Student Instructions Handout

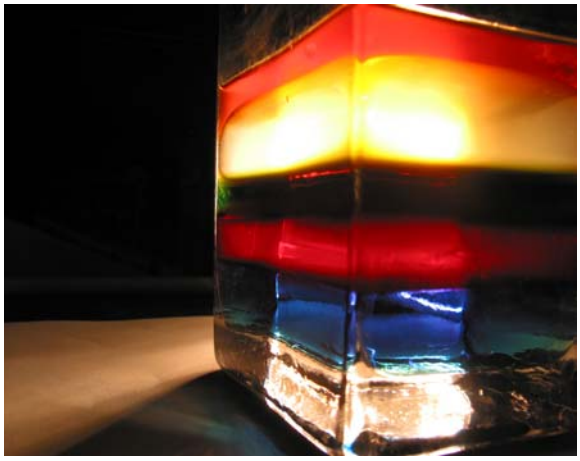

Figure 1. Rainbow created by layers of fluids with different densities.

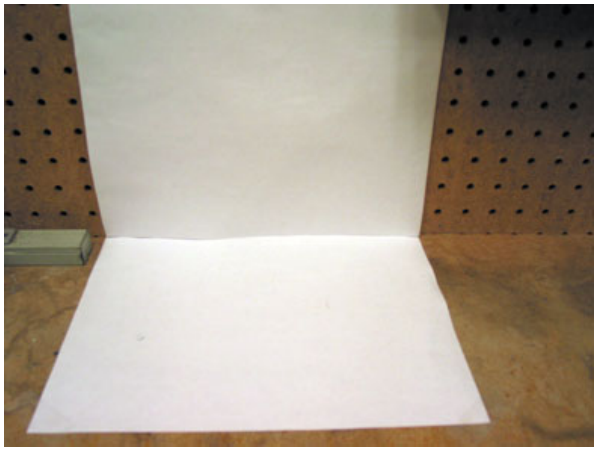

Figure 2. Use two pieces of white paper to create a white background.

Part 1: The Density Rainbow

1. Dye the corn syrup, alcohol and shampoo different colors by dropping 1 or 2 drops of food coloring into each cup. Make sure not to dye a fluid pure red because the strawberry syrup is already that color. You can also experiment with mixing different colors of food coloring to obtain colors such as purple and orange by dropping in drops of two different colors into a fluid. It is important that no more than 2 drops of blue are dropped into the fluid because too much food coloring makes a very dense color which, in turn, looks black. Record on your worksheet what color is used for each fluid.
2. Stir each dyed fluid thoroughly with the spoon/mixing rod. (Remember to rinse the spoon or mixing rod so the food colors do not mix, or use disposable plastic spoons or stirrers.)
3. Answer questions 2-3 on your worksheet.
4. On your worksheet, predict which fluid will be the densest, and which will be the least dense.
5. As a team, decide on the order of fluids, from the most to least dense. Then pour what you think is the most dense fluid into the glass container first, being careful not to drip any on the sides of the container. Slowly pour the next densest fluid on top of the previously poured fluid. If poured slowly, no mixing should happen between them and the layers will remain visible. If the container is very tall, use a spoon to ease the fall (see Figure 3). Although some mixing will probably happen, your fluids will settle after a while (see Figure 4). Keep pouring in the fluids in order of density (the most dense at the bottom, and the least dense at the top).

Figure 3. The "spoon-method" of pouring green-dyed shampoo into a density rainbow.

Figure 4. After pouring, the fluids settle, creating a rainbow.

6. When you poured in the fluids, did they stay in the order you poured them? Or did some that you thought were denser move up a layer? Why did the fluids set in that order? Answer question 5 on your worksheet.
7. The rainbow takes at least five minutes to settle out and have distinguishable layers (see Figure 7).

Part 2: The Great Viscosity Race

1. Our two racing fluids are chocolate syrup and ketchup.
2. First, see which is denser. Pour about 1/3 cup (78 ml) of chocolate syrup into the clear 8 oz (.24 l) drinking glass.
3. Pour ketchup into the glass, above the syrup. If you pour it in slowly, it should stay above the syrup, showing that the ketchup is less dense than the syrup.
4. Answer questions 6-8 on your worksheet.
5. Place a white piece of paper on the table, and at one end of the paper, place a small spoonful of ketchup next to a small spoonful of syrup. Make sure that they are not touching (see Figure 5).
6. Based on your observations so far, which liquid do you think will flow faster down the sheet? Answer question 9 on your worksheet.

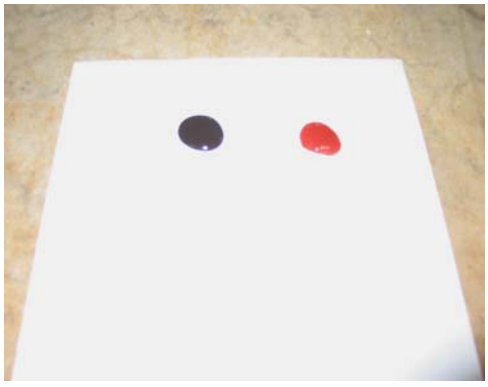

Figure 5. Drops of chocolate syrup and ketchup placed on a white piece of paper lying on a table.

7. Tilt the piece of paper to a vertical orientation. Observe which fluid flows faster down the paper (see Figure 6). The winner is the less viscous fluid.
8. Compare the ranking of viscosity to the ranking of density for the ketchup and chocolate syrup. Was the least dense also the least viscous? Answer questions 10-12 on your worksheet.

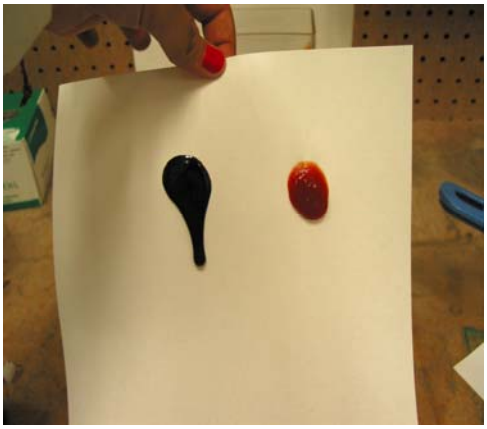

Figure 6. Tilting the paper to compare the flow of chocolate syrup to ketchup.

Figure 7. The result: A rainbow created by fluids of different densities.

Part 3 (optional): The Density Rainbow Revisited

1. Return to your density rainbow container and observe how the fluids have separated (see Figures 1 and 7).
2. Position a black background behind the density rainbow.
3. Experiment with the clip light and camera position so that the light glows through the density rainbow while the rest of the image is dark. Adjust your camera to make the rainbow fill the composition. Use the camera to capture stunning pictures of the rainbow.

Source of all images: