SCI 265 – Investigating Density, Volume, Mass and Weight

Name: _____ Group: _____

Density, Volume and Mass

Play around with the PhET simulation *Density.*
Choose "Custom" and "My Block"

1. If you change the mass of the block, how does the block change?

As I increase the mass slider, The color changes to a darker color and the number of kg on the block goes up.

2. If you change the volume of the block, how does the block change?

The size gets bigger.

3. How does the density of the block change when you adjust the volume?

The density goes down if I increase the volume

4. How does the density of the block change when you adjust the mass?

The density goes up if I increase the m

5. *Prediction:* If you have several blocks of the same mass, will they all float or all sink the same in water?

6. Try out the button "Same Mass" Explain what is different and what is the same about each of these blocks.
   A. Compare features you can observe out of the water.

   The blocks have the same number of kg on them but they are different color and different sizes.

   B. Compare the behavior in water.

   One floats and the rest sink. The biggest one is the only one that floats.

7. *Prediction:* If you have several blocks of the same volume, will they all float or all sink the same in water?
8. Try out the button "Same Volume" Explain what is different and what is the same about each of these blocks.
   A. Compare features you can observe out of the water.

Now the sizes are the same but the colors are still different and the number of kg are different.

B. Compare the behavior in water.

In water two float and two sink. The two with the lowest kg float and the biggest kg sink.

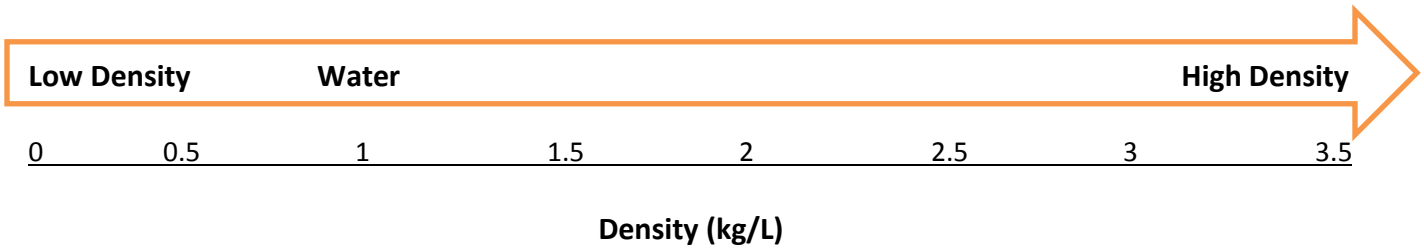
9. *Prediction:* If you have several blocks of the same density, will they all float or all sink the same in water?

10. Try out the button "Same Density" Explain what is different and what is the same about each of these blocks.
    A. Compare features you can observe out of the water.

Out of water they are completely different. The number of kg are different, the sizes are different and the colors are all different.

B. Compare the behavior in water.

They behave the same in water. All float with about ¼ of the tops out of the water.



Write these labels under the density scale above:

Sinks quickly Any number bigger than 1.1 or so
Barely sinks Numbers about 1.01, 1.02 maybe 1.03
Barely floats numbers about 0.99, 0.98 , maybe 0.97
Floats well Any number smaller than 0.95

The density of water is 1. If something has that exact density it will hover in the water wherever you place it. If it has a larger density than water, it will sink, if it has a smaller density than water it will float.

☆ ***Check your answers with your instructor***

11. Rank the relative density of the five mystery blocks A – E compared to each other and to water. Write a clear description of how you determined the order.

Blocks A and E are most dense and are both denser than water because they sink.

Block D is just a little less dense than water because only a small fraction of it is out of the water.

Block C is next because about a ¼ of it is above the water level

Block B is the smallest density because about half of it is above the water leve.

12. The grey brick on the supplies cart is solid lead. This gives you an idea of how something *very* dense feels. It has a density of 11.4 g/ml. Believe it or not, gold is nearly twice as dense as this lead brick at 19.3 g/ml! What did you notice when you picked up this lead brick? (Please do not place it in the water – it could crack the tank if you drop it!)

It is MUCH heavier than I expected for its size

13. Does a can of soda float? Does it matter if it's diet or regular? Why do you think this is the case?

The diet floated but the regular did not. The regular has about a quarter of a cup of sugar in with the carbonated water. The diet only has a fraction of a teaspoon of aspartame. So the same amount of regular soda weighs more than diet soda. Another word for this is the regular soda is more dense than the diet.

Do bowling balls sink or float?

14. *Prediction* How about a bowling ball?

15. Compare the two bowling balls.

A. How does their behavior in water compare? (Please put them in the tank one at a time and place them carefully so you do not crack the tank)

Depends on the ball!! One of them sank and one floated with just the very top above the water.

