

NAVAL HISTORY STEM-H LESSON PLAN

TEACHER HELP GUIDE

LESSON PLAN: How Do Submarines “see” Underwater?

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INSTRUCTIONAL GOAL:

During this inquiry based lesson the students will demonstrate an understanding of how SONAR is used in submarines to develop a “picture” of what is in the water around them; from fish, to other submarines, to surface ships, or mountain peaks that protrude up from the ocean floor. The students will develop their understanding of how scientist use SONAR to “see” what the bottom of the ocean looks like, where underwater volcanoes are located, and how the ocean floor is constantly moving and changing shape, all based on the way sound waves behave in a medium (water).

As the student small groups begin to examine how SONAR (sound waves) has been used and developed by the United States Navy for submarines, they will collaboratively develop and write an exposition paper about uses and behavior of sound waves in other areas of science; areas such as medicine, navigation, guidance, echolocation in bats, dolphins, and birds, fish finders for sport fishermen, and future potential uses.

BACKGROUND:

SONAR was first invented in 1906, by Lewis Nixon, to help detect icebergs in the ocean. In 1915, with the invention of submarines and the need to locate them underwater, Paul Langevin invented a device that could detect submarines. By 1918 the United States and Britain developed “active sonar” that sent out a signal and received the reflected wave. Many Navy sonars now use “passive sonar”, which listens to sounds in the water and uses powerful computers to compute ship, submarine, or “sea creature” locations and tracks from their own sounds. During World War II the Americans coined the term SONAR which stands for Sound Navigation and Ranging. Sonar is an integral part of submarine effectiveness and stealth. By listening to the sounds around the submarine a highly trained and experienced sonar operator can guide the submarine effectively simply by the sounds he(or she) can hear through the hydrophones. SONAR continues to be developed and now includes depth detection, rapid scanning, and side scanning capabilities.

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RESOURCES:

1. Video "Dive, Dive: The Submariners", 1967
http://www.youtube.com/watch?v=E_tYb0ws66E&feature=BFa&list=UUGiS44OoLuJJIiAWk341OAw
2. Video: "Sonar: The Submariners (1967)"
<http://www.youtube.com/watch?v=CNBlx7ozFnI&feature=BFa&list=UUGiS44OoLuJJIiAWk341OAw>
3. Video: "Underwater Sounds: How Sonar Works", from Cold War Gallery
(attached video file "Underwater sounds: How sonar works") Cold War Gallery Museum
4. Worksheet: SONAR Worksheet 1

STANDARDS:

South Carolina Science Standards:

- SC 8-5.1 Use measurement and time-distance graphs to represent the motion of an object in terms of position, direction, or speed.
- SC 8- 1 Recall that waves transmit energy but not matter.
- SC 8-3 Summarize factors that influence the basic properties of waves (including frequency, amplitude, wavelength, and speed).
- SC 8-4 Summarize the behaviors of waves (including refraction, reflection, transmission, and absorption).

South Carolina Eighth Grade Mathematics:

SC 8-1: The student will understand and utilize the mathematical processes of problem solving, reasoning and proof, communication, connections, and representation.

Common Core Standards – Literacy in History, Social Studies, Science and Technical Subjects Gr. 6-12

1. The student will write arguments focused on discipline-specific content.
 - a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
 - b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
 - c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons and evidence.
 - d. Establish and maintain a formal style.

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- e. Provide a concluding statement or section that follows from and supports the argument presented.

INSTRUCTIONAL PROCEDURES FOR LESSON:

Engage: The teacher will show the short video clip about a cold war era submarine crew diving the boat underwater. (video “Dive, Dive: The Submariners, 1967”) http://www.youtube.com/watch?v=E_tYb0ws66E&feature=BFa&list=UUGiS44OoLuJJiAWk341OAw

Ask students, as a whole group, how they think this crew knew they weren’t diving right into the sand, or into the side of an underwater volcano? Allow various students to respond to the question and write responses on the whiteboard (or on a large poster, flip chart, etc...), for students to review at the end of the lesson.

