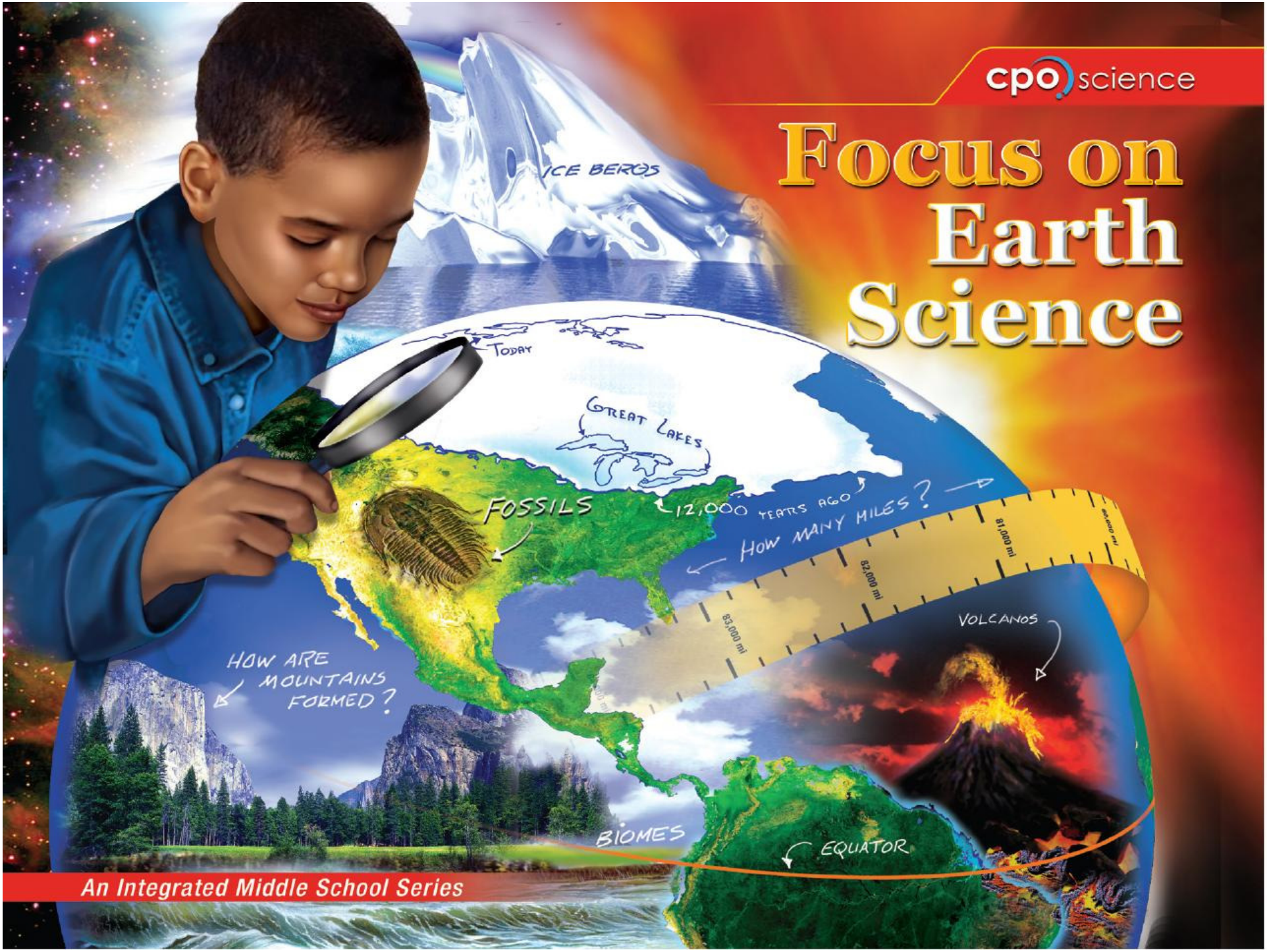

cpo science
Focus on Earth Science
ICE BERGS
TODAY
GREAT LAKES
FOSSILS
12,000 YEARS AGO
HOW MANY MILES?
81,000 mi
82,000 mi
83,000 mi
VOLCANOS
HOW ARE MOUNTAINS FORMED?
BIOMES
EQUATOR
An Integrated Middle School Series

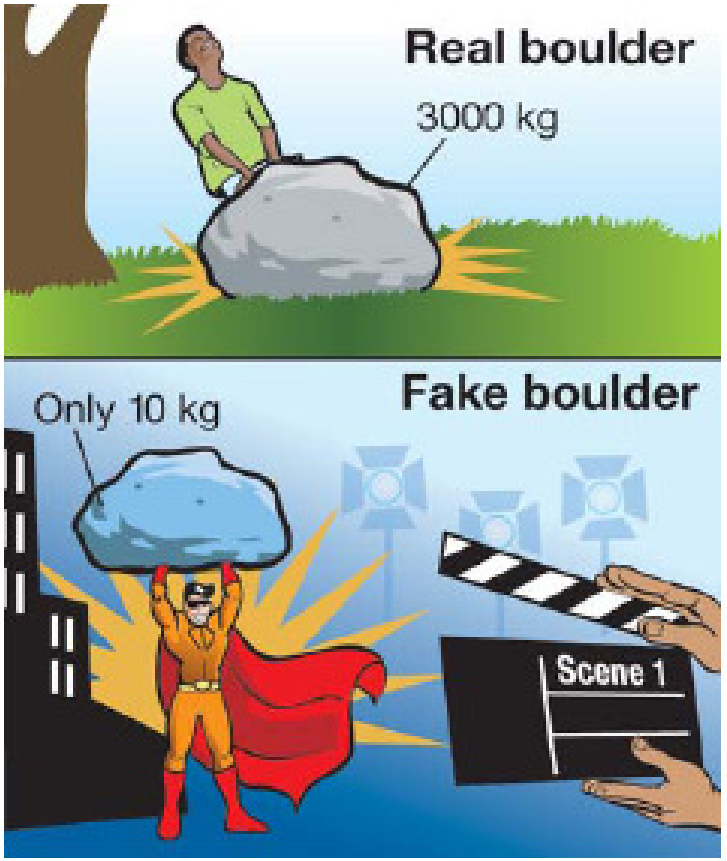
Chapter Five: Density and Buoyancy

- 5.1 Density
- 5.2 Buoyancy
- 5.3 Heat Affects Density and Buoyancy

5.1 Mass and Weight

- **Mass** is the amount of matter in an object.
- **Weight** is a measure of the pulling force of gravity on mass.

