DIY Air Force Activities:

Cool Chromatography

Materials:

- scissors

Part A

- white construction paper
- craft sticks
- vinegar
- rubbing alcohol
- water
- 2 large clear cups
- black marker

Part B

- white flower (carnation)
- yellow and red food coloring
- large clear cup

Chromatography is used to separate mixtures. It works by dissolving them in a fluid (the mobile phase) that pulls the components through a structure (the stationary phase). Elements in the mixture interact with the phases in different ways, which leads them to travel at different speeds, causing them to separate. Techniques like this are essential in the field of chemistry. Capillary action, or the ability of a liquid to flow in narrow spaces without the assistance of an external force, powers chromatography experiments. The fundamental properties of this experiment are also how paper towels absorb water! The chromatography experiments below will teach you to separate the components of black ink by the power of capillary action.

Directions: Part A: Paper Chromatography

1. Cut white construction paper in 1 inch strips. Make a line in black marker 1 inch up from the bottom of your strip.
2. Mix your solvent consisting of equal amounts of vinegar, rubbing alcohol, and water in one cup. Pour a small amount in the bottom of your other cup (less than 1 inch deep).
3. Suspend the strips in the glass by wrapping the non-inked end around a craft stick and submerging the bottom in your solvent. Do not submerge your line in the solvent. Allow paper to soak up the solvent and watch what happens!

The more soluble components of the ink will move faster along the paper and thus end up near the top of the paper. Less soluble components will move slower and remain closer to the bottom. Changing the composition of the solvent (for example, adding more vinegar or using less alcohol) will change the solubility of the ink components and therefore change where these components migrate on the paper. You can also experiment with different colors of ink!

Air Force Associations:

When an ordinary thin glass tube is exposed to water, it begins to flow into the tube via capillary action. However, researchers at Georgia Tech, funded by the Air Force Office of Scientific Research (AFOSR), discovered that when the inside of a tube is coated with a very thin layer of a so-called “smart” polymer, they could gain more control over the process. Coating the inside of glass microtubes with a polymer hydrogel dramatically altered the way capillary forces drew water into the tubes. The discovery could provide a new way to control microfluidic systems.

Plants pull water from the ground, but have you ever wondered how? Water moves through the plant via capillary action! The plant sucks water up its stem much like a straw. The water then evaporates out of the leaves and petals by a process called transpiration. As that water evaporates it pulls more water up the stem in a continuous cycle. As the water climbs the stem it pulls up nutrients as well. Different types of molecules will travel at different rates. We can observe this progress by adding dye to the water of a cut flower. Using a white carnation, we can see the components of orange food coloring separate and recombine to create a beautifully colored flower.

Directions: Part B: Fantastic Colored Flower

1. Fill the glass halfway with water and add 8 drops of red food coloring and 8 drops of yellow food coloring. Mix well.
2. Cut the end of the stem off diagonally so that the flower rests easily in your glass.
3. Leave the flower in the water and observe the petals over a period of a few days. Take notes!

Which color reaches the end of the petal first? What can we infer about the size of the yellow and red dye molecules based on their position on the flower petals?

Try this experiment with different types of flowers and different colors! Make a rainbow bouquet! For the best results, call your flower shop and ask them when the carnations will be delivered. Flowers are transported in a slightly dehydrated and cooled state. Prior to sale they are re-hydrated. You want a "thirsty" flower and will observe the fastest results if you get a flower that has not yet been allowed to drink.