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#SeaworthySTEM

Golf Ball Float

Grades 6-8

Teacher Guide

Seaworthy STEM™ in a Box Series

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Golf Ball Float

Teacher Guide for 6-8

Seaworthy STEM™ in a Box Educator Kit description:

Seaworthy STEM™ in a Box activities are a Navy initiative to provide enhanced Naval-relevant, standards aligned, hands-on activities to K-12 teachers and students. Components of this program include, curated sets of classroom activities that aim to build deep conceptual understanding in Naval-relevant content areas. The kits also includes comprehensive lesson plans, material lists, scientific background information, STEM related literacy books, and student activity sheets. The Seaworthy STEM™ in a Box program is designed to support teachers as they select content, acquire materials, and implement more hands-on STEM activities in their classrooms. Increasing student access to hands-on STEM activities, also increases awareness of STEM career paths, engage students in STEM, and support development of student's abilities in STEM content.

The Seaworthy STEM™ in a Box kits were designed to guide students through the scientific inquiry-based theory and the engineering design process. The content and Naval-relevant activities are aligned with the Next Generation Science Standards. The topics and content covered within the lessons are connected and scaffolded based on distinct grade bands (K-2nd, 3rd-5th, 6th-8th, and 9th-12th).

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Lesson Title: Golf Ball Float

Time:

45-60 minutes

Student Objectives:

The students will take accurate measurements (both mass and volume) and use the appropriate mathematical formulas to attempt to solve an engineering design challenge.

Lesson Overview:

The students will use math to better understand how to calculate density and also have a better understanding of the impact of that density on a mixed group of objects. They will also understand that the density of a substance can change if it is mixed with another substance.

Next Gen Science Standards (NGSS):

MS-PS1-2
MS-PS2-2
MS-ETS1-1
MS-ETS1-2

Notes

Materials and Equipment List (For groups of 3-4 students):

- ☑ Jar with tight-fitting lid (for example, tennis ball tube, or large peanut butter jar, etc.)
- ☑ Golf ball
- ☑ 1 cup of water softener salt pellets
- ☑ Blue food coloring
- ☑ Pitcher
- ☑ Water
- ☑ Trays, towels, sink for clean up
- ☑ Graduated Cylinder
- ☑ Beaker
- ☑ Pipette
- ☑ Digital Scale

Student Activity Sheets/Handouts:

Student Activity Workbook: Golf Ball Float

Technology Tools:

Digital Scale

Procedure:

1 Demo Set-up:

Prepare a sample of the system pictured. It consists of a golf ball that is floating at the interface between a blue-colored freshwater layer and a colorless salt water layer. There are undissolved water softener salt pellets in the bottom of the jar.

To make this system:

1. Place a cup of salt pellets and the golf ball in the jar. Add water to fill it about half way and tightly screw on the lid.

2. Shake the salt and water vigorously for several minutes until the salinity of the water has increased its density enough that the golf ball floats.

3. Add blue-dyed freshwater from a pitcher, taking care to pour slowly down the side of the tilted jar so that the water layers do not over mix. Adding water incrementally with a large pipette is another good way to ensure that the layers do not mix."

Tip: it will take longer than you think!

2 Set up for activity, prior to class:

Place salt pellets and golf balls in jars. Provide pitchers of un-dyed and blue-dyed water. Do not label any of these since part of this activity involves students reasoning about the materials without knowing for sure what they are.

Fun Fact!

Designing a ship can be quite complicated for naval ship designers. A ship designer needs to make sure that the ship is never more dense than the water to make sure it floats. For example, did you know that the USS Zumwalt not only looks cool but weighs almost 16,000 tons!

3 During class:

1. Have the demo system sitting in a visible location so that you can show it to students without having to move it. Students are to record/brainstorm their observations, inferences, and questions using the student activity worksheet in the engineering notebook. **Do not answer questions at this point – students should not know the exact composition of the contents at this point.**

2. Challenge students to use their hypotheses and science knowledge to recreate the system they observe.

3. Give them materials and allow them time to make and modify their prototypes. This will likely take the rest of the class period and some groups may not have accomplished the task.

4. Have the students mathematically prove why the system works. They can do this by finding the mass of the salt water and the food colored tap water using a graduated cylinder and the scale. Followed by finding the mass of the golf ball by using the beaker (water displacement) and the scale. The students should use their pipette to retrieve samples of the two different types of water. **If the students fail to have clean samples of water, allow them to draw from the demo.* The students will then complete the math section in their workbook.

4 Follow-up:

1. Have students debrief in an independent or group assessment for understanding. Have students complete the activity guided worksheet.

2. Students sketch the system and label it in ways that show their understanding of the phenomena involved.

3. Students extend their thinking by predicting what would happen if the system were allowed to remain undisturbed for several weeks.

Teacher Background Information / Notes:

Remind students not to touch or taste the materials in this lab. They aren't actually hazardous, but would give away the identity of the materials.

Most students will not be familiar with water softener salt pellets and may assume that they are made of plastic based on their appearance. Students may also assume that the blue liquid is something other than water.