How are these boulders different?
Which boulder would you rather lift?



5.1 Mass and Weight

- Weight can change from place to place, but mass stays the same.

	Mass (kg)	Weight (newtons)
Earth	45.5	445
Jupiter	45.5	1,125

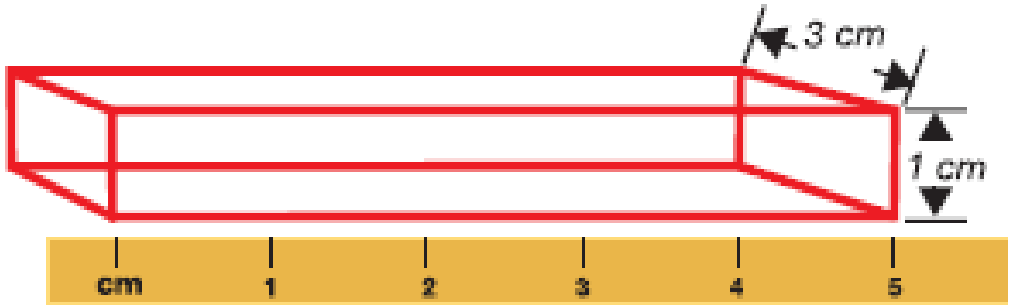
Mass versus weight on Earth and Jupiter.
Which planet has MORE force due to gravity?

5.1 Volume

- **Volume** is the amount of space that something takes up.
- To find the volume of a solid cube or rectangle, you measure the length, width, and height of the object.

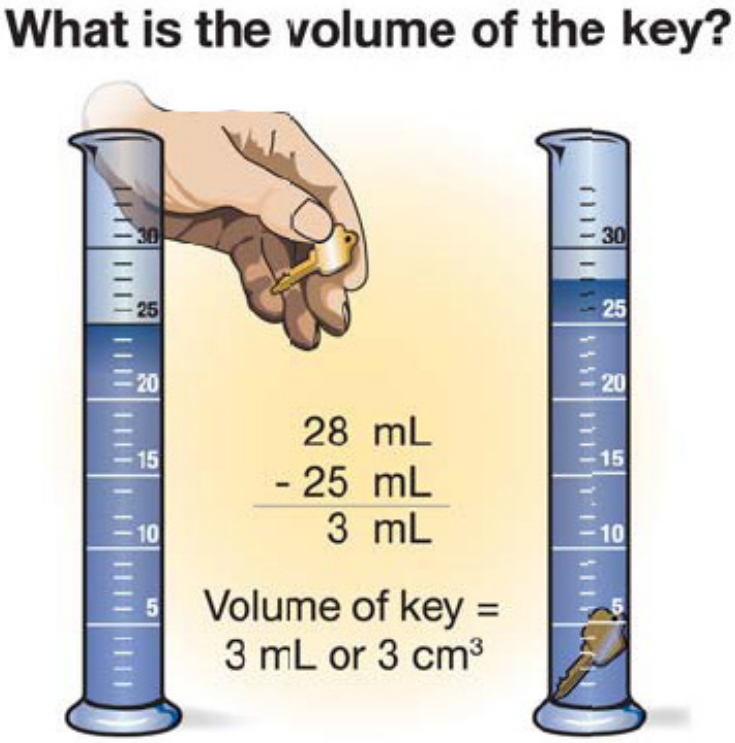
Volume of a rectangular box:

5 cm × 3 cm × 1 cm = 15 cm³



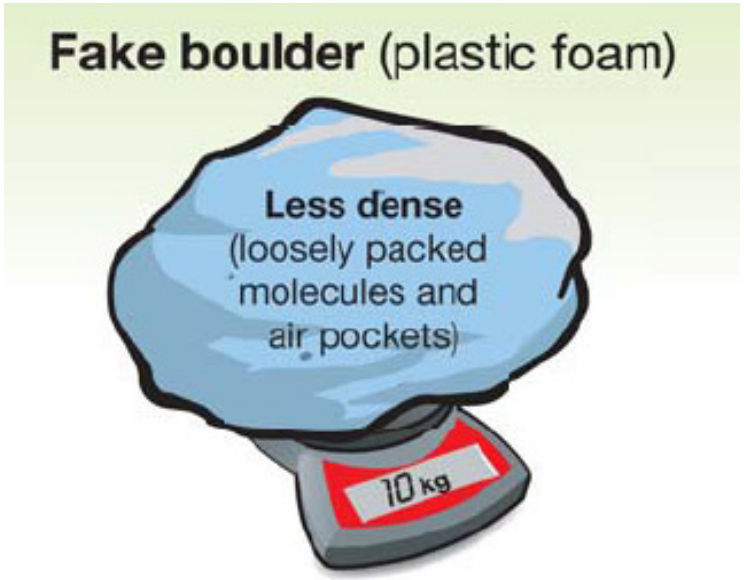
5.1 Volume

- You can find the volume of an odd-shaped object by placing it in water.
- This is often done in a container called a **graduated cylinder**.



5.1 Density

- **Density** is the word used to describe the comparison between an object's mass and its volume.

