#SeaworthySTEM

DIY Hydrophone

Grades K-2

Teacher Guide

Naval STEM-in-a-Box Series

DIY Hydrophone

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).

NAVSEA
SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

Table of Contents

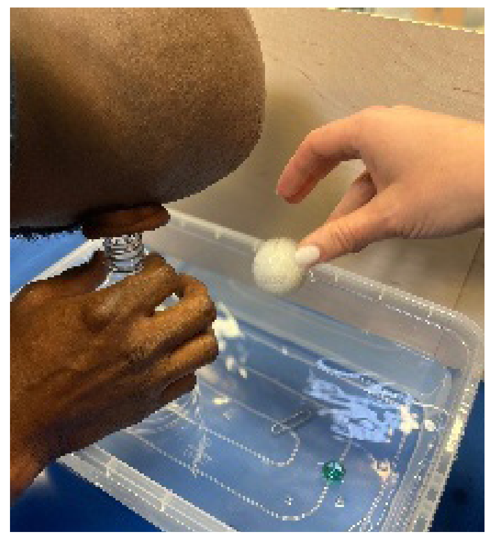
Lesson Title: DIY Hydrophone

Time:
1 Class period (30-45 minutes)

Student Objectives:

Students will learn about sound waves and build a simple version of a hydrophone. Students will explore different types of sounds created by a variety of objects dropped in water. Students will collect data on their own personal assessment of sounds the objects produced.

Lesson Overview:



Students will create a hydrophone. A microphone which detects sound waves underwater. Students will use the empty soda liter and place it in a container of water. The mouthpiece of the soda liter will be used as an earpiece for listening. Students will work in teams by taking turns and listening to objects being dropped into the container. Students will collaborate and discuss the similarities and differences of sounds created by dropped objects.

Next Gen Science Standards (NGSS):

K-PS2-1
1-PS4-1
1-PS4-4
K-2-ETS1-1
K-2-ETS1-3

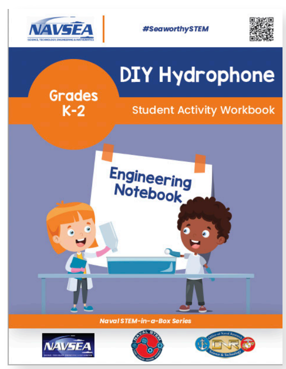
Notes

Materials and Equipment List (Per Team):

- 1 precut empty soda liter bottle
- Water
- 1 Fish tank or Clear container w/ depth
- Materials to drop in water, items within the classroom such as:
  - Rocks
  - Coins
  - Blocks

Student Activity Sheets/Handouts:

Hydrophone Graph Student Activity Workbook

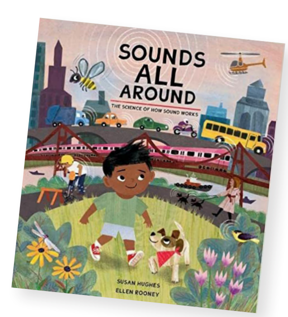


Technology Tools:

None needed

Suggested STEM Related Literacy Book:

Sounds All Around
by Ellen Rooley



Fun Fact!

The first hydrophone was invented in 1914. It was designed as a way to locate icebergs following the Titanic disaster.

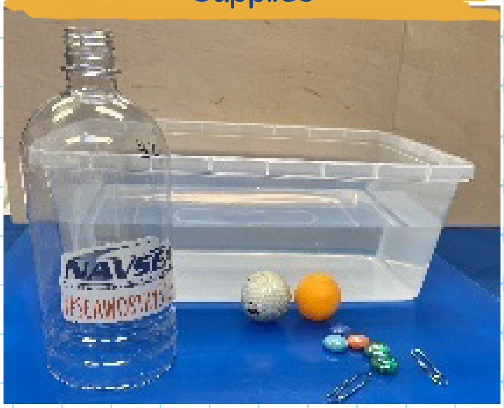
Pre-Activity set up:

Make sure to cut off the bottom of the empty soda-liter bottle.

