



SCMEA

The South Carolina Marine Educators Association

Too dense, too light...just right!

Connecting history, science and the maritime industry (Grades 3 and Up)

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www.patriotspoint.org

Focus Question

How might ships, even some animals, regulate their position in the water column?

Activity Synopsis

Students will experiment with different materials and volumes of materials to adjust the position of their “vessels” in the water.

Time Frame - 45 minutes

Objectives

The learner will be able to:

- Define the terms **density** and **volume** relative to objects and their buoyancy in water
- Measure volume of a liquid*
- Explain the importance of stability and position in the water to the natural and man-made world

Background - Key Points

- **Density** is how much matter is taking up a defined space (volume); $D = M/V$
- **Volume** is the amount of space an object occupies
- In the late 1800s there was a concern for ships that were packed with too much with cargo and sinking. Lines were painted on the hulls of ships to mark where the waterline should be. These lines told captains and crew if the ship was overloaded. Learn more about Plimsoll lines here: <http://oceanservice.noaa.gov/facts/plimsoll-line.html>
- Where a ship sits in the water can be adjusted with ballast. In the past stones were often used. Today, water is used.
- In some cases, it is necessary for ships to sink! When the aircraft carrier USS Yorktown was decommissioned and brought to its present location in Charleston Harbor, it was “sunk” using 10 million gallons of harbor water as ballast into a 27 foot deep channel to become a museum.
- Aquatic animals also regulate where they sit in the water using organs such as gas bladders or fatty tissue.

Materials & Procedure

Using 50mL centrifuge tubes as “ships”, students will use different materials and volumes of materials to see where their ship will float (or sink) in the water.

- 50mL graduated clear centrifuge tubes with lids, at least 3 for each group if working in teams
- Clear plastic tub or Tupperware at least 10in deep, 1 for each group
- Gravel, vegetable oil and water, access to sink
- Hot glue gun
- One small nut (hardware) for each centrifuge tube
- Permanent marker

1. Prior to activity starting, hot glue one nut to the pointy bottom end of each centrifuge tube. This will help the “ships” remain upright.
2. Fill tubs mostly full with water.
3. Instruct students to fill centrifuge tubes with different materials (ballast), but similar volumes (if students have not yet learned to find the volume of a solid they can approximate*). Place vessels in tub. Compare and contrast.
4. Next, try all of the same material, but different volumes. Compare and contrast.
5. Arbitrarily choose a particular volume that will become a Plimsoll line for the entire class. For example, 25mL. Have the class remove a centrifuge tube, dry it, and mark the 25mL line with permanent marker. See which team can add the appropriate amount of “ballast” to get their ship to sit correctly in the water.

Math and Earth Science Extension

While ships must consider the waterline at which they sit, they also need to consider their draft (how deep the hull of the ship sits below the waterline). On June 15, 1975 the USS Yorktown pulled into a shallow Charleston Harbor. Using the following ordered pairs, have students make a line graph with time of day on the x-axis and water depth in feet on the y-axis. Have students determine the best time of day for the USS Yorktown to have pulled in if it was worried about scraping the bottom of the harbor. For more information on tides, visit: https://tidesandcurrents.noaa.gov/tide_predictions.html .

Time of Day	Water Height in feet
12am	6
6am	0
12pm	6
7pm	0.5

These numbers approximate the actual archived tidal heights for June 15, 1975.

Language Arts Extensions

1. Have students draw a Venn diagram to compare and contrast their results with different volumes and ballast materials.
2. Have students research an animal that uses a gas bladder or fatty organ to help regulate their position in the water. Have them summarize their findings in paragraph form.
3. Have students research the pros and cons of using water as ballast and write a report on what they discover.

Language Arts and Social Studies Extension

Students can research ballast used for ships. What used to be used? Why is it no longer used? Were there other uses for discarded ballast? Have them summarize their work in complete sentences and paragraph form.

PATRIOTS POINT

★ HOME OF THE USS YORKTOWN ★