

## EDUCATOR'S GUIDE

# Submerged: How Submarines Dive and Resurface

## Preparation

### Overview and Objectives

This lesson is geared toward students in grades K-5.

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 students to interact in small groups.

For **asynchronous adaptations**, we provide suggestions for teachers to provide additional support for the activities and for students 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
- Plastic Egg (That can open and close)

### Standards

Next Generation  
Science Standards

K-2-ETS1-1

3-5-ETS1-1

5-PS1-1

- **Marbles**

## 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 students. 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 students 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?**

- Share [visual instructions](#) on slides 11 through 13 to show students how to create their very own plastic egg “submarine”
  - **How many marbles did it take to submerge your “submarine” in water without touching the bottom of the container?**
  - **What can you do to allow the egg to rise to the surface?**
  - **How is this similar to how submarines submerge and rise out of the water?**

## Asynchronous Adaptation

Have participants go through the [slideshow](#) on their own. Using their [activity sheet](#), participants can respond to questions about the [video](#) and test out their own plastic egg submarine. Have participants share how many marbles it took to submerge their “submarine” in water without touching the bottom of the container using Padlet or Google Doc.

## Extension Activities

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

### **Make a Boat for Pennies**

Have students 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 students 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 2: Plastic Egg “Submarine” Visual Instructions



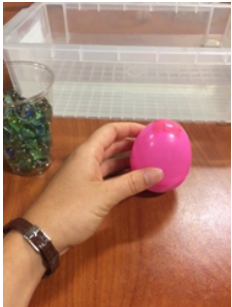
Directions:

The goal of this challenge is to submerge most of the plastic egg without sinking it to the bottom! Follow the visual instructions below.

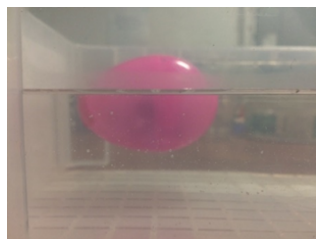
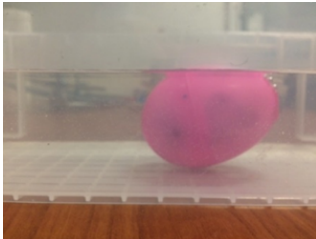
For this challenge you will need a plastic egg, marbles, and a clear container of water.



Open the egg and add marbles for weight.



Close the egg when you are ready to see if your egg submarine floats or sinks. Then gently place egg in the container of water.



Look through the side of the container to see if your egg floats or sinks.



If your egg floats, try adding some more marbles.  
If your egg sinks try taking some marbles out.

Success! What can you do to allow the egg to rise to the surface? How is this similar to how submarines submerge and rise out of the water?

