Electrowetting Demonstration Kit

Developed by K-8 Teachers:
Katrina Henderson and Gina McCormick
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RET Host: Novel Devices Laboratory, University of Cincinnati.

Parts to be Purchased with a $30 Budget:

1) Standard Aluminum Foil
   -this is the lower electrode

2) 1" wide, 36 yrd long, KPT-1 Kapton Tape: www.Kaptontape.com
   -this is the hydrophobic dielectric, wider tape may be purchased if budget may exceed $30 total

   -this is the voltage source. Careful this can lead to a painful (but non-harmful) electrical shock! A high-voltage charger is needed because the ~50 μm thick Kapton Tape is 50X thicker than most ~1 μm thick electrowetting dielectrics.

Other parts include 18 gauge insulated wire, electrical tape, food coloring dye (optional), vegetable oil (optional).

Instructions for Water/Air Electrowetting (example photos coming soon)

Attach two 12" sections of insulated 18 gauge wire to the ground electrode of the charger. The electrical ground is the nut near the push button. Use electrical tape to further secure the wire to the charger, and to electrically insulate the ground (so your fingers cannot touch it).
Place a small (2”x2”) sheet of Al foil on a flat surface. Using Kapton tape, tape the other end of one of the 18” gauge wires to the Aluminum foil. Cover the remaining surface of the Aluminum foil with strips of Kapton tape.

Apply a small dose of water to the Kapton tape. The droplet diameter should be small (~2-3 mm) because of gravity effects. Bring the pointed end of the charger close to (but not touching) the droplet and click the charger. Make sure your fingers are not near the pointed end of the charger. You should witness electrowetting. By keeping an air gap between the droplet and charger, charge is transferred to the droplet via an observable electrical arc, but does not return to the charger (i.e. the droplet stays charged/elecrowetted). The droplet should electrowet once the charge is transferred. In order to remove the charge from the droplet (dewetting) the free 12” wire lead should be brought into contact with the droplet. This grounds the foil to the droplet.

The high voltages caused by the charger can cause loss of Kapton hydrophobicity. Gently rubbing the Kapton surface with a cloth and vegetable oil can replenish surface hydrophobicity. A thin film of oil may be applied to the Kapton, the experimenter will notice several interesting oscillations and satellite droplet formation using this setup.

**Instructions for Water/Oil Electrowetting (example photos coming soon)**

This modified setup: (1) reduces gravity effects and allows much larger 'marble-sized' water droplets; (2) results in a 2-3X larger change in water contact angle. Obtain a metal spoon or wrap a plastic spoon in foil. Use Kapton tape to attach a 12” wire lead to the spoon (similar to water/air setup with foil). Cover the concave or 'bowl' portion of the spoon with Kapton Tape. Place the spoon in a shallow glass dish or bowl. Mix food-coloring dye (blue) into some water, a light blue color will do. The dye allows one to easily view the water inside the oil. Add water to the spoon (the amount should be about the same volume as a marble). Fill the glass container with vegetable oil to the point where the water droplet is covered by ~1 mm of oil. Repeat the charging experiments of the water/air setup.