Relative Floatation 2

(Ireland)

Background

Building on concepts established by the Titanic Model and Relative Floatation Model 1 demonstrations, this demonstration emphasises that the floatation of an object depends not only its density i.e. the number of particles in a fixed space, but also on the density of the liquid in which it floats. Students may already be somewhat familiar with this through the density tower of liquids.

This model builds on previous density concepts by adding a layer of complexity/student understanding in a modelling scenario that emphasises a conceptual, non-mathematical approach to density, using only simple measurement for comparison purposes. Rivers/lake and oceans are modelled using tap water and salt water.

You will need….

- ✓ Felt-tip marker
- ✓ One opaque, screw-top plastic containers
- ✓ Two identical brass weights
- ✓ Water
- ✓ Mass balance
- ✓ Table salt/NaCl
- ✓ Two large beakers (or two large cut-down plastic drinks bottles)
- ✓ Retort stand
- ✓ Metre stick

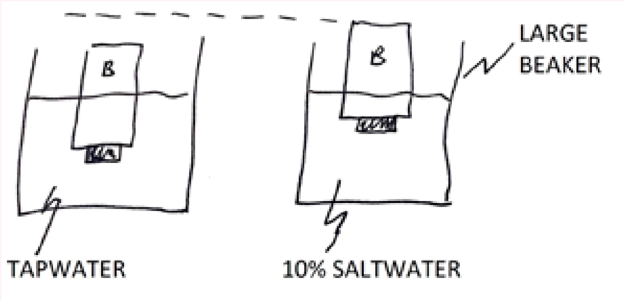
Follow these steps:

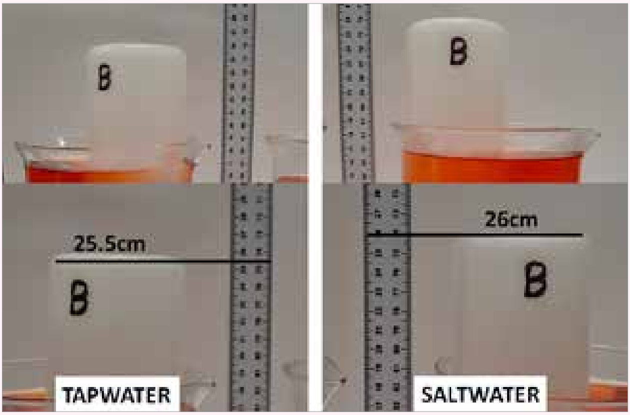
1. Container B from the previous demonstration can be used. It is possible to use two identically weight containers, but to eliminate any extraneous factors in the minds of students, using a single container is advised.
2. Three quarters fill a large beaker, with tap water.
3. Fill a second large beaker in the same way, adding 10% of the waters mass in table salt.
4. Stir the salt mixture until all the salt is fully dissolved.
5. Seawater is approximately 4% salt, however this difference in water density would not be enough to show a meaningful difference on this scale, so a higher concentration is used in order to demonstrate a principle with sufficient clarity.
6. Place both beakers either side of a meter stick that has been suspended from a retort stand.
7. Zero the metre stick to the surface of the water.
8. Don not tell students the purpose of the demonstration, simply that they are to note observations, and use these in combination with the previous two demonstrations to explain a question that will be posed at the end.
9. Place B into the tap water and note its height reading.
10. Remove B from the tap water, dry any excess water on its surface and place into the saltwater.
11. Note the height of B above the water.
12. Compare the two heights. The difference will be small but measurable.
13. Students can then be asked “If Container B is unchanged, why did it float higher in the second beaker than the first?

So what happened?

Container B was the same density throughout so both beakers did not contain the same liquids, but liquids of similar appearance but different densities.

Salt water has a greater density because of the added salt. The difference in densities between B and saltwater is greater that between B and tap water, which causes B to float higher in salt water.





What next?

- This can be linked to the stability of ships as they pass out of ports into oceans, as water density in a part may be less than outside it. This is especially so if a port sits in a river estuary, as ships might than pass from fresh-water to salt water. This is one of the reasons that ships avoid sailing with empty cargo holds, as without cargo they have to use their ballast systems carefully.
- Ships which have adjustable ballast tanks of water, to increase stability when sailing, especially if cargo holds are empty.
- As there are layers of density in the ocean (haloclines), submarines have to adjust ballast levels carefully as they pass from one layer to another.
- This difference in salt layers can also create effective sound barriers as the speed of sound changes between layers, allowing submarines to move between layers to avoid sonar detection.
- It is possible to revisit this model when teaching forces (buoyancy). This may be helpful as students will already have a clear link to mass being a factor, and may have also completed pressure as a topic.

This demonstration is the third of three consecutive demonstrations, and is best done following the Relative Floatation 1 demonstration, (see Titanic Model and