SINKING OR FLOATING

NAME_______________
DATE_______________
PER______PAGE_____

OBJECTIVE: ____
____

RESEARCH:

to determine the volume of a large container of liquid:
____

if an object is immersed in the liquid (water), it ________________ the liquid.

the mass of the displaced water ______________________________

to determine the mass of displaced water, multiply the displaced ____________ by water's ____________ which equals ____ g/ml.
(Therefore, the volume of displaced water __________ it's mass)

buoyant force: ____

to convert the mass of the displaced water to buoyant force:
____

If an object floats: ____
____

If an object sinks: ____
____

MATERIALS:

large rectangular container, metric ruler, triple beam balance, container which floats, 20 metal washers

PROCEDURE:

1. Fill the rectangular container half full with water.
2. Measure in centimeters the length, width, and initial height of the water. Record your measurements in the data table.
3. Using the equation l x w x h, determine the initial volume of water in the container. Record the volume in the data table under V_1.
4. Place 14 metal washers into the plastic container. Place the container into the water (it should sink to about three quarters of its height). This will cause the water level to rise. Use the metric ruler to measure the new level of the water and record the new height in the data table. Then use this value to determine and record the new volume of water (V_2).

5. Determine the volume of water that was displaced. It is equal to the new volume minus the initial volume.
6. Determine the mass of the displaced water by multiplying the displaced volume by its density (1 g/ml). (The volume = the mass, simply change the unit to grams.)
7. Divide the mass by 100 to get the weight of the displaced water in Newtons. This equals the buoyant force of the water.
8. Remove the container and washers, and determine their mass in grams using the triple beam balance. Convert the mass to Newtons by dividing by 100. Record the weight in Newtons of the container and washers in the data table.
9. Repeat steps 4-8 using 20 metal washers. This should make the container almost sink.

DATA TABLE:

Measurement	**14 washers**	**20 washers**
length (l), cm		
width (w), cm		
initial height (h_1), cm		
initial volume (V_1), cm^3 $l \times w \times h_1$		
new height (h_2), cm		
new volume (V_2), cm^3 $l \times w \times h_2$		
displaced volume, cm^3 $V_2 - V_1$		
mass of displaced water, g		
weight of displaced water, N **Buoyant Force**		

WEIGHT LOSS UNDER WATER

NAME________________
DATE________________
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OBJECTIVE:____
____

RESEARCH:

weight:____
mass:____

weight loss:____
buoyancy:____
____

buoyancy causes some objects to ________________.

density of a liquid compared to density of immersed object:________________
____
____

to investigate buoyancy:____
____

HYPOTHESIS:

The metal objects will have a greater/same/less weight change under water than the glass objects.

MATERIALS:

spring scale
objects to weigh: mug, candle holder, washer, fishing weight
bucket of water

PROCEDURE:

1. Weigh each object in air, suing the spring scale. Record the weights in the data table.
2. Weigh each object in water. Be sure the object is completely submerged but doesn't sink to the bottom or touch the sides of the water container. Be careful to keep the spring scale from contacting the water. Record the weights in the data table.
3. Calculate the difference in weights in air and in water for each object. Record these differences in the Weight Loss column in the data table.

DATA TABLE:

	Weight in Air	Weight in Water	Weight Loss
mug			
candle holder			
fishing weight			
washer			

CALCULATE:

Divide the weight in water by the weight in air for each object:

Ratio of Weight in Water to Weight in Air:
mug:______ candle holder:______ fishing weight:_______ washer:_______

CONCLUSIONS:

1. Did any of the objects lose mass?

2. Did any of the objects lose weight?

3. What causes the objects to lose weight while immersed in water?

4. How would using salt water instead of fresh water to immerse the objects in affect the amount of weight loss? Why?

5. Which kinds of objects (metal or glass) had a higher ratio of weight in water to weight in air?

6. What does it mean when objects have a higher ratio?

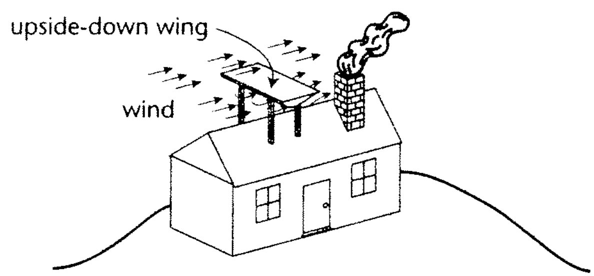
7. What causes the ratio of weight in water to weight in air to be different for different objects?

Name ______________ Date ______________ Class ______________

Bernoulli's Principle

Understanding Main Ideas

Answer the questions below in the spaces provided. Use the back of this sheet or a separate sheet of paper if you need more room.