Procedure:

1. The teacher will give a brief introduction/ review about sound waves. The teacher will ask students, **"Do you think sound can travel in water?"** The teacher will let students discuss and provide short answers to the discussion.
2. After discussion, explain to students that they will be split into teams and will work together to listen to sound waves in water.
3. The teacher will split the class into small groups, (3-4 students).
4. The teacher will give each team 1 soda liter bottle, objects to test, and water container.
5. The teacher will then guide students to use the objects to test and observe sound traveling in water. The teacher will model an example of dropping an object in the water while listening.

"Supplies"



"Dropping an object in water while listening"

(Helpful tip: This will be easier for students to achieve if one student listens while another student drops the object, students should take turns.)

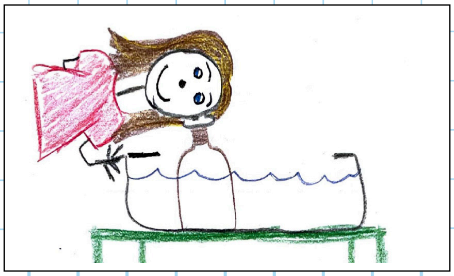
6. Give students 10-15 minutes to discover and explore how they can listen to sound waves using the soda liter. During this time, the teacher will walk around to help guide groups that may need help.

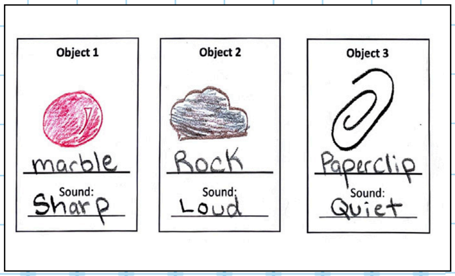
7. When students have completed dropping an object and observing with their ears, students should record their observations in the engineering notebook. The teacher should give students time to complete the activity and guided questions.

8. When completed, the teacher can guide students on clean-up and have guided whole group discussion on the recorded graph. The teacher can ask the following questions,
   - "Which object made the loudest noise? (Softest?)"
   - "Why do you think that object was quiet? (Loud?)"
   - "Do you think sound can travel in water? (Why?)"

9. After discussion, the teacher can extend the lesson by using the following STEM literacy book.

Check out these great examples of a student's observation!





Vocabulary Terms:

- Sound Waves
- Sonar
- Hydrophone
- Density
- Reflect

STEM Related Career:

- Sonar/Electronics Technician
- Engineering Technician
- Oceanographer

Misconceptions/ Science information:

This activity is to introduce students to sound waves and how they can travel in air and water. Sound waves travel faster in denser substances such as liquid. Sound waves will travel faster in water than they do in air. When an object hits the bottom of the seabed, that energy will produce a sound. The sound will bounce off the bottom of the seabed and the sound wave will travel throughout the water. Students are using the soda liter bottle as a “headphone” to listen to the different sounds being created when the objects are dropped, hit the bottom of the water container, and being reflected out. The Navy will use the same concept but on a much longer scale using sonar. Sonar is used to detect objects underwater and for measuring the water’s depth by producing sound and detecting when the sound is reflected. Sonar is the only way to communicate in the water and to seek potential marine life or other ships in the surrounding area.

Fun Fact!

