

Name: _____ Date: _____

Section 4:10: The Ups and Downs of Buoyancy

Key Question: What is buoyancy?

BEFORE YOU READ

Preview Section 4.10, looking at the figures and captions, and the yellow-highlighted vocabulary words. Predict what you will learn by reading this section.

WHILE YOU READ

1. Define buoyancy. Give an example.

2. Describe how buoyancy and gravity are related.

3. What is Archimedes' principle? Use diagrams to make your answer clear.

AFTER YOU READ

Explain how your knowledge of buoyancy would help you design a submersible device.

4-10The Ups and Downs of Buoyancy

Name:

Date:

Vocabulary: buoyancy, Archimedes' principle

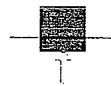
Student Notes

Big Ideas:

- As the density of a fluid decreases, its buoyancy also decreases.
- A fluid exerts a force (pressure) in all directions on any object that is immersed in it. The upward force is known as buoyancy.
- Buoyancy is a property of all fluids. The more dense a fluid is, the greater the buoyant force it exerts on an object.

Key Question: What is buoyancy?

- Three properties of fluids are viscosity, density, and _____.
- The _____ of an object relates to the amount of water the object displaces.
- An object inside a fluid experiences a _____ directed straight upwards, opposite to the direction of _____.



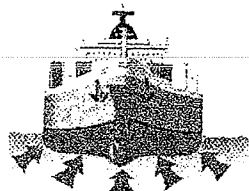
- When you try to push a ball down you feel the ball pushing you back. Therefore, the fluid pushes an object that is inside it upwards and gravity pulls the object downwards.



- This is the force from buoyancy that pushes the ball

upwards and does not allow you to sink the ball.

- A ship floats on top of water because the force from buoyancy is stronger than the force from gravity



- Buoyancy is an important factor in the design of many objects and in a number of water-based activities:
 - Boating
 - Scuba diving.
 - a beach ball floating in a pool,
 - a ship floating on water,
 - The shut-off valve inside a toilet tank.

_____ (father of buoyancy)

- In summary the story of the legend is that Archimedes was commissioned by the king to determine if his new gold _____ was actually made of gold.
- Archimedes was in a public bath and noticed that the water level _____ when people entered (or left the bath).
- He then realized and concluded that the weight of the fluid _____ by an object in the fluid is equal to the _____ force upward on the object from the fluid.
- He then ran through the streets yelling _____! (I have found it!). Presumably naked. He was then able to show that the crown was not pure gold and that the king had been swindled.

Archimedes' Principle

The buoyant force on an immersed object is equal to the weight of the fluid displaced.

Can you make a dense object less dense?

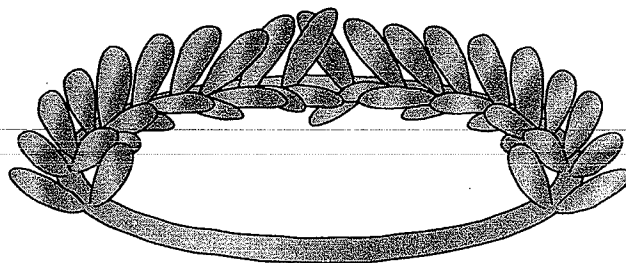
- _____, you could add _____ - _____ spaces to the solid substance to get it to float in a less dense fluid.
- You can increase the volume, thereby decreasing the density
- You can create a boat shape with a hollowed out centre

Look back at Inquiry investigation 4.8. Explain the behavior of the cork and plastic block using the terms buoyant force and density:

- The cork and the plastic block have different densities.
- Each will float on the first liquid in the column that has a density close to, but not less than, its density.
- The buoyant force of the liquid must be equal to or greater than the weight of the object in order for it to float.

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Archimedes and the Ups and Downs of Buoyancy



Although Archimedes could weigh the crown, his problem was to find the volume of the crown. Since the design of the crown was complicated, this was indeed a problem. Archimedes realized that if he immersed the crown in water, the volume of the water displaced would be equal to the volume of the crown. Comparing the mass of the crown with the volume of the displaced water would allow him to calculate the density of the crown. If the density of the crown was less than the density of gold, Archimedes would know that the goldsmith had tried to cheat the king!

1. The mass of the crown is 0.850 kg, and its volume is 56.7 mL. Using $D = \frac{m}{V}$, calculate the density of the crown. Hint: 1 mL = 1 cm³. Remember to convert kilograms to grams before making your calculations.

2. Is the crown gold? (Refer to Table 1 in Section 4.7.) Explain your answer.