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1. Fill an empty container (as big and transparent as possible) with water so that you can clearly see objects floating/sinking on it. Find two objects that **sink** in the water but that have different densities. Try to find objects that are as compact as possible, to minimize drag.

   a) How could you tell which of the two sinking objects has a higher density? Hint: Use Newton's second law ($ma = F_{\text{total}} = F_{\text{buoyancy}} - F_{\text{gravity}}$), Archimedes principle ($F_{\text{buoyancy}} = \rho_{\text{water}} V_{\text{displaced}} g$) and $F_{\text{gravity}} = mg$ to find an expression for the acceleration only in terms of the densities of the object and the water. You should arrive at a formula like this: $a = (1 - \rho_{water}/\rho_{obj})g$.

   b) Which of your objects was more dense? How could you tell? Upload clips showing the different accelerations as the objects sink.

2. Now find two objects that **float** in the water but that have different densities. Try to find objects that are compact and that they don't soak in water, to minimize effects due to surface tension and changes in density.

   a) How could you tell which of the two floating objects had a higher density? Hint: Here you should find an expression that relates how much volume of the object is immersed relative to its total volume to its density: $V_{displaced}/V_{object} = \rho_{obj}/\rho_{water}$. Hint: Because the objects float, they are at rest, that means $0 = F_{\text{total}} = F_{\text{buoyancy}} - F_{\text{gravity}}$. Plug in the corresponding forces into the equation to arrive at the formula: $V_{displaced}/V_{object} = \rho_{obj}/\rho_{water}$.

   b) Which of your objects was more dense? Estimate the density of each object using the formula $V_{displaced}/V_{object} = \rho_{obj}/\rho_{water}$ where $\rho_{water} = 1\ g/cm^3$. Use this online simulator https://ophysics.com/fl1.html to find what the buoyancy force is for each of your objects (using the densities that you got). Upload pictures that clearly show the ratio $V_{displaced}/V_{object}$ for each object.

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3. Take the container filled with water and add an ice cube. The ice cube should be clearly floating in it (shouldn't be touching the bottom of it). Why does the ice float if it is made of the same material as the liquid (water)?

4. Take a look the water level when the ice is floating. What do you think will happen to the water level after the ice cube has melted?

5. Now you are going to design an experiment to check your answer in 3. To do that figure out a way to measure the water level before the ice cube melts (**when the ice cube is floating**) and after the same ice cube has melted (you can draw a mark at the water level before and after). Upload a picture of the water level before (with the ice cube floating) and another picture of the water level after the ice cube melted, to see the difference in the level, if any.

6. Different liquids that do not mix (dissolve into one another) also obey the Archimedes principle. That means that they will stack on top of one another according to their density like in the figure below. Can you find three different liquids at home that show this behaviour? Upload a picture of your result. Here is an example.

7. Extra credit: mathematically prove the result of the experiment in number 4 using Archimedes principle.