Materials Needed: Cardboard box with hole cut in it large enough for student to place head into (or a blindfold), cones (arranged in a zigzag random course in the room), meter stick or meter tape, ball of string, notebook, pencil, miscellaneous tools/equipment (the teacher can include an assortment on things here to allow students to determine the usefulness of materials for solving the problem)

Procedure:

Activity “A”

- * The teacher will pre-set the cones in an arrangement that requires the teams to “navigate” through the cones. Any arrangement is acceptable but do not set the course too long for the time limits of the activity.
- A. Each student group (team) will be given a box with a hole cut in it large enough to place over one member’s head. (That individual will be designated the “submariner”), a meter stick, and a ball of twine, and other materials.
 - B. Each group will choose one member to be the “submariner”, and that person will place their head into the box, or place the blindfold over their eyes (so there is no sight of the room).
 - C. The team, or group, will collectively devise a method they think will be effective in guiding the team member in the box around a designated obstacle course. The team should record their ideas in their notebooks for reference. Teams may not touch, or hold on to, the submariner.
 - D. The members of the group will assist and direct, or “drive”, the submariner around a designated course using the team’s agreed upon method of guidance. Each group can use any method except touch, or vision, to guide the team member through the course.

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- E. The teacher should move about the room challenging each group with guiding questions to direct them when they get “bogged down”, questions that will stimulate recall of important prior knowledge, questions that will stimulate the students to think independently and “out of the box”, questions that will cause students to apply and analyze ideas (data), and questions that will cause students to choose, judge, or defend their ideas.
- F. Groups can “regroup” at any time and revise their method of guidance.
- G. After 10-15 minutes each group will compete to guide their “submariner” through the obstacle course. The groups will be timed based on how effectively they guide their team member through the course. If a “submariner” touches an obstacle the group will have to restart their “submariner” back at the beginning of the course. The group with the lowest combined times for the course will be declared the winner.

Explain: The teacher will allow the groups to discuss, as a whole group, how they decided to navigate the course, what challenges they had to address as a group, what things they encountered that made this a difficult task, and how they solved the challenges. Once the student groups have discussed the activity the teacher will introduce SONAR

Brief history of SONAR:

SONAR was first invented in 1906, by Lewis Nixon, to help detect icebergs in the ocean. In 1915, with the invention of submarines and the need to locate them underwater, Paul Langevin invented a device that could detect submarines. By 1918 the United States and Britain developed “active sonar” that sent out a signal and received the reflected wave. Many military sonar now uses “passive sonar”, which listens to sounds in the water. During World War II the Americans coined the term SONAR which stands for Sound Navigation and Ranging. SONAR continues to be developed and now includes depth detection, rapid scanning, and side scanning capabilities.

(Insert video “Sonar:The Submariners”, 1967)

<http://www.youtube.com/watch?v=CNBlx7ozFnI&feature=BFa&list=UUGiS44OoLuJJiAWk3410>
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(Insert video “Underwater sounds: How sonar works” Cold war Gallery)

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Activity “B”

Discuss uses of active SONAR in studying the ocean floor, and sea-floor spreading.

Sonar can be used to plot the ocean floor and map the topography of the bottom.
(insert worksheet “B” for determining the distance to the bottom of the ocean)

- Extend:** (1) Have the students work in pairs and brainstorm the various ways Sonar is used in the civilian world. (fish finders, lake and river topographic maps, ultrasound, etc..) After 3-5 minutes each group should be given the opportunity to share with the class.
- (2) Have student groups discuss how animals use sonar and why. (bats use for navigation and finding food, dolphins use for navigation and finding food, and swallows use for navigation and finding food)

Culminating Activity:

- A. Return to whiteboard (or flip chart, etc...) and discuss student’s first answers to the question “How does the crew know they aren’t diving into the sand or an underwater volcano?”
- B. The students will write a four paragraph paper discussing the uses of SONAR in the military, and in civilian companies.

INSTRUCTIONAL PROCEDURES FOR ACTIVITIES: See Activity Plan A&B

Assessment: The teacher will use anecdotal observations and guided questioning throughout the explore and explain activities to assess student understanding. The teacher will use the written paper to formally assess using the state writing assessment tool.

Reflective Practice: The teacher will continually assess student understanding and critically assess the effectiveness of the instruction. The teacher should be willing to modify and adjust as needed to effectively address individual and class needs and peculiarities.