Be prepared to discuss what a water softener is and why it needs salt – this is a side topic, but relevant to students' lives. Water softeners contain materials (zeolite) that absorb "hard water" calcium and iron minerals from home water sources. The salt is used in a regeneration cycle to flush the calcium and iron ions from the zeolite and replace them with sodium so that the zeolite can be reused over and over. Having hard water depends on the source of your water and varies by regions and their geology. Hard water will leave deposits that leave behind residues on shower doors and faucets and, over time, can build up in appliances such as coffee pots and water heaters.

Most water softener pellet bags are sold in 40 pound bags and can be found at local home improvement stores. One bag usually costs less than $10 and can supply more about 40 lab stations.

"water softener pellets"

Extension Activity Ideas:

This system could be kept and monitored for several weeks and months. Students could take quantitative measurements and make qualitative observations about how it changes as time goes on. Data could be graphed for a discussion on dissolving and/or diffusion rates.

1. As time goes on the salt in the bottom will continue to dissolve, increasing the salinity in the bottom of the jar. The salt water and blue water layers will diffuse, resulting in a changing color profile. Over time, the golf ball will rise due to the extra salt dissolving (unless the salt all dissolves before it reaches the top).

Vocabulary Terms and Mathematical Formulas:

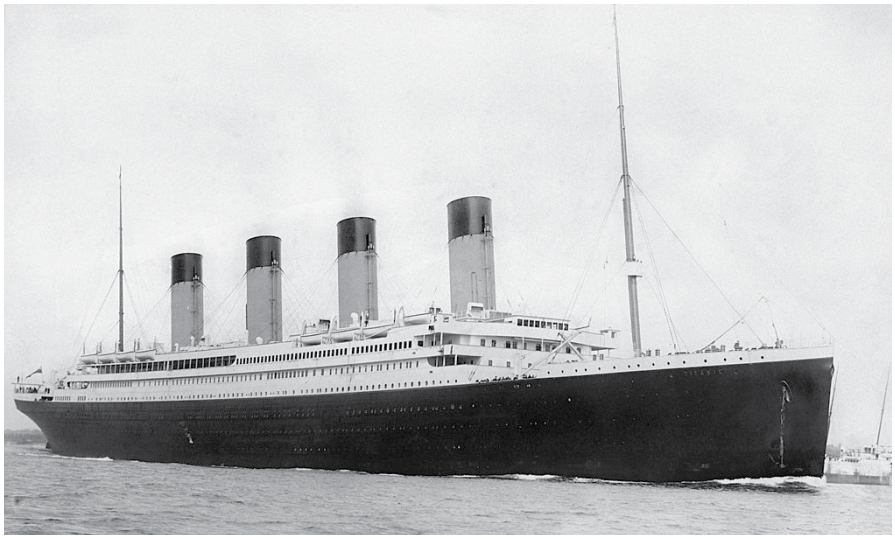
- Buoyant Force: The upward force exerted by any fluid upon a body placed in it
- Density: The amount of space an object or substance takes up (its volume) in relation to the amount of matter in that object or substance (its mass) Density = M/V
- Displacement: The volume of water displaced by an object is also equal to its immersed volume, which, in the case of a floating boat, will be its underwater hull volume.
- Liquid: A state of matter where particles are free to flow. It has a definite volume, it does not have a definite shape
- Mass: The amount of matter in an object
- Volume: The amount of space occupied by an object

STEM Related Careers:

- Chemical Engineer
- Mechanical Engineering

Fun Fact!

Ship designers must make sure the ship is secure and watertight. If water gets into a ship, it will make the ship more dense and it will sink. The famous Titanic sank in 1912 due to the amount of water that got into the boat causing it to be more dense than water.




Notes

The Seaworthy STEM™ in a Box curricula was developed through collaborative efforts of a team of individuals at the Naval Surface Warfare Center Carderock Division and Albert Einstein Distinguished Educator Fellows via an inter-agency agreement with the U.S. Department of Energy for the Albert Einstein Distinguished Educator Fellowship (AEF) Program. We are grateful to the following Content Specialists who contributed their knowledge and expertise by researching and writing on selected topics: Suzanne Otto, Stephanie Klixbull, and Thomas Jenkins. We'd also like to acknowledge the contributions of AEF participant Ms. Deborah Reynolds, the inaugural AEF Educator at Carderock that helped inspire the design of Seaworthy STEM™ in a Box content. With the help of Albert Einstein Fellow, Melissa Thompson, and Carderock Outreach Specialist, Ashlee Floyd, special additions to the curriculum such as career portfolios, workforce trading cards, and in-house short story publications are included that reflect the diversity of NAVSEA Sites.

It is the goal of the SeaWorthy Curriculum to embrace NAVSEA technologies from sites nationwide to empower the youth of our nation to purse STEM-centric career pathways. The views and opinions of the Content Specialists expressed herein do not necessarily state or reflect those of the AEF Program, the U.S. Department of Energy, or the U.S. Government. Reference herein to any specific commercial product, process, or service by trade name, trademark, service mark, manufacturer, or otherwise does not constitute or imply endorsement, recommendation, or favoring by the AEF Program, the U.S. Department of Energy, or the U.S. Government.

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