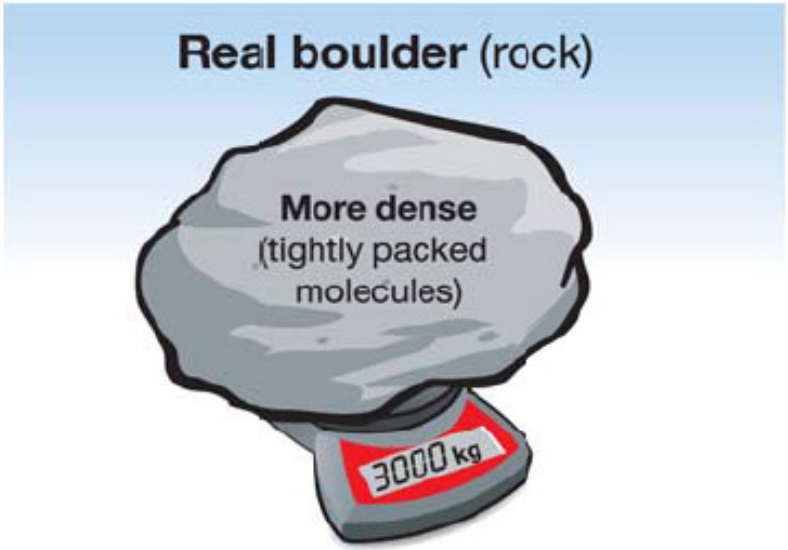


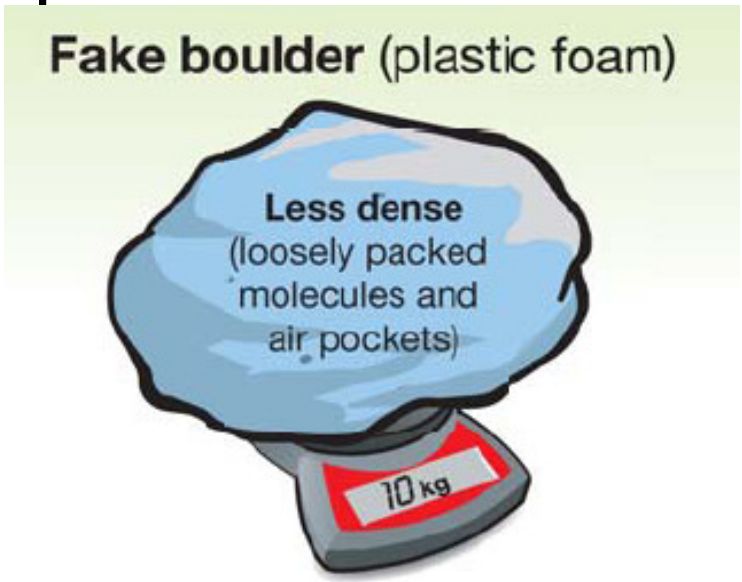
5.1 Density

- The density of a material depends on two things:
  1. The **mass** of each atom or molecule that makes up the material.
  2. The **volume** or amount of space the material takes up. This is related to how closely the atoms or molecules are “packed” in the material.

5.1 Density

- The density of a real boulder is greater than the density of a fake boulder.
- It's molecules are more tightly packed in the same amount of space.



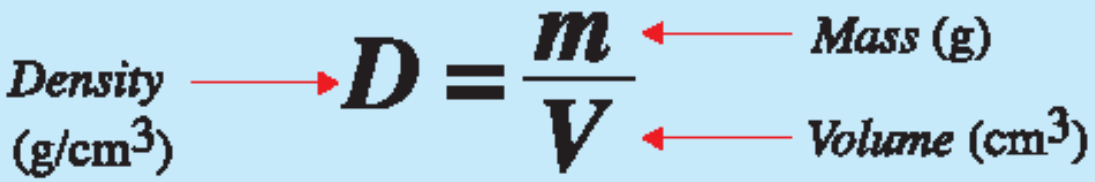


5.1 Density

- Solid objects, liquids and gases are made up of atoms and molecules so they have **both** mass and volume.
- The density of a material is always the **same** under the same conditions.
- Density can be used to identify materials.
- The density of an object is found by measuring it's mass and volume, then dividing the mass by the volume.

