

**MEASURING MATTER STUDY GUIDE**

Indicate whether each clue corresponds best to density, mass, or volume by writing “D” (for density), “M” (for mass), or “V” (for volume) on the line provided.

- V** - usually measured in milliliters or centimeters cubed (cubic centimeters)
- M** - the amount of matter an object/substance is made of
- V** - can be calculated by formula or measured in a graduated cylinder
- V** - the amount of space an object/substance takes up
- D** - the amount of matter in a given space
- M** - usually measured in grams
- D** - indicates how closely packed the particles are in a substance
- M** - measured on a balance or scale
- D** - is independent of sample size (amount)
- D** - determines whether objects sink or float

Complete the following table comparing “weight” and “mass”.

	<b>MASS</b>	<b>WEIGHT</b>
11. How are they different?	- <b>AMOUNT OF MATTER</b> - <b>DOES NOT DEPEND ON LOCATION</b>	- <b>PULL OF GRAVITY</b> - <b>VARIABLES BASED ON GRAVITY</b>
12. How are they related?	- <b>INFLUENCES WEIGHT</b>	- <b>DEPENDS ON AN OBJECT’S MASS AND GRAVITY</b>
13. How would they be affected if the object were on a different planet or moon?	- <b>BECAUSE THE OBJECT WOULD BE MADE OF THE SAME AMOUNT OF MATTER, ITS MASS WOULD REMAIN THE SAME NO MATTER WHERE IT IS</b>	- <b>BECAUSE WEIGHT IS AFFECTED BY THE GRAVITATIONAL PULL, AN OBJECT’S WEIGHT WOULD CHANGE BASED ON WHERE IT IS AND HOW MUCH GRAVITY IT IS SUBJECTED TO</b>

Provide a short answer to the following questions. If math is required, remember to show your work [i.e.: 1) write the equation, 2) plug in the numbers, 3) solve it with units].

- How does density determine whether an object sinks or floats?  
**OBJECTS THAT ARE MORE DENSE THAN THE FLUID (LIQUID OR GAS) THEY ARE PLACED IN WILL SINK. OBJECTS THAT ARE LESS DENSE THAN THE FLUID THEY ARE PLACED IN WILL FLOAT.**
- You have a 25 g metal block with a volume of 9.26 cm<sup>3</sup> and a 5 mL chunk of metal with a mass of 13.5 g. Are these two samples made of the same substance? Explain your reasoning.  
1)  $d = m/V = 25g/9.26cm^3 = 2.70 g/cm^3$   
2)  $d = m/V = 13.5g/5mL = 2.70 g/mL$   
**YES, THE TWO SAMPLES ARE LIKELY MADE OF THE SAME METAL BECAUSE THEIR DENSITIES ARE EQUAL. DENSITY IS INDEPENDENT OF SAMPLE SIZE, AND EACH SUBSTANCE HAS ITS OWN CHARACTERISTIC DENSITY, SO METAL SAMPLES WITH SIMILAR CHARACTERISTICS AND THE SAME DENSITY ARE LIKELY THE SAME METAL.**
- Will either of the two samples in question 15 float if they were placed in water? Explain your answer.  
**NO, NEITHER OF THE SAMPLES WILL FLOAT IN WATER. BOTH HAVE A DENSITY GREATER THAN 1.0 g/mL, WHICH IS THE DENSITY OF WATER. IF AN OBJECT’S DENSITY IS GREATER THAN THE FLUID IT IS IN, THE OBJECT WILL SINK.**
- The density of gold is 19.32 g/cm<sup>3</sup>. Are either of the samples from question 15 made of gold? Explain your answer.  
**NO, THE DENSITIES OF BOTH SAMPLES ARE DIFFERENT FROM GOLD. IF THE SAMPLES WERE MADE OF GOLD, THEY WOULD HAVE A DENSITY OF 19.32 g/cm<sup>3</sup>.**

18. How would you classify water as a type of matter (element, mixture, or compound)? Describe the composition of a water molecule.  
**Water is classified as a compound because it is a molecule consisting of two hydrogen atoms and one oxygen atom bonded together (H<sub>2</sub>O).**
19. Why is water a "POLAR MOLECULE"? What does "polar molecule" mean?  
**Water is a polar molecule because the oxygen atom pulls stronger on the shared electrons than the hydrogen atom does. This creates a slightly negative charge on one side of the molecule (the oxygen side) and a slightly positive charge on the other (the hydrogen side).**
20. Hydrogen bonds between water molecules result in COHESION and ADHESION. Describe these two properties of water.  
**Cohesion is the tendency of water molecules to be attracted to other water molecules like little magnets due to their polarity.**  
**Adhesion is the tendency of water molecules to be attracted to other objects due to their polarity.**
21. Why does ice float on top of water? What causes this to happen? (*discuss density*)  
**Ice floats on top of water because it is less dense than liquid water. Usually, the solid form of a substance will be more dense than its liquid form. However, water is unique in that its solid form is less dense than its liquid form due to the polarity of the water molecules forming crystal structures.**
22. What property of water allows it to be a good solvent? How does this affect the water we usually encounter?  
**Water's polarity allows it to be such a good solvent. Any polar or ionic substances will easily dissolve in water. For this reason, we rarely encounter pure water (H<sub>2</sub>O).**
23. What effect does water's high specific heat capacity have on Earth's ability to sustain life?  
**Water's high specific heat means that it takes a lot of energy to change its temperature. As a result, water is slow to heat and cool. Because there is so much water on Earth, this helps to moderate the temperature, making Earth suitable for sustaining life.**
24. Why do we sometimes encounter water in solid, liquid, and gas form all in the same location?  
**The melting/freezing point of water and the boiling/condensation point of water are both relatively moderate temperatures that we encounter regularly on Earth's surface. As a result, it would not be uncommon to see water in all three states at the same time in one location.**
25. What is the density of water?  
**The generally accepted (or "known") density of water is 1.0 g/mL. This means that each milliliter of water has a mass of 1 gram.**
26. How can you predict if an object will sink or float in water?  
**Because the density of water is 1 g/mL, objects with a density lower than 1 g/mL will float in water, while those with a density higher than 1 g/mL will sink in water.**