



MODULE 3 LESSON GUIDE // U.S. NAVY SUBMARINES
USS CLEVELAND LEGACY FOUNDATION STEAM STARS PROGRAM

LESSON OVERVIEW

This module introduces students to U.S. Navy submarines, beginning with brief mention of the U.S.S. COD in Cleveland and the history of hull design and technology. This lesson engages students with facts about the U.S. Navy’s history and present use of dolphins and their tie to submariners, and inspires diversity and women in STEM fields. Students will discover the importance of maintaining life systems in a submarine and compare them to space. They will participate in a practical math lesson adjusting a real Navy food recipe to see how submarine chefs plan menus for crews on long missions under sea.

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LESSON TITLE

U.S. Navy Submarines

TIME

60-90 min

LEARNING OBJECTIVES

Students will:

- Discover the technology and life systems that power modern submarines
- Discover how dolphins influenced early submarine technology and design, and some of the ways they are used by the Navy today
- Learn about women in U.S. Navy submarine history
- Learn about the Culinary Specialist Submarine (CSS) occupation, and its importance in submarine operations
- Real-world knowledge of what is required to increase/decrease the size of a recipe to accommodate a larger/smaller group of people using equivalent fractions, ratios, and proportions
- Practice operations involving fractions and proportional relationships

MATERIALS AND EQUIPMENT LIST

- Module 3 Presentation (U.S. Navy Submarines)
- Cookie Calculations Classroom Activity
 - Worksheet

TECHNOLOGY TOOLS

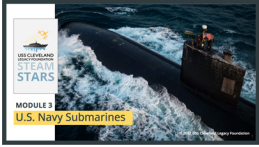
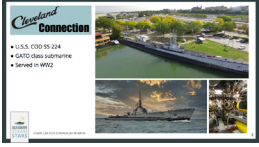

- Digital display projector with internet access
- Ability to project and play Google Slides and YouTube videos with sound

PREP WORK

- Test slide deck, embedded videos
- Print worksheets (double-sided, black and white or color)
- Pre-sort materials


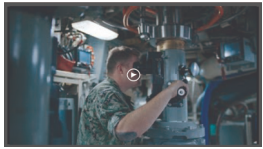
PROCEDURE PART 1: PRESENTATION

Module 3 - U.S. Navy Submarines

<p>Slide 1.</p> 	
<p>Slide 2.</p> 	<p>Here's a submarine some of you may already be familiar with. It's the U.S.S. COD, and it's here in Cleveland.</p> <p>Who here has been to see the U.S.S. COD before? Have you been inside for a tour?</p> <p>The U.S.S COD SS-224 is a Gato class submarine that served in World War II. One thing you may notice is how it looks more like a ship at first glance. Doesn't really look like the subs we are used to seeing in movies, right? That's because prior to WW2, submarines used to spend most of their time on the surface. So since they had to be able to move fast above water, the design of the hull was optimized for speed on the surface of the ocean, and it really only had limited endurance while submerged.</p> <p>Which leads us to our Submarine Navy Fun Fact ...</p>
<p>Slide 3.</p> 	<p>Did you know that the U.S. Navy looked at dolphins as inspiration for modern submarine design? And that they still use dolphins in the Navy today?</p> <p>During the cold war, the U.S. Navy began studying dolphins for ways to improve their submarine technology so that they could move faster and stealthier underwater. But the program yielded several other surprising discoveries, from their use of fins and echolocation for navigation, to their intelligence for tracking and hunting prey.</p> <p>Dolphins naturally possess the most sophisticated sonar known to science. Since 1959, the Navy has trained dolphins to help guard against explosives and other threats underwater. Because of their superior abilities, they can go into small harbors, coastal areas or deep into the open sea to find objects. They can also find enemy divers that threaten national security or Navy ships, and are great at marking the location of undersea mines.</p> <p>Dolphins have excellent low light vision and underwater directional hearing that allow them to detect and track undersea targets, even in dark or murky waters. They can dive hundreds of feet below the surface, without risk of</p>