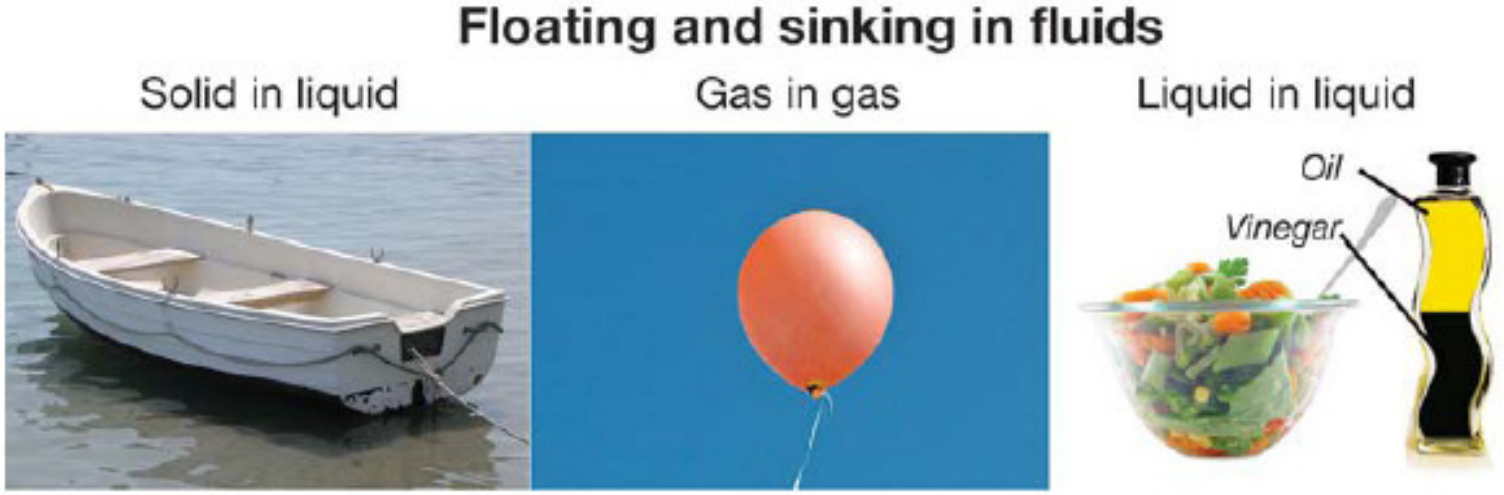
Finding Density

DENSITY



5.2 Fluids

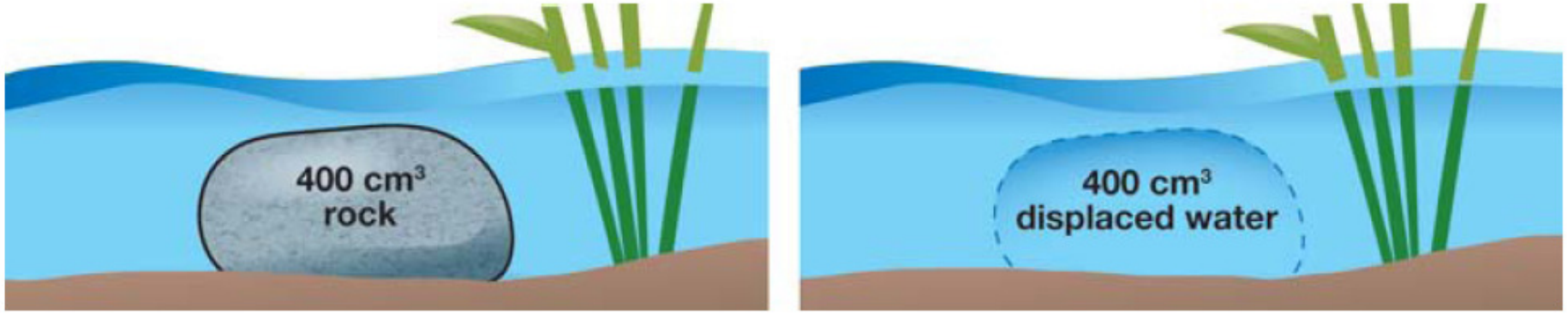
- Matter that can flow is called a **fluid**.
- "Fluid" does not mean the same thing as "liquid."
- Liquids and gases are **both** fluids.



What causes things to float or sink?

5.2 Sinking and Buoyant Force

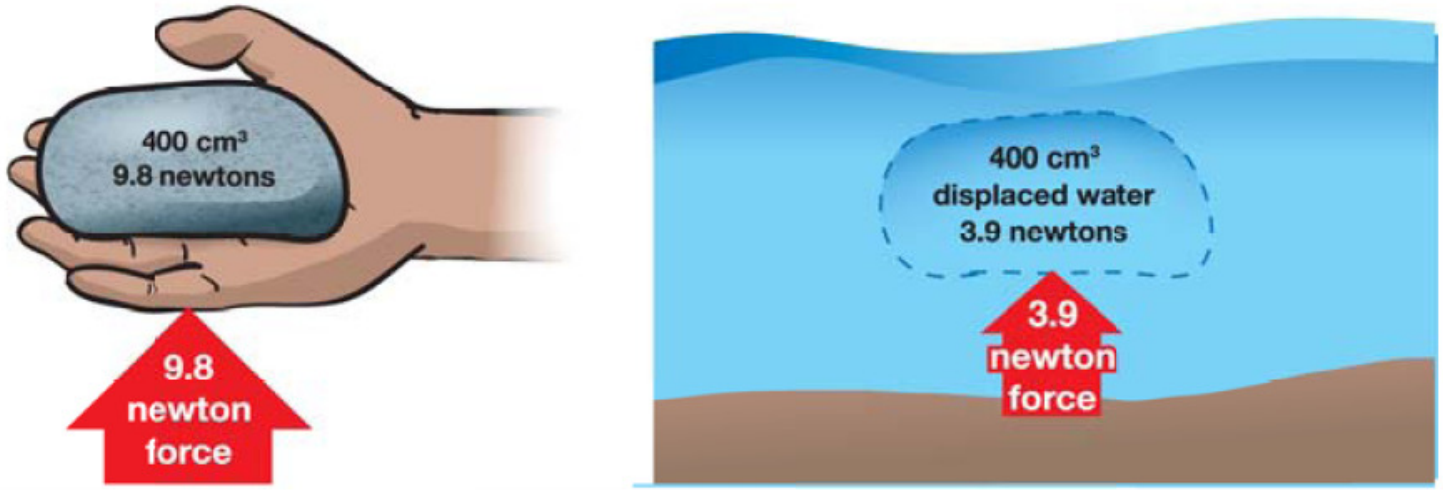
- A 400 cm^3 rock sinks to the bottom of a pond.
- When the rock is completely underwater, it **displaces** (pushes aside) an amount of water that is equal to its volume.



Which has it's molecules more tightly packed: the rock or the displaced water?

