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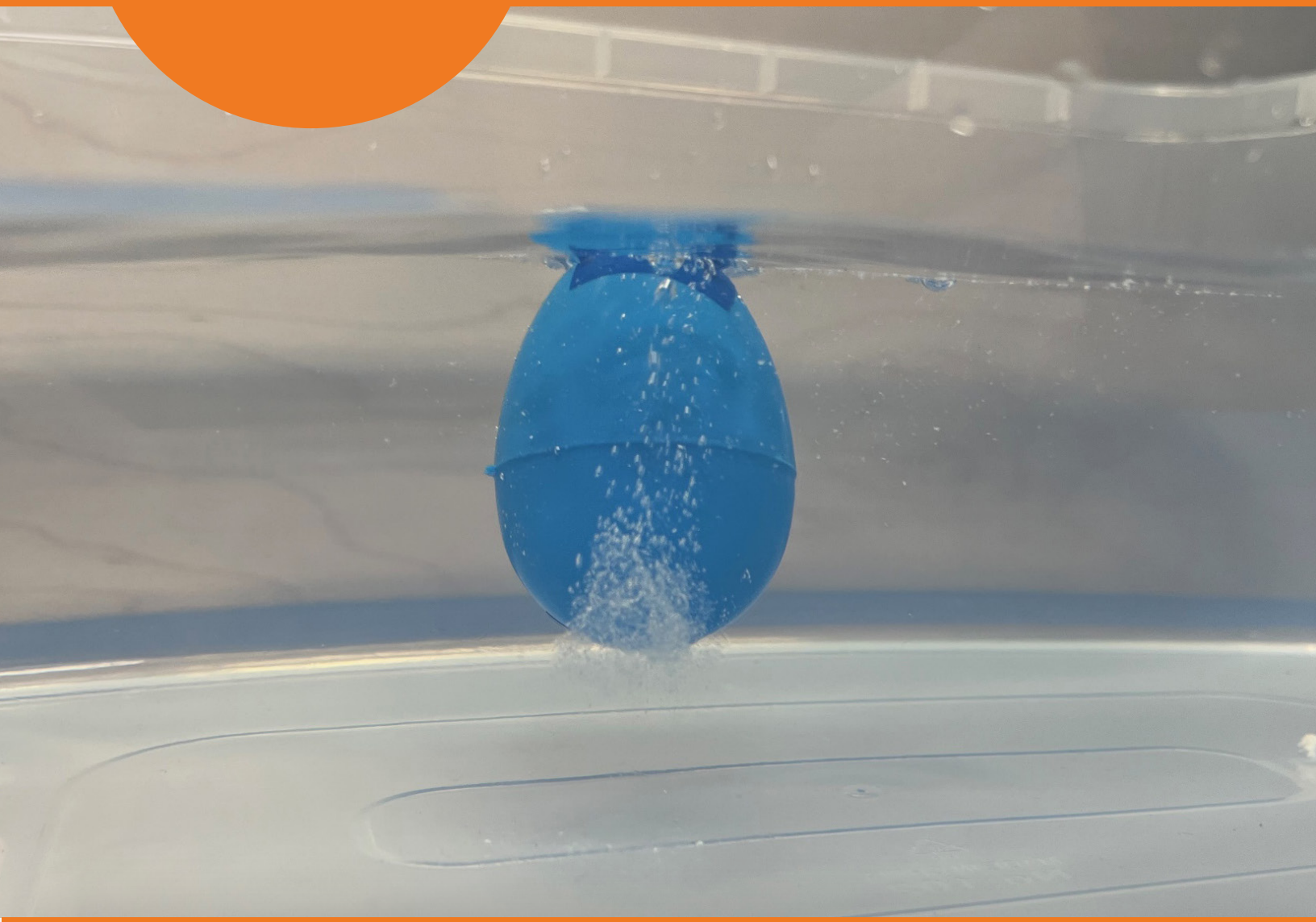
SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

#SeaworthySTEM

Submarine Eggs

Grades K-2

Teacher Guide



Naval STEM-in-a-Box Series

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Office of Naval Research
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Submarine Eggs

Teacher Guide for K-2

Naval STEM-in-a-Box Educator Kit description:

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 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 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 (2019). 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: Submarine Eggs

Time:
1 Class period (30-45 minutes)

Student Objectives:

Students will learn what a submarine is and how it travels in the water. Students will make observations on how carbon dioxide is produced when Alka-Seltzer tablets react with water. Students will also observe how gas can be a force to push a plastic egg in water.

