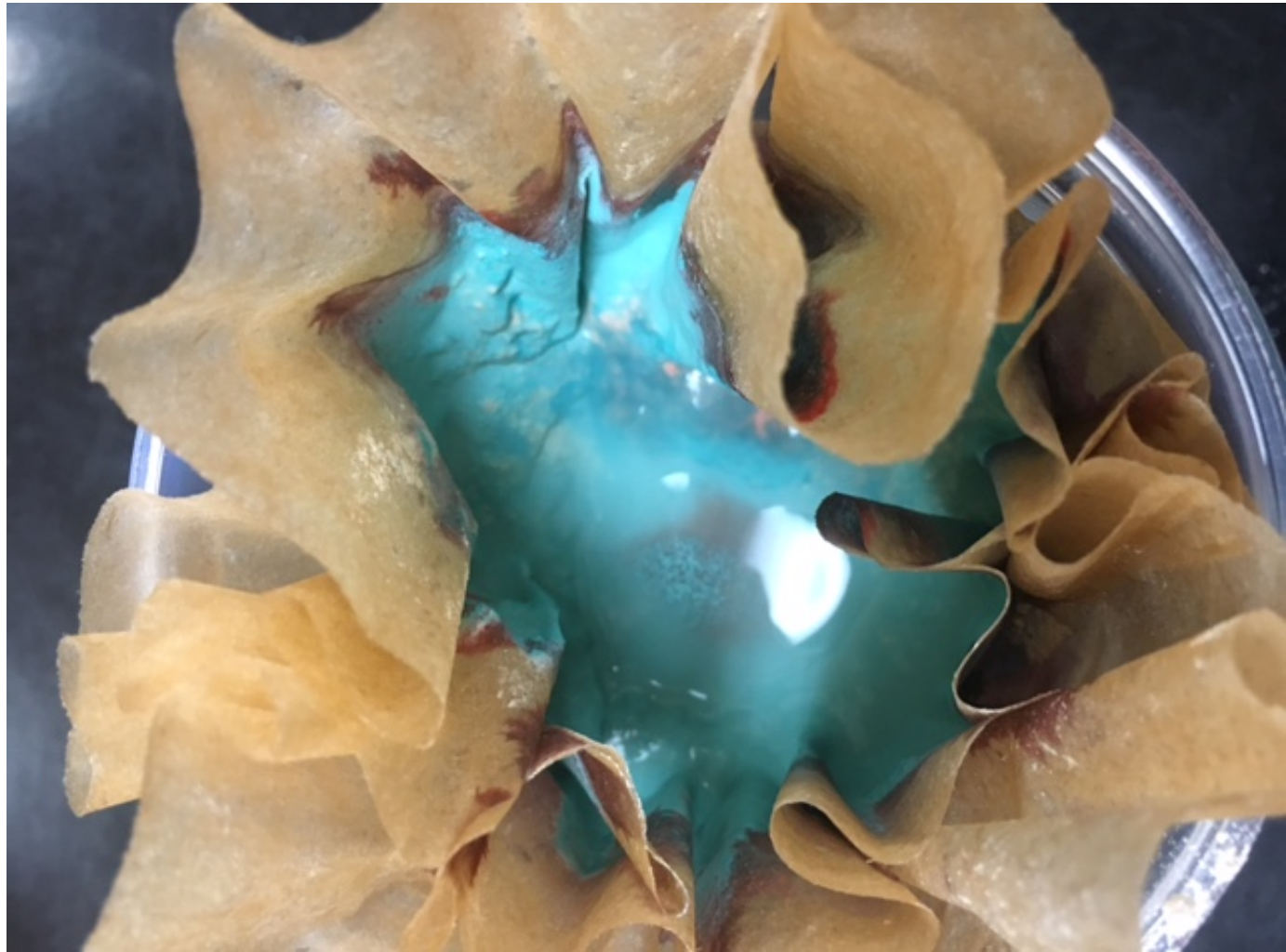
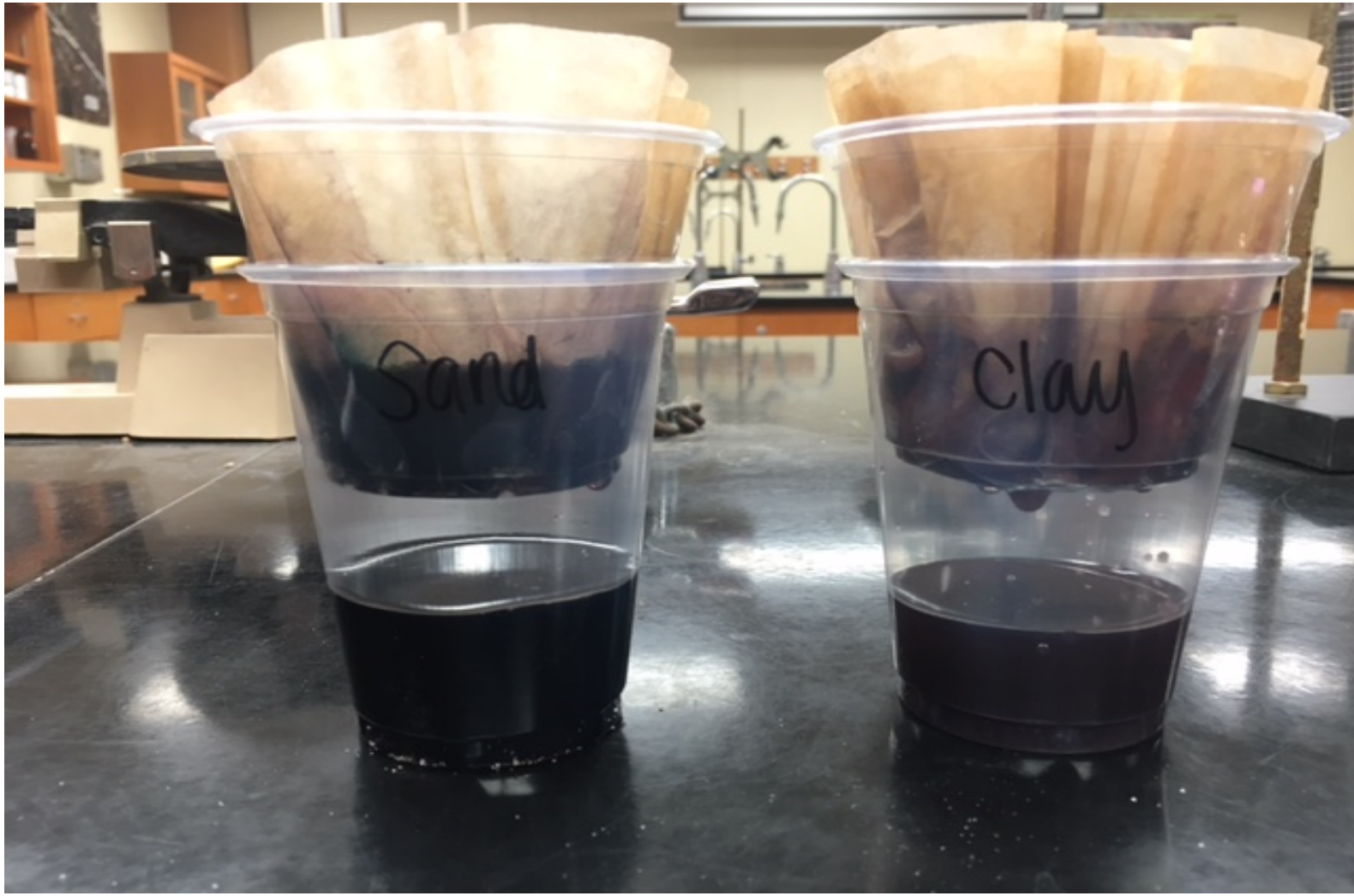
Approach #1

- Note the blue dye attached to the clay soil.



Approach #1

- This is what the leachate looks like when only ½ packet of Kool aide is used. The difference can be faint, as seen in this photo.
- Pro Tip – Use a white background for your pictures for comparisons.



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Approach #1

- The clay soil has much more blue dye retained in the soil

Approach #1

- Close-up of the blue dye attached to the soil

Approach #2

- Make a Kool-Aid® ‘solution’ (1 Kool-Aid packet with 2 liters of water) and add to each soil type (about 100 ml).
- The two soil textures used in this demo were a fine sand and a clay soil texture (rather than a clay mineral) with 56% clay, 5% sand, and 39% silt. Using the USDA soil textural triangle, this is classified as a clay soil texture and it will be made up of various amounts of clay minerals (kaolinite, montmorillonite).

Approach #2

- Using the second approach, there is a much greater difference in leachate color. The main reason for this is that the Kool-Aid® solution is much more diluted. However, the blue dye did not attach to the soil as clearly as Approach #1.
- Try both ways out and see what works better with your classroom!