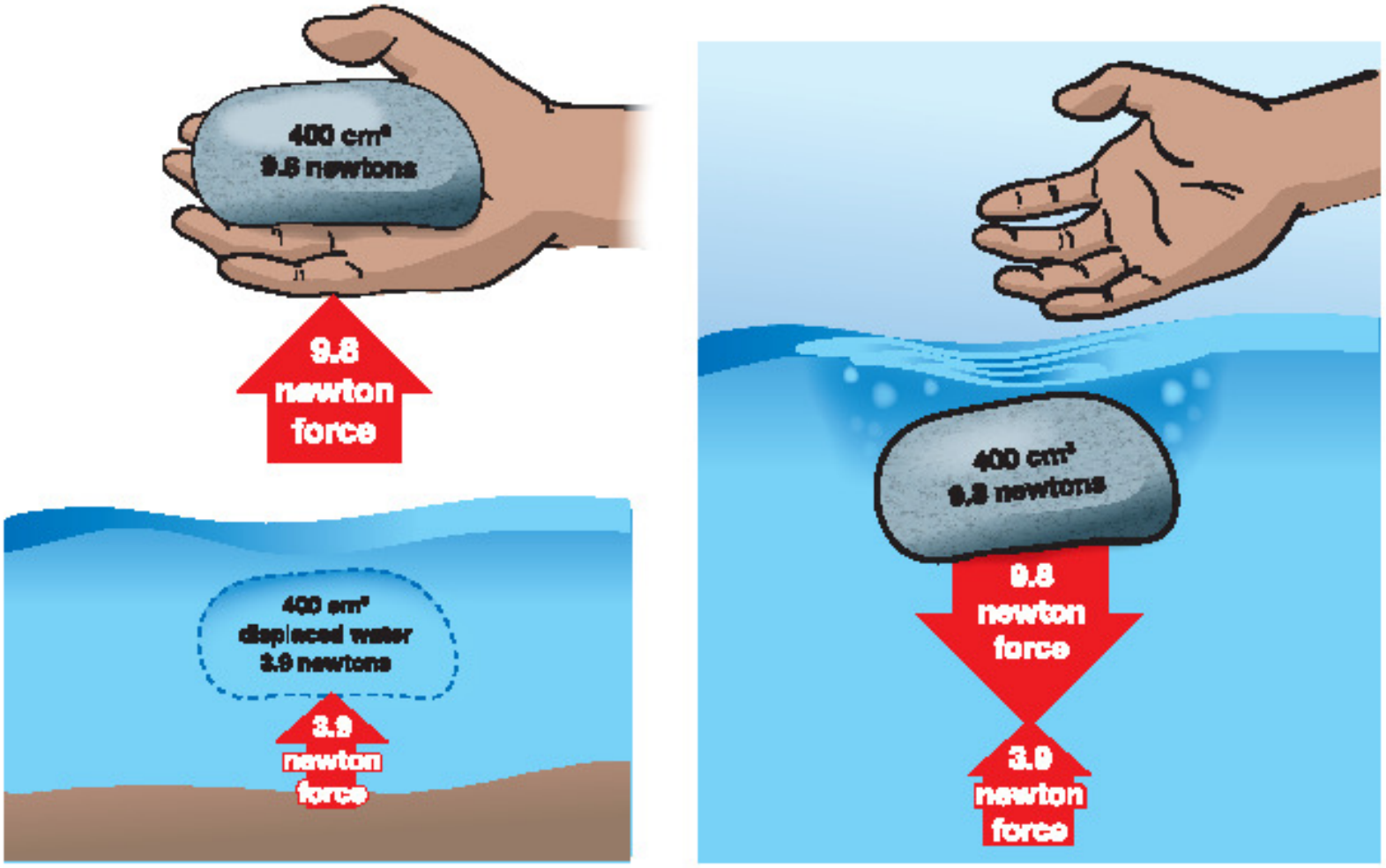
5.2 Sinking and Buoyant Force

- On Earth, both the rock and the water exert an upward buoyant force equal to their weight.



Which substance has a greater buoyant force on Earth?

Buoyant Force



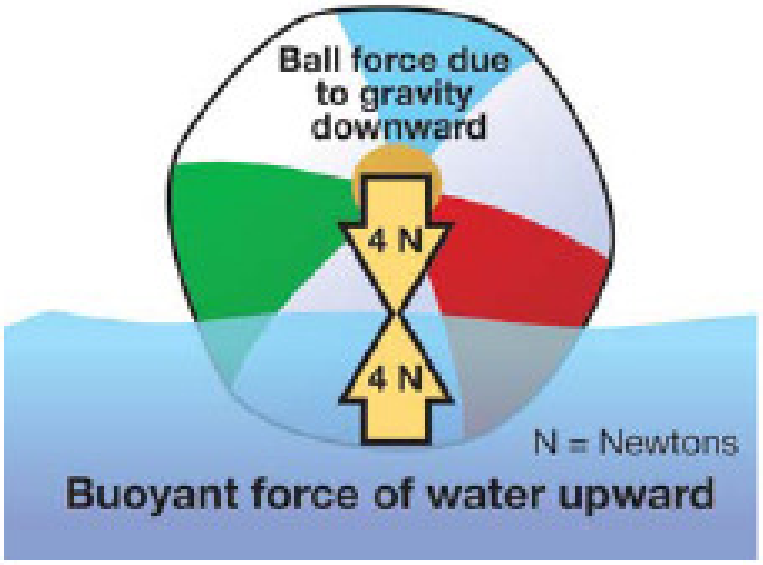
5.2 Sinking and Buoyant Force

- When the rock is dropped into the water, the water's buoyant force is not enough to support it.
- The rock sinks because its weight is greater than the weight of the displaced water.

Which substance floats?

5.2 Floating

- Why does a beach ball float so well?



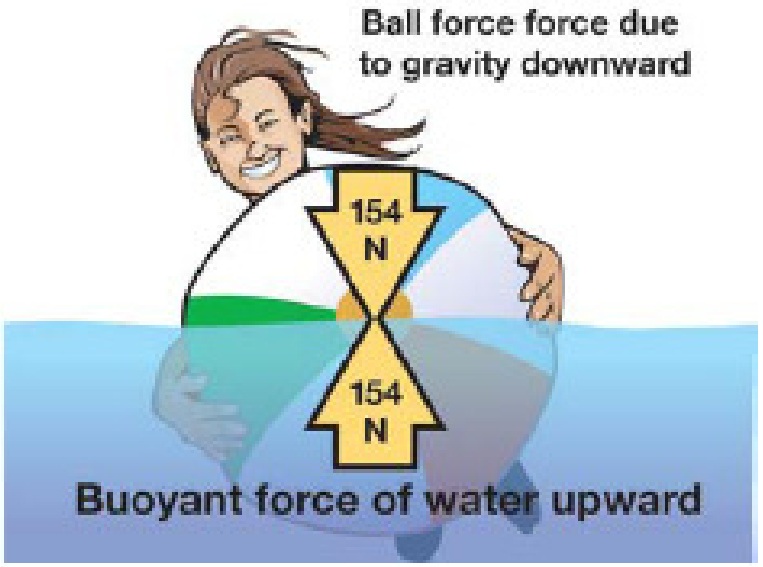
A beach ball floats very well on top water.

The weight of the ball is very small.

The amount of displaced water needed to keep the ball afloat is also very small.

5.2 Floating

- Why do you need to work so hard to push a beach ball underwater?



To push the beach ball completely underwater, we must displace a volume of water equal to 30,000 cm^3. The same amount of water weighs 294 newtons.
Why is the girl still floating?

