The Magic Disk Trick

--- or ---

A Macroscopic Demonstration of Hydrophobic vs. Hydrophilic Interactions.

We are always looking for ways to connect the macroscopic world in which kids live with the invisible world of molecules. For example, how can we help them construct an understanding of how hydrophobic and hydrophilic forces play a major role in determining the folded structure of a protein? Here is an activity that does just this.

Materials:

1. Hexane (~10 ml) (Lighter Fluid works as an alternative)
2. Water (~10 ml)
3. Paper….the cheap stuff, not shiny /glossy paper.
4. A number 2 graphite pencil
5. A capped test tube or vial (plastic or glass) that will hold ~20 ml of liquid.

Procedure:

1. Take the raw paper --- which is made of cellulose, and is therefore hydrophilic --- and scribble on one side with the # 2 pencil. This will coat one side of the paper with carbon --- which is hydrophobic.
2. Using a single hole punch, punch out 5 disks. One side of each disk is black --- and hydrophobic (graphite is pure carbon), while the other side is white --- and hydrophilic (paper is made from cellulose, which has a lot of OH groups).
3. Add both the water and the hexane to the test tube or vial. Cap and shake vigorously. These two solvents will quickly separate into two distinct phases, with the less dense hexane on top.
4. Add the bi-colored disks to the vial, cap and shake.
5. Observe how the disks orient themselves at the interface between the hydrophobic hexane and the hydrophilic water.

What can go wrong? Almost nothing, except:

1. You can use glossy paper….that has been treated with clay and other materials that decrease the hydrophilic nature of the cellulose surface.
2. You can scribble only very lightly, and therefore not completely cover the hydrophilic cellulose with hydrophobic carbon.
3. You can use a dirty or soapy test tube/vial….that will confound the disks.
4. You can handle the paper with oily/greasy fingers --- in which case the hydrophilic cellulose will become somewhat hydrophobic, confounding the disks.
5. You can fail to test all your reagents in advance, in which case this experiment is guaranteed …. not to work.