

Eyedropper Hydrometer

Buoy your understanding of density

Materials

plastic pipet or eyedropper (narrow stems work better)
sand
water
masking tape
permanent marker
cm ruler
scissors

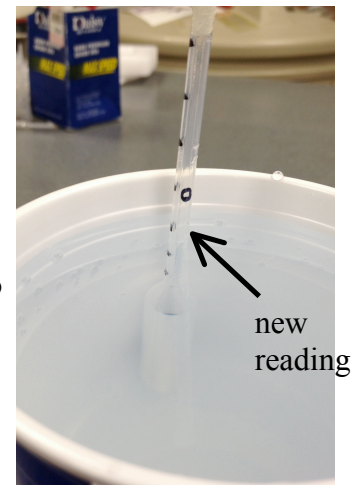
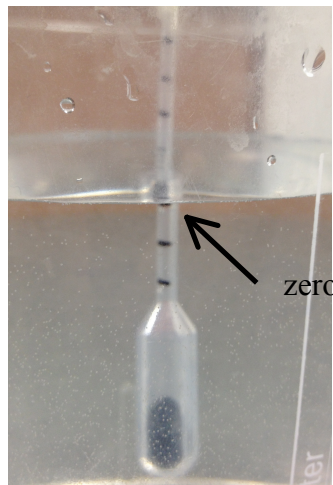


To do and notice

1. Cut the tapered tip off of the pipet. The opening needs to be large enough to pour sand into.
2. Make centimeter marks along the stem of the pipet.
3. Use a paper funnel to add sand into the pipet so that it collects in the bulb.



4. Place the pipet with the bulb side down in a beaker of water. Adjust the amount of sand so that it is floating or neutrally buoyant. Cover the pipet opening with a small piece of tape.
5. Notice where the surface of the water meets the stem of the pipet. Mark this point along the stem as "0" as the reference point.
6. Make a solution of salty water. Place your hydrometer in this solution. Using the marking as a guide, is the hydrometer higher or lower in the solution? How does this change if you change the concentration of salt?



What's going on?

A hydrometer measures the relative densities of different liquids. When an object floats in a liquid, or is neutrally buoyant, the upward force of the liquid perfectly balances the downward force of gravity on the object. According to Archimedes' principle, this force is equal to the weight of the fluid the object displaces, which you can visualize by looking at how much of the object is below the surface. The force that your hydrometer needs to keep it buoyant is dependent on its shape, mass, and volume. When it is placed in a fluid, it will sink until it displaces enough fluid to balance this force. The amount displaced will be a fixed mass of fluid, regardless of the fluid. Therefore, the volume displaced depends on the fluid's density. If a fluid is less dense, it will take more volume to reach the balancing point, so the hydrometer will sink deeper into the fluid. If the fluid is more dense, the volume needed will be less, so the hydrometer will float higher.

You may have noticed that your hydrometer sunk less in the saltwater solution. Adding salt to the water makes it more dense, so a smaller volume of liquid needs to be displaced. By using water as a reference point of zero, you can calibrate your hydrometer to show the relative density of liquids compared to water. Try testing different concentrations of saltwater or other liquids, such as corn syrup, oil, alcohol, etc.