5.2 Density and Buoyancy

Whether objects sink or float depends on:

1. the object's weight
2. how much fluid it displaces

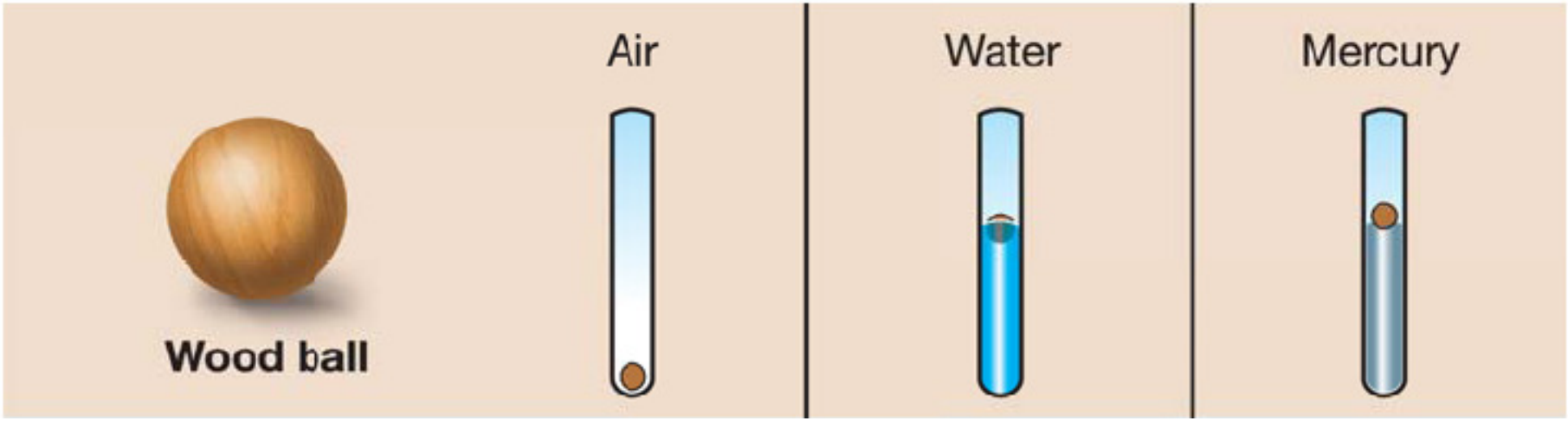
5.2 Predicting sinking and floating

- When an object is **less dense** than the fluid it is in, the object will _____ (sink/float).
- When an object is **more dense** than the fluid it is in, the object will _____ (sink/float).

	Density (g/cm^3)
air	0.001
wood	0.9
water	1.0
glass	2.3
mercury	11.0

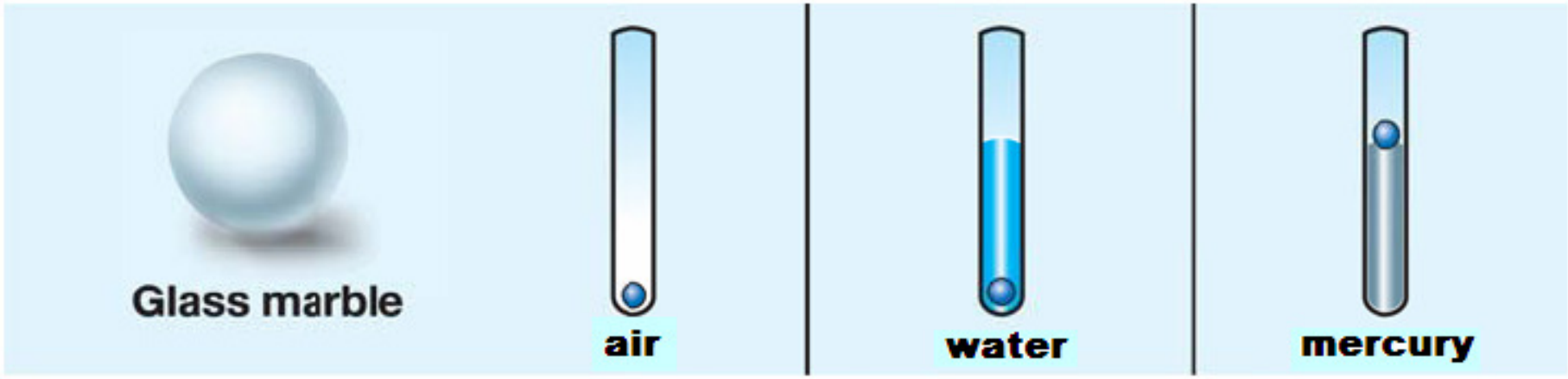
5.2 Density and Buoyancy

- Wood is **less dense** than _____ and **more dense** than _____ .