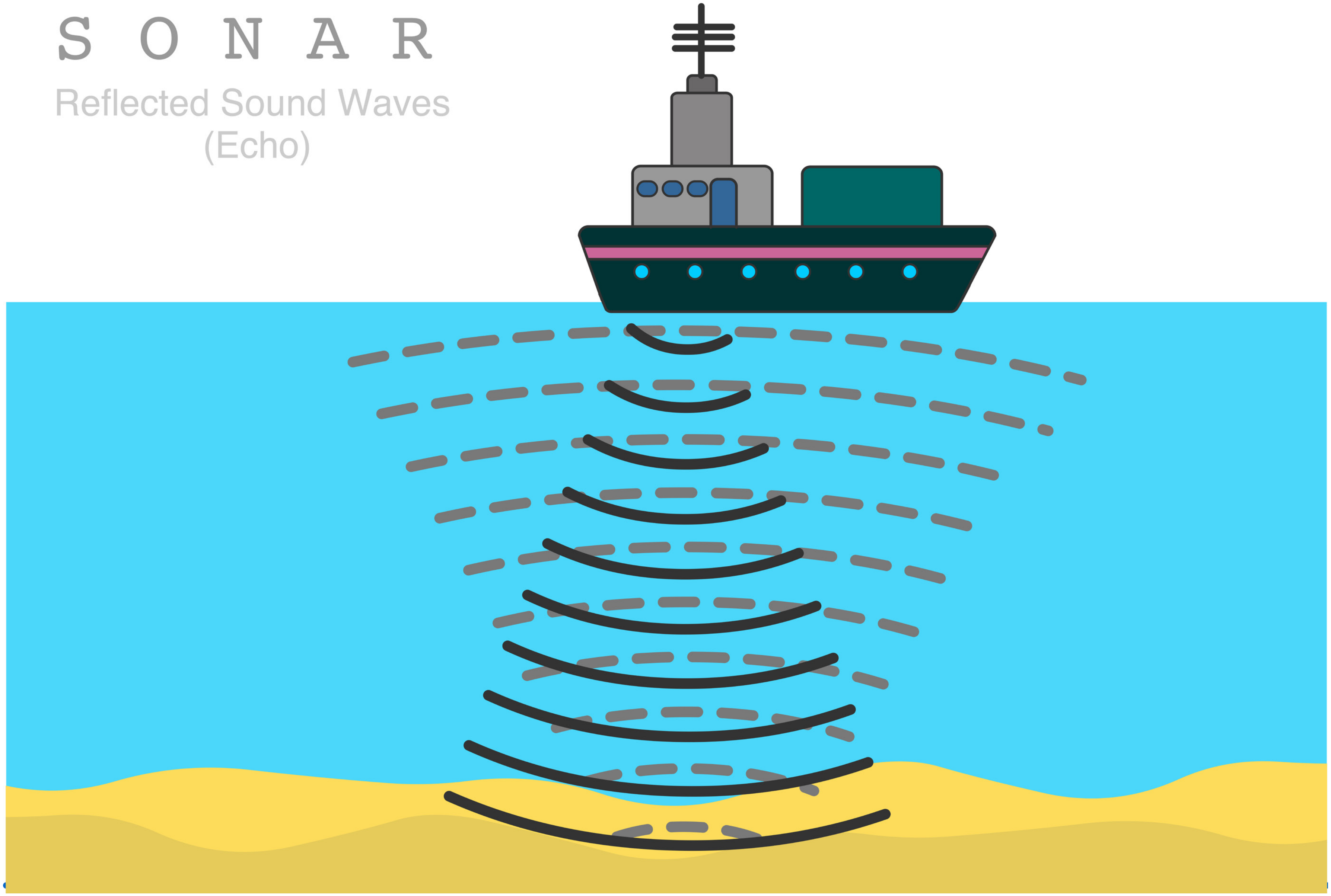
The DDG 1000 is one of the newest naval fleets! Its sleek shape is not only cool to look at but purposefully designed this way! The composite superstructure significantly reduces radar cross section and other signatures, making the ship harder to detect by enemies at sea.

Fun Fact!

Sonar is used to identify, track, and navigate safely in the ocean. With advances in technology, newer-generation submarines are extremely quiet and hard to detect in the noisy ocean environment due to new technology in engineering design.

S O N A R

Reflected Sound Waves
(Echo)



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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