1. Is air moving faster above the wing or below the wing?

____

2. Is the pressure greater above the wing or below the wing?

____

3. Is the wing being pushed upward or downward?

____

4. If the wind speeds up, what happens to the force of the push on the wing?

____

5. As the wind speeds up, what happens to the speed of the smoke rising in the chimney? Explain why this happens.

____

____

____

____

Building Vocabulary Skills

Define the term in your own words.

6. Bernoulli's principle

____

____

7. lift

____

____

A Wing for All Circumstances

A wing is an example of an *airfoil*. An airfoil is a shaped surface designed to provide lift. As Figure 1 shows, there are many different shapes of airfoil. When engineers decide what shape to use in an airplane, they must think about two factors:

Lift: The upward force caused by the pressure on the top side of the wing being lower than the pressure on the bottom side of the wing.
Drag: The air friction on the wing as it moves through the air.

In general, an airfoil with a more sharply curved upper surface creates more lift. Unfortunately, it also creates more drag, which slows the airplane down. A less curved upper surface produces less lift, but has less drag. When taking off and landing, during which it is moving relatively slowly, an airplane needs all the lift it can get, but is not as hampered by drag. At faster speeds, reducing drag is more important.

If you have flown in an airplane, you may have noticed that various flaps extend from the front and back edges of the wing. The pilots use these flaps to change the shape of the wing for various flying conditions. At takeoff and landing, with the flaps extended, the airfoil is more curved (like Figure 1a). At fast cruising speed, with the flaps pulled in, it is flat and smooth (like Figure 1c).

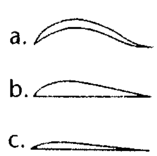


Figure 1

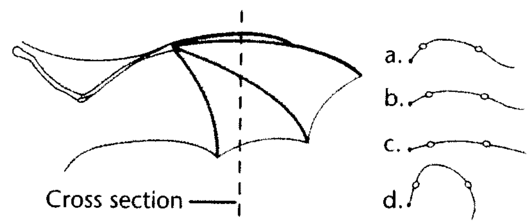


Figure 2

Flying animals also change the shapes of their airfoils to meet different circumstances. A bat's wing is made of skin stretched across its long arm and finger bones. By curling its fingers, a bat controls the shape of its airfoil. The questions below refer to the cross sections of the bat's wing in Figure 2. Answer them on a separate sheet.

1. Would a bat use airfoil *a, b,* or *c* when coming in to land? Why?
2. Which of the three airfoils might a bat use while chasing a fast insect in straight flight? Why?
3. Which airfoil might a bat use in flight of average speed? Why?
4. What do you think would happen if the bat were to hold one wing in shape a and the other in shape *c* at the same time? Explain.
5. Why do you think the bat would probably not hold its wing in shape *d* while flying?

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Phase Comparisons

A simple definition of density is "compactness," or the closeness of the tiny particles within a substance. The physical properties associated with a substance being a solid, liquid, or gas are related to this compactness of particles. Particles within a solid are the most compact; solids are the densest phase of matter. Particles within a gas are spread the farthest apart; gases are the least dense phase. As a general rule, a gas is approximately 1000 times less dense than its corresponding solid. In other words, the particles in a gas are 1000 times farther apart than those particles in the solid.

In this activity, you will develop an understanding of the compactness of the particles within a phase by comparing the density of that phase to the density of another phase of the same substance. This comparison will be expressed as a ratio. Remember, density is mass per unit volume, which is expressed mathematically as D = M/V.

1. Use the given volume and mass to calculate the density of each substance in each phase.
2. Calculate the ratio of the densities of the given phases.
3. Identify the given phase change.

1. *Substance:* Water

Phase: Solid			*Phase:* Gas		
Volume	Mass	Density	Volume	Mass	Density
cube, 3 cm on a side	24.7 g	________	9 cm^3	0.0053 g	________

Ratio of solid density to gas density ____________

Name of phase change from solid to gas ____________

2. *Substance:* Oxygen

Phase: Liquid			*Phase:* Gas		
Volume	Mass	Density	Volume	Mass	Density
25 cm^3	37.3 g	________	25 cm^3	0.035 g	________

Ratio of liquid density to gas density ____________

Name of phase change from liquid to gas ____________

3. *Substance:* Carbon dioxide

Phase: Solid

Volume	Mass	Density
100 cm^3	156 g	________

Phase: Gas

Volume	Mass	Density
100 cm^3	0.198 g	________

Ratio of solid density to gas density ________________

Name of phase change from solid to gas ________________

4. *Substance:* Mercury

Phase: Liquid

Volume	Mass	Density
10 cm^3	135.9 g	________

Phase: Solid

Volume	Mass	Density
10 cm^3	136.5 g	________

Ratio of liquid density to solid density ________________

Name of phase change from liquid to solid ________________

5. *Substance:* Pentane

Phase: Gas

Volume	Mass	Density
3800 cm^3	10.7 g	________

Phase: Liquid

Volume	Mass	Density
3800 cm^3	2370 g	________

Ratio of gas density to liquid density ________________

Name of phase change from gas to liquid ________________