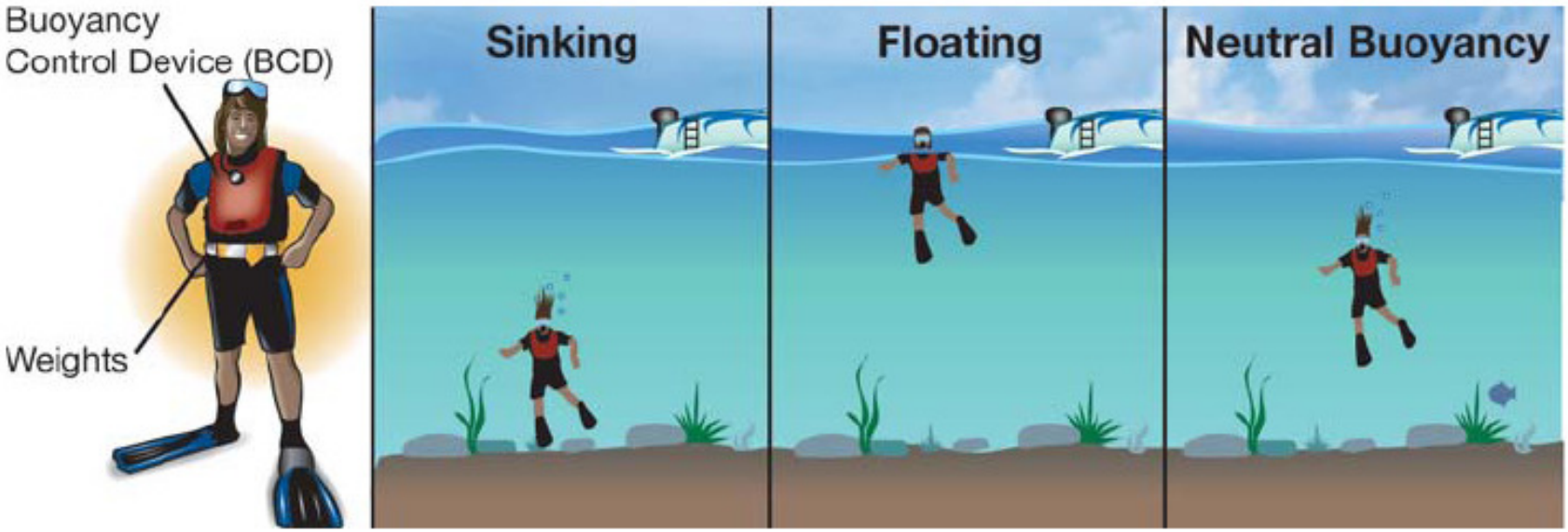


5.2 Density and Buoyancy

- Glass is **less dense** than _____ and **more dense** than _____ .



5.2 Density and Buoyancy

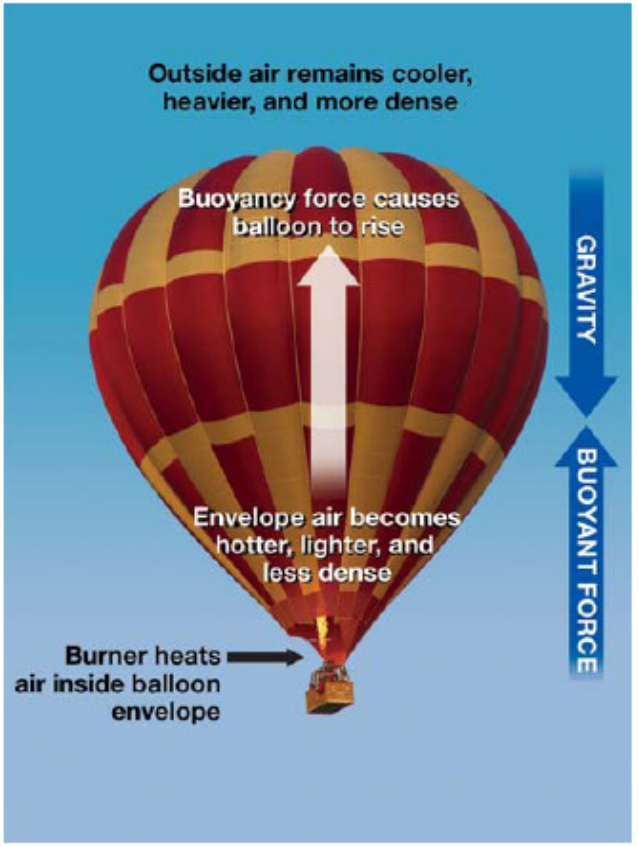


- **A scuba diver uses a buoyancy control device (BCD) to sink or float in water.**
- **How do you think it works?**

Connection

Full of Hot Air

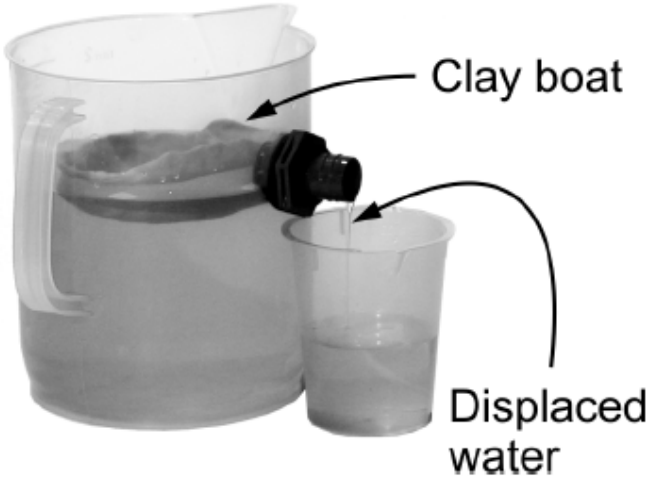
- Hot air balloons have three major parts: envelope, basket, and burner.
- In a hot air balloon, the heat from the burners makes the envelope air less dense.



Investigation 5B

Buoyancy

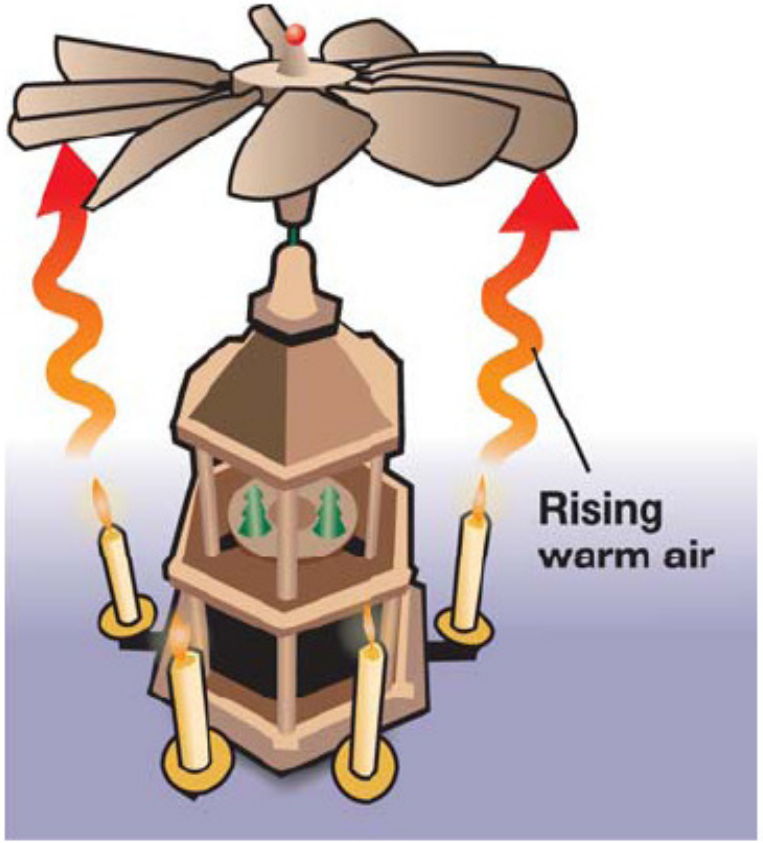
- *Steel is denser than water so why do steel boats float?*



