Why Boats Float: It Speaks Volumes about Mathematics

Investigating Volume of Vessels

Guiding question: What is volume, and how is it measured?

Goals: (1) To help students understand volume means taking up space; (2) To help students visualize a cubic centimeter or milliliter of volume and begin to think about volume as *l x w x h* for rectangular prisms.

Materials: about 300 1cm x 1cm x 1cm unit cubes per group, scotch tape (at least 1 per group), plastic bin with water (1 per group), 100 mL graduated cylinders (1 per group), scissors (1 per student), laminated copies of A, B, C, and D boats (for a group of four students, each student will receive a different boat. If groups vary in size, distribute the boats as evenly as possible among the group.)

Description: Students will use the A, B, C, and D nets to build a rectangular prism boat. Each student will fill their boat with unit cubes to find the volume. The students will compare the volume of each boat. The students will fill a graduated cylinder so it contains 100 mL of water. They will use this to find the liquid volume of the boat by pouring the water from the graduated cylinder into their boat until it is full. Summarize the lesson by asking students what volume is, how to measure solid and liquid volume, and why the boats have the same volume even though they look different.

For more information see: Appelgate, M. H., Jackson, C., Jurgenson, K., & Delaney, A. (2018). Mathematics concepts using STEM connections. *Teaching Children Mathematics, 24*(6), 394-396.

Exploring Volume in the Virtual World

Guiding question: What is volume, and how is it measured?

Goal: To help students explore the relationships between volume, shape, load, waterline, and displacement

Materials: laptops (ideally, one per student), DESCARTES mini challenge-Turn up the volume

Description: Students will use the DESCARTES virtual world to complete the Turn up the volume challenge. Make sure to download the app onto the computer (https://www.dropbox.com/sh/ykfsmwgzbmz9mkm/AABl8dXSasnHaPH2KkksOjTia?dl

=0). In the challenge, students will measure the solid and liquid volume of a variety of boats. The students will design a boat that would carry the most solid sample of cargo and the most liquid sample with the given constraint (cost).

Learning about the Effects of Loading a Boat

Guiding Questions: How does load effect how a boat floats? How can we figure out the maximum load a boat can hold without it sinking?

Goals: (1) To show that more load in a boat is related to more water displacement and causes the water level line to rise on the boat; (2) To introduce the ideas of water displacement and waterline; and (3) To use mathematics to predict how much load a boat can hold before sinking.

Materials: 100 mL graduated cylinders (1/group), buckets with water, pennies (about 15/group, all 1990 or newer), graph paper, food coloring.

Description: Students will add load (pennies) to their boat (100 mL graduate cylinder) to investigate how the waterline changes on the boat. Students will measure the waterline and record it on their data sheet. Students will add two pennies to the boat, measure and record the waterline. Students will repeat this process. Students will graph their data, and use it to make predictions about how much load a boat can hold before it sinks.