B. How do their volumes compare? Include a description of how you determined this.

Their volumes are the same, they are the same size.

C. How do their masses compare? Include a description of how you determined this.

I used the red and white spring scale and found that one of them was about a pound heavier than the other one.

D. How do their densities compare? Include a description of how you determined this.

Density is mass / volume. The volume's are the same but the mass is bigger for the one that sinks so that one has a bigger density than the lighter one.

The Buoyant Egg

Materials: An egg, electronic balance, graduated cylinder, stirring spoon, salt and tap water.

Experiment

- Determine the mass of your egg. Record this value in Table 1.
- Determine the volume of your egg. Record this value in Table 1.
- Place your egg in a warm bath of water so that it is FULLY submerged beneath the surface of the water (no portion of the egg is above water).
- Add salt to the water until the egg *just* floats (be sure to stir).
- Determine the volume of your salt water
- Determine the mass of your salt water (without the container)

	Data
Mass of egg (g)	
Volume of egg (ml)	
Density of egg (g/ml)	
Mass of salt water (g)	
Volume of salt water (ml)	
Density of salt water (g/ml)	

Table 1 Experimental data.

Analysis

- Compare the density of your salt water to the density of the egg.

  Are they the same or different? Why is this?

Questions

1. What would you need to do make a large fraction of the egg float above the surface of the water?

Lots of salt in the water so that the water is much more dense than the egg.

a) How would the volume of the displaced water compare to the volume of the entire egg?

The volume of the displaced water will be smaller than the volume of the egg. Because only part of the egg is under water when we do what 1. Says to do "Float a large fraction of the egg above the water".

b) How would the density of this water compare to the density of the egg?

Very dense salt water if lots of egg is above the water.

2. Apply your plan from above to get half the egg to float.

Mass and Weight

Mass: A property of an object. A measure of the amount of "stuff" or matter contained in an object. Measured in slugs (English) or grams (metric)

Weight: The force due to gravity on an object. The force with which an object is pulled to Earths' (or other planet/moon) surface. Measured in pounds (English) or Newtons (metric).

1. Prediction: List all the devices that you have used to weigh something.

A scale is an instrument for measuring weight. The two main types of scales are spring scales and balance scales. The spring scale is what someone might typically have in a home bathroom. You step on the scale and a spring inside moves a distance that measures the weight. On this type you see an indicator prong that will land on the number of the weight. A spring scale is also used in weight measurements in grocery stores.

Go to *Springs and Masses* simulation on the PhET site and play around with the sim, trying all the features.

2. Explain what happens to Spring 1 if you gently hang the smallest mass (50 grams) from the spring and let it settle to rest. Specifically, where does it hang with the mass compared to without the mass?

It now hangs lower with the mass attached.

3. Explain what happens to Spring 1 if you hang the largest mass (250 grams) from the spring. Where does it hang compared to the 50 gram mass?

It now hangs much lower with the bigger mass attached.

The scale in the fruit section works by the same principle. A spring stretches and it pulls the needle around the dial depending on how much it stretches.

A table top fruit scale works similarly.

The difference is instead of stretching a spring by pulling it down, this type of scale compresses (or squishes) a spring that you cannot see.

A bathroom scale also has a spring inside (a very stiff spring) to measure your weight.

4. On *Springs and Masses* investigate what happens to the rest position of the 100g mass on a spring if you change from the Earth, to the Moon.

When I change to the Moon, the rest position of the mass is higher. I think that is because the moon has a weaker gravitational force so it pulls less on the mass.

5. How about from Earth to Jupiter?

When I change to Jupiter, it hands much lower! So Jupiter's gravitational force must be stronger pulling on it harder

6. Are these spring type scales measuring *weight* or *mass?* Explain why.

They measure weight because weight is how hard gravity pulls on an object. If it measured mass, there would be no difference on the Moon, Earth and Jupiter.

On the moon, astronaut John Young jumps 2 feet straight up, despite his spacesuit that weighs 370 pounds on earth. On the moon, where $g = 1.6\ m/s^2$, he and his suit together weighed only 90 pounds.

7. Would these spring type scales measure weight or mass correctly on the moon if it is working properly on earth?

It would measure weight properly. They measure how hard gravity pulls something down.

☆ ***Check your conlcusion for the last two questions above with your instructor***

A balance compares one object to another. If they are the same mass/weight then the balance will be balanced. If not, the heavier object's pan will be lower than the lighter side.

8. Use the balance to determine the mass of your cell phone.

varies

9. Now use the scale to measure your cell phone.

varies

10. If you took this balance and scale to the moon and measured your cell phone. Will you get the same value with each of these devices as you did in lab today? Why do you say this?

I will get the same value using the balance but not using the scale since the weight changes.