

EDUCATOR'S GUIDE

Submerged: How Submarines Dive and Resurface

Preparation

Overview and Objectives

This lesson is geared toward families interested in exploring how submarines dive and resurface in water.

The submarine USS Growler (SSG-577) was commissioned on August 30, 1958 and decommissioned on May 25, 1964. *Growler* was a guided missile submarine capable of launching and guiding the Regulus I nuclear missile. This program discusses how submarines like *Growler* can dive deep into the ocean and resurface by changing their density.

This lesson includes a [slideshow](#) in which an instructor can lead participants through an exploration of how submarines can dive and resurface. The lesson culminates with participants creating their very own plastic egg “submarines” that can submerge completely and resurface by changing the amount of marbles inside.

Instructional Modalities

This activity was designed for both synchronous or asynchronous instruction.

For **synchronous instruction**, we recommend a platform that allows both for whole class discussion and for participants to interact in small groups.

For **asynchronous adaptations**, we provide suggestions for teachers to provide additional support for the activities and for participants to share their work with each other.

Materials

- [Submerged: How Submarines Sink and Resurface Slideshow](#)
- [Activity Sheets](#)
- Empty Water Bottle
- Soy Sauce Packet
- Container of Water
- Eight objects palm sized or smaller

Discussion

Questions

What helps objects float?

How can submarines resurface after diving in water?

Lesson

1. Introductory Activity

- Ask Participants:
 - **What is a submarine?**
 - **What can submarines do that makes them special?**
- Discuss the responses with the group.

2. Core Activity

- Share [video](#) of the submarine *Growler* and discuss the job of the submarine.
 - **Growler can float in the water and also dive, or submerge. What helps objects float? What makes objects sink?**
- Discuss density with participants. Objects sink when they are more dense than the water around them. The more mass within a volume, the denser that object will be. If that volume becomes smaller with the same amount of mass, that object becomes more dense. One can demonstrate by rolling one sheet of paper into a ball and placing it in water then wrapping a few marbles or coins in another sheet of paper and placing it in water. Submarines can manipulate their mass in order to sink and rise out of the water
- Share [video](#) on cartesian divers and how they differ from submarines
 - **How are cartesian divers different from submarines?**
 - **What happens to the cartesian diver when pressure is applied to the sealed bottle?**
 - **What happens when an object has greater density than the water around it?**
 - **How do submarines increase their density?**
- Guide participants in creating their own cartesian divers using a bottle and soy sauce packet (other condiment packets with air pockets inside may work as well)
 - **Why does the soy sauce packet sink when the bottle is squeezed?**
 - **How is this similar to how submarines submerge and rise out of the water? How is this different?**

Asynchronous Adaptation

Have participants go through the [slideshow](#) on their own. Using their [worksheet](#), participants can respond to questions about the [video](#) and test out which household objects sink and which float. Have participants share their observations about cartesian divers using Padlet or Flipgrid.

Extension Activities

To deepen student engagement with this content, you may choose to add the following activities :

Make a Boat for Pennies

Have participants experiment with objects floating by challenging them to float as many pennies as possible on one piece of aluminum foil.

Experiment with Liquids of Different Densities

Fill a bottle halfway with water and add in some food coloring. Add baby oil to the bottle and seal the bottle tight. Ask participants to observe what they notice as they shake the bottle or turn it upside down. Which liquid is more dense?

Additional Resources/ References

More information on the submarine *Growler*:

<https://www.intrepidmuseum.org/The-Intrepid-Experience/Exhibits/submarine-growler>

Information on *Growler's* sail:

<https://www.youtube.com/watch?v=sNmv0R5BnVI>

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ACTIVITY 1: SINK OR FLOAT CHALLENGE

Directions:

Find eight objects (that you don't mind getting wet) that can fit in the palm of your hand. Write the object's name in the object column and check off whether you think that object will sink or float when placed in water. Once you finish, place each object in water and identify if your guess was correct or not in the last column.

Object	Check here if you think the object will SINK	Check here if you think the object will FLOAT	Was your guess correct?

1. Did anything surprise you?

