Floating Spheres Activity

Two containers, A and B.

Each have a clear liquid, but A has twice as much liquid as B.

A has five balls in it, two floating and three sunk at the bottom.

Take a green floating ball from A and forcefully throw it into B.

What questions come to mind?

From this one demo, identify two different observations that someone might bring up to explain why the green ball floats in A and sinks in B. You don’t have to explain anything, just identify a difference that you observed. At this point any difference could be brought up.

Be ready to tell us your difference in one or two words. We will report orally by group.

* Breakout rooms -

Report your ideas by group. Did anyone think of color?

What are some tests that might be used to make one of your ideas more or less likely?

I’ll pick at least one of the suggestions to try. We can do more focused tests later.

Remember we are trying to come up with a theory about why the green ball floats in A and sinks in B using things that we have seen.

Now we want to write a statement using one of your ideas that explains why the green ball floats in A, but not in B.

For example, if you were thinking about colors you might remember ROY G BIV and come up with the theory that the closer the color is to violet, the easier it is for the object to float.

Write one of your differences as a theory.

* Breakout rooms -

How easy was it to write these theories? Examples?

The differences identify variables.

Think about the variable of how hard the ball is thrown. What science concept does it depend on?

How would you state the theory having to do with this?

What experiment could you do to test the theory?

* Breakout rooms -

How would you state the theory having to do with the amount of liquid?

Could this theory account for all of the observations? Can we prove the theory wrong?

In science we often have to choose between alternative theories. If one of the theories doesn't agree with well-established scientific "facts" it is not as likely to be correct as one that does agree, or at least doesn't conflict, with well-established principles. If the theory can't be supported by experiments, it is also less likely to be correct. If the limits of the theory don't make physical sense or result in predictions that don't make physical sense, it is less likely to be true.

For our purposes it is sufficient to say that the "Amount of Liquid" theory results in something that doesn't make physical sense. We have never observed an object begin to float due to the addition of more water. If the theory were correct we should see a change in the ability of objects to float by addition of water at least once in a while. It doesn't prove the theory wrong, but it does make it less likely to be true.

So far there are two theories that have been articulated (surface tension and the amount of liquid) and both of them seem unlikely to be the real reason why the green ball floats in beaker A, but not in beaker B. In science it is often a matter of going through each theory and deciding if it is likely to explain our observations or not.

Now consider the idea that the liquids may be different. How would you articulate the theory to explain why the green ball floats in A but doesn't float in B if they think the liquids are different?

* Breakout Rooms -

The more dense a liquid is, the more likely an object will float in that liquid.

What is the result of this theory?

* Less dense objects or liquids float in more dense liquids.
* More dense objects or liquids sink in less dense liquids.

For us it must mean that the green ball is less dense than liquid A and more dense than liquid B.

Day 9

Last time we had thought about and discounted a couple of theories (surface tension and amount of liquid) for the green ball floating in A and sinking in B. We decided that density would be the best theory and wrote the density theory a couple of different ways and described what it meant in our case.

Remember last time the green ball and the blue ball (both now at the bottom of B) were previously floating in A and the pink ball at the bottom of B started out at the bottom of A.

What does the density theory predict for our spheres? Right now there are two sunk in A and three sunk in B. What does the density theory predict when these balls are moved from one liquid to the other?

What words do you associate with density? If something is more dense it is more …?

* Breakout rooms – Remember your room number.

Write words in shared notes.

Now list the variables associated with these words. This is a “brainstorming” exercise. List everything that comes to mind.

* Breakout rooms -

Write the variables in shared notes.

Which ones are fundamental variables?

How could you write a definition of density using the fundamental variables?

Our first word model:

The density depends on . . .

Directly and inversely proportional -

For our purposes two things are directly proportional when one goes up and the other also goes up and two things are inversely proportional when one goes up and the other goes down.

Can you give me some examples?

How are the fundamental variables for density related? Are they directly or inversely proportional?

Blackboard work –

One more slide -

So, how does a big ship float? What condition must be met?