Lesson Overview:

This activity is in introduction to this kit. Students will observe the teacher building and experimenting with a plastic egg acting as a submarine. The teacher will discuss what a submarine is and other water vessels such as boats. The teacher will build the model submarine following the directions below. Students will observe the submarine egg moving up and down in the water similar to submarines. Students will collect data and draw their observations.

Next Gen Science Standards (NGSS):

K-PS2-1

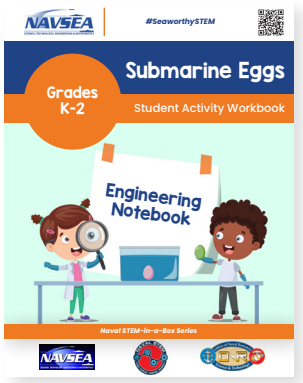
Notes

Materials and Equipment List (Per Team):

- ☑ 1 Plastic egg with 2 holes
- ☑ 1 Alka-Seltzer Tablet
- ☑ 4 Pennies
- ☑ Putty
- ☑ Water
- ☑ 1 Fish tank or Clear container w/ depth

Student Activity Sheets/Handouts:

Submarine Egg Observation Sheet

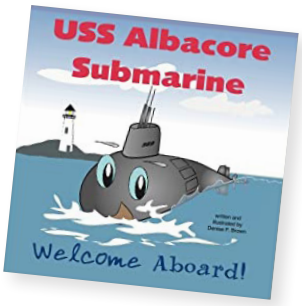


Technology Tools:

None needed

Suggested STEM Related Literacy Book:

USS Albacore Submarine by Denise F. Bowen



Pre-Activity set up:

Make sure the submarine egg has only two holes. One hole on the top of the egg and one hole on the bottom of the egg. If the egg has more than two holes, you can cover the remaining holes with tape.

Procedure:

Prelab Procedure: Teacher must have water within fish tank or clear container prior to lesson.

1. The teacher will introduce the lesson by asking students in a whole group discussion, **"What is a submarine?"** After student responses, the teacher will give the definite answer to students.

2. The teacher will then explain to students how she/he will make a plastic egg act like a submarine using the force of a gas.

3. The teacher will explain and model to students how to build the inside of the plastic egg vessel. Follow the directions below to build the submarine egg:

    - Put a quarter sized amount of putty inside the bottom of the egg. Do not cover the hole of the egg!
    - Push the 4 pennies into the putty.
    - Place 1 Alka-Seltzer tablet into the egg.

"Building the submarine egg"

Fun Fact!

The U.S. Navy officially joined the undersea world when it purchased the USS Holland in 1900. The boat, Holland, proved valuable for experimental purposes during her 10-year career. Since then submarines have evolved dramatically, but remain a vital part of the American fleet.

4 Once the inside of the egg is complete, the teacher will model to students the inside of the egg. Have students draw their observation of the inside of the egg on question #1 in the engineering notebook.

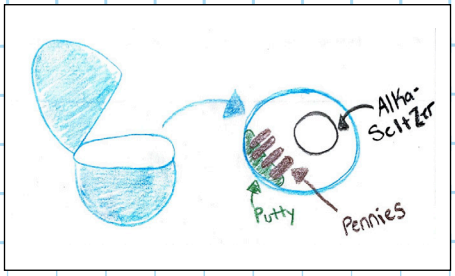
5 After observations, close the egg and place the egg in the water.

(Helpful tip: the egg will take a few minutes to fill up with water. The egg will only start to submerge when the egg has water in it.)

