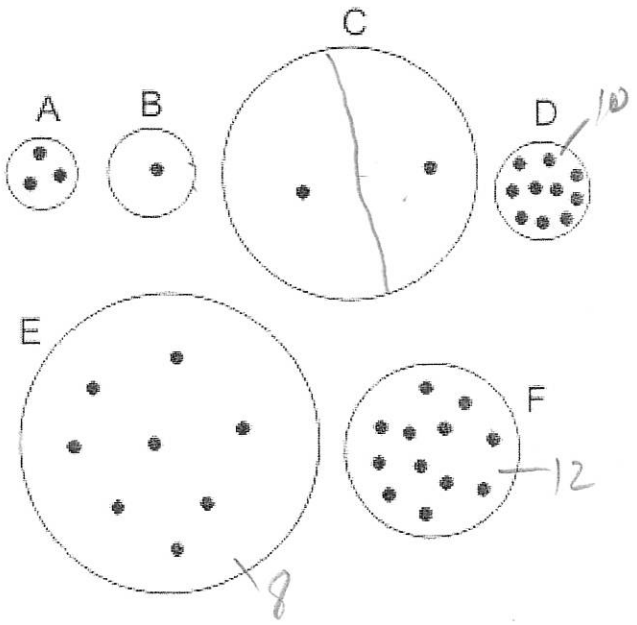
ESS 100 (Stapleton) Name: B 1/2
Physical Properties of Matter, Density

Match each term to the appropriate description: ~~Volume~~, ~~Mass~~, Weight, Density

1. mass The amount of "**stuff**" in something.
2. Volume The amount of space something takes up; how big something is; **size** in three dimensions
3. Density How compressed or **crowded** the stuff inside an object is; a ratio of stuff to size. $Density = \frac{mass}{volume}$ — Dense things sink
4. Weight The **force of gravity** pulling an object toward a planet. — more mass → more weight

The circles on the right represent objects with varying masses, volumes, and densities. The dots inside the objects represent identical particles of "stuff." The rest of the object is empty space.



5. Which object has the greatest volume? E
6. Which object has the least volume? A
7. Which object has the greatest mass? F
8. Which object has the least mass? B
9. Which object has the greatest density? D
10. Which object has the least density? C
11. *Which object has the greatest weight? F
12. *Which object has the least weight? B
13. There are asterisks above because, in special circumstances, all of the objects can have the same weight. Explain.

Take them to a place with no gravity

ıd the descriptions below and decide whether each property increases (+), decreases (-), or stays the same . *Some answers will vary depending on your assumptions (such as whether air has significant mass).*

Description of Change	Property	Change in Property (+, -, or =)	Explanation
14. A dry towel is squeezed.	Mass	=	No stuff was added or removed.
	Volume	−	Got smaller
	Density	+	More compressed
	Weight	=	Same as mass
15. A piece of paper loses its corner when the corner is cut off and thrown away.	Mass	−	Stuff was removed
	Volume	−	Smaller
	Density	=	Was not compressed or fluffed
	Weight	−	Same as mass
16. A balloon is inflated by mouth.	Mass	+	Stuff (air -- breath) was added
	Volume	+	Bigger
	Density	−	Floats better
	Weight	+	Same as mass
17. A moon rock is taken to the Earth.	Mass	=	No stuff added or removed
	Volume	=	No size change
	Density	=	Same stuff in same space → same crowdedness
	Weight	+	Earth's gravity is stronger
18. An actor needs to gain weight for a movie, so he packs on an extra 40 pounds of fat.	Mass	+	Adds stuff (fat)
	Volume	+	Gets bigger
	Density	−	Float better
	Weight	+	Adds 40 pounds

19. An army recruit has his head shaven (buzzed).	Mass	−	Lose stuff (hair)
	Volume	−	Hair takes up space
	Density	?	Depends on hair
	Weight	−	Same as mass

20. A plastic bottle of water splits open when the water inside freezes	Mass	=	No stuff lost; just breaks
	Volume	+	H_2O expands during freezing
	Density	−	Same stuff, bigger space → less crowded
	Weight	=	See mass

★ 21. An earthworm stretches as it inches forward.	Mass	?	
	Volume		
	Density		
	Weight		

22. Someone takes your stick of solid wood, drills some holes in it, and gives it back to you.	Mass	−	Wood was lost
	Volume	?	
	Density	=	Wood was not compressed
	Weight	−	lost mass

23. Someone exercises and gets much stronger, but her weight does not change.	Mass	=	Same as weight
	Volume	−	Muscle is more dense than fat → takes up less space
	Density	+	
	Weight	=	Doesn't change

*– The whole truth later

24. A hot air balloon is hovering over your town. The pilot turns on the flame, and the balloon begins to rise.	Mass	=	As far as we know, no stuff enters or leaves
	Volume	+	Heating makes air expand
	Density	–	It's rising
	Weight	=	Same as mass

Film Canister Submarine

up to 12 pennies

Using a film canister, some weights, some effervescent tablets, some water, and a drill (or the equivalent) your goal is to create a film canister "submarine" that sinks to the bottom of an "ocean" of water, comes to a complete stop, and then (after a while) rises back to the top of the water – all by itself.

- Design a and test a solution
- Clearly describe your procedure so that it could be repeated by a very literal reader.
- Explain how changes in your submarine's volume, mass, and density cause it to sink and then rise.
- Explain what is causing those changes.