5.3 Heat Affects Density and Buoyancy

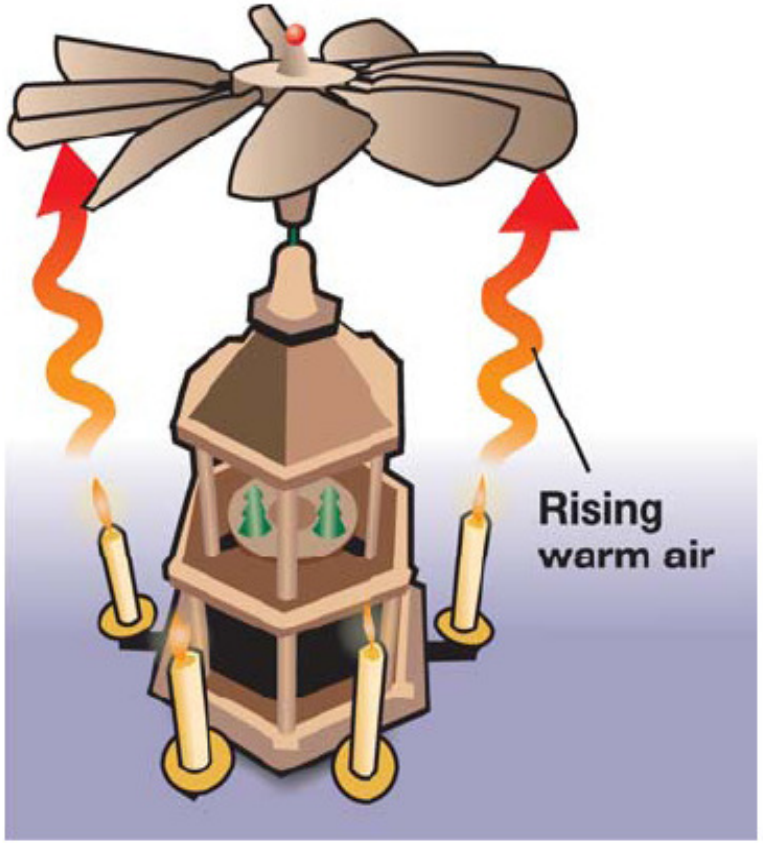
Have you ever seen a candle carousel?

1. The burning candles under the carousel heat the air.
2. Warmed air rises and pushes the wooden paddles of the fan.



5.3 Heat Affects Density and Buoyancy

3. The fan turns.
4. The base of the carousel is connected to the fan, so it also turns, like a merry-go-round.

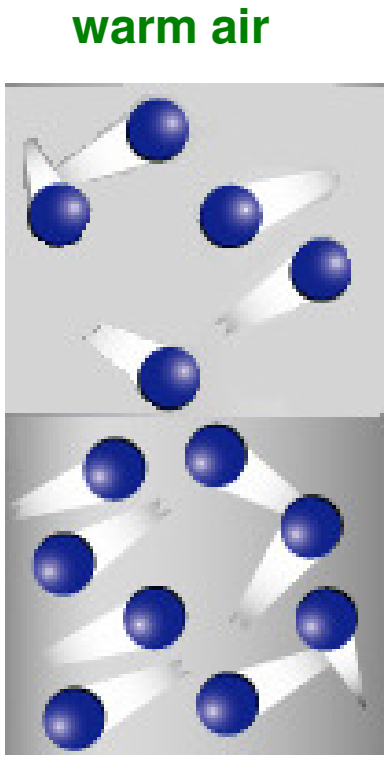


5.3 Why does warm air rise?

- The density of warm air must be *less than* the density of cool air, since warm air rises.
- So, did the burning candle *decrease the mass* or *increase the volume* of the warm air so that it became less dense than the cool air?

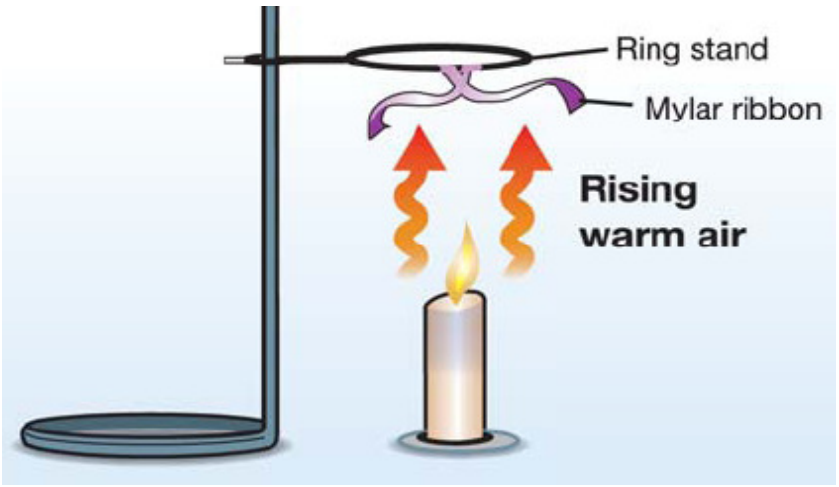
5.3 Why does warm air rise?

- Warm air molecules move faster than cool air molecules.
- Faster moving molecules push against each other with more force than slow molecules.
- Warm molecules that have been pushed farther apart take up more space.
- The burning candle *increased the volume* of the warm air, making it less dense.



5.3 Heat Affects Density and Buoyancy

- Why do the mylar ribbons move in this experiment?



5.3 Heat Affects Density and Buoyancy

- Why do helium balloons and blimps float?

5.3 Heat Affects Density and Buoyancy

- How are hot air balloons and helium balloons the same?
- How are they different?