"place the egg in the water"

6 Have students observe the egg in the water. At this time, have students draw their observation in the box, question #2 on the guided worksheet.

Check out this great example of a student's observation!



7 When the egg is fully submerged, ask students, **"Why is the egg at the bottom of the tank/ container?"** After students' responses, give students the correct answer.

"submarine egg is submerged"

8 Once the plastic egg is full of water, the Alka-Seltzer within the egg will start to dissolve and create carbon dioxide gas. The gas has nowhere to go but is forced out of the hole of the egg. The egg will start to move up and down within the tank/container. While the Alka-Seltzer is reacting, remind students to observe the plastic egg.

9 When the egg has stopped moving. Ask students to continue to draw their observations in the box.

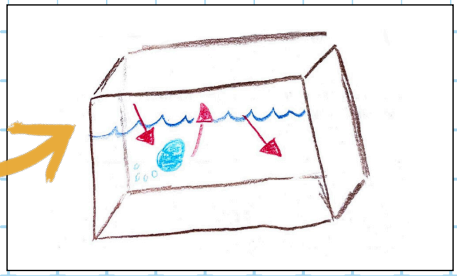
10 When students have completed their observations, the teacher will guide the class in a whole group discussion about the movement of the plastic egg. The teacher will ask students the guided questions in the side panel.

11 After a whole group discussion, open the egg and show students the inside of the egg. Students will draw their observation of the inside of the plastic egg in question #3. (Students will notice the Alka-Seltzer table is dissolved and water is in the egg.)

12 When students have completed their work, the teacher can go into depth to explain the force of the carbon dioxide and how the plastic egg needed energy/force to move in the water.

13 The teacher can extend the lesson by having students create their own submarine egg and have it move in the water.

Check out this great example of a student's observation!



The teacher can ask these guided questions:

"Why did the egg start to move?"

"What inside the egg would make it move?

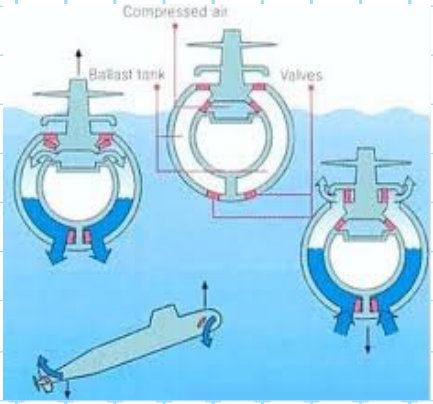
"Did you observe anything coming out of the egg?"

"What would force the egg to move?"

"Why did the egg stop moving?"

Did you know?!

A ballast tank is a compartment within a boat or submarine that holds water. Ballast tanks are used to control the buoyancy of the vessel by adding and releasing air or water.



Vocabulary Terms:

- Submarine
- Density
- Carbon dioxide
- Ballast Tank
- Forces (push/pull)
- Energy

STEM Related Career:

- Marine Engineer
- Naval Architects
- Mechanical Engineer

Misconceptions/ Science information:

Throughout this lesson, students will receive a visualization of how submarines move in the water. How do submarines submerged and move in the water? Similar to submarines, the egg starts full of air and no water within the vessel. The object is less dense than water in the container and thus will float. Due to the hole in the egg, as water fills up the egg, the egg will submerged and start to sink. Submarines have tanks that are called ballast tanks that are attached on the left and right side of the vessel. When the tanks are filled with air the submarine rises to the surfaces and when water is inside the tank, the submarine will sink. Submarines are able to move up and down within the water by changing the amount of air and water within the ballast tanks. For this activity, students are recreating this effect by the use of the Alka-Seltzer tablet. When the water reacts with the tablet inside the egg, carbon dioxide is created. The gas takes up space within the egg and the gas will eventually be forced to push out of the hole in the egg. The force of the carbon dioxide will move the egg and recreate the similar motion of a moving submarine.

The Naval 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 and Stephanie Klixbull. 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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