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	<p>decompression sickness or “the bends” like human divers. While the Navy has also begun to use unmanned underwater drones, the technology is no match for dolphins!</p> <p>Dolphins are special to the Submarine Force. When a submariner qualifies, as in they meet the qualifications to serve on a sub, they are pinned and it’s called the day they “earned their dolphins.”</p>
<p>Slide 4.</p>  <p>The slide titled "Submarine Fast Facts" contains the following information:</p> <ul style="list-style-type: none"> Types of submarines in the U.S. Navy fleet <ul style="list-style-type: none"> Ballistic Missile Submarine (SSBN) Guided Missile Submarine (SSGN) Attack Submarine (SSA) All current U.S. Navy subs are nuclear powered Ballistic missile submarines are called "boomers" Jobs on a Submarine <ul style="list-style-type: none"> Operating nuclear reactor, power generation and propulsion systems Maintaining onboard weapons systems Managing all life support systems Driving the ship and charting its position Operating sonar, radar, fire control, communications and specialized mission equipment 	<p>The United States submarine force consists of three types – SSBN, SSGN, and SSN – and four operational classes – Ohio, Los Angeles, Seawolf, and Virginia – all of which are nuclear-powered.</p> <p>This picture is one of the Navy's ballistic missile submarines, often referred to as a “boomer.” They are designed for stealth and the precise delivery of nuclear warheads. They can carry more than 16 tons, travel more than 20 knots - more than 23 miles per hour - and submerge more than 800 feet, although their exact capabilities are top secret.</p> <p>Their sole mission is to deter a nuclear attack. A command from the president, passed through U.S. Strategic Command and ultimately to the ship's captain, allows the crew to fire a long-range ballistic missile in a matter of minutes.</p> <p>Submarine crew are responsible for all aspects of submarine operations from supervising the reactor plant to running the ship both in port and at sea. Jobs for submarine officers can range from:</p> <ul style="list-style-type: none"> ● Operating a nuclear reactor, power generation and propulsion systems ● Maintaining onboard weapons systems ● Managing all life support systems ● Driving the ship and charting its position, and ● Operating sonar, radar, fire control, communications and specialized mission equipment <p>Let’s take a tour now and see what life looks like on an Ohio-class submarine...</p>
<p>Slide 5.</p>  <p>A photograph showing the interior of a submarine, with a crew member in a dark environment, possibly a control room or engine room, looking at a screen or instrument panel.</p>	<p>Run Time: 2:45</p>
<p>Slide 6.</p>	<p>Did you know that women used to not be allowed to serve on submarines? The U.S. Navy lifted their ban in 2010 to allow female officers to serve on board subs. Then enlisted female sailors were allowed to serve a few years after that. Today, retention rates of female submariners are as high as their male</p>



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	<p>counterparts.</p> <p>Yeoman Suraya Mattocks, pictured on the left, is a trailblazer, one of the very first women to ever serve on board a submarine. Kayla Barron, pictured on the right, served on a submarine as well, and then was inspired by her experience, explaining that being in a submarine sounded a lot like being in a spaceship. She went on to become an astronaut with NASA.</p> <p>Wow! Have you ever thought of the ocean being similar to space? What do you think about a Submariner being like an astronaut?</p> <p>Let's hear a quick clip from Kayla Barron speaking from space herself!</p>
<p>Slide 7.</p> 	<p>(Clip Run Time: 1:23 min. - from 6:52 to 8:15)</p>
<p>Slide 8.</p> 	<p>This is a diagram of a Los Angeles-class fast attack submarine, the USS Cincinnati. Much like the space shuttle you saw in the last video, the modern submarine is full of systems that are critical to maintain even the most basic functions of life, like breathing, eating, and generating fresh drinking water. There are systems for communication, warfare, protection, and navigation, and also things like cleaning the air from bad odors, and flushing human waste.</p> <p>In a previous lesson, we learned how large ships stay afloat and even tested what can make them sink. But submarines need a way to control their buoyancy and density to dive in and out of the water. And once they're under the ocean, they use technology to navigate. Let's see how they do it...</p>
<p>Slide 9.</p> 	<p>Have you ever wondered how they cook in a submarine? Did you know submarines have kitchens, nearly identical to the one in your own home?</p> <p>The kitchen, or galley, is a small space around 8x10 feet, with ovens, flat top grills, and microwaves stacked together. But the biggest difference is there is no open flame like a gas grill. Why do you think that is?</p> <p>Because of the danger of fire. As you can imagine, a fire in a submarine would be very dangerous. Not only is there no place to escape when you're in a sub, fires consume oxygen, so in a sealed environment like a submarine, this can lead to a rapid depletion of breathable air and a life-threatening situation for the crew if the fire wasn't quickly contained.</p>

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	<p>Luckily, submarine chefs are specially trained for cooking under pressure! Let's watch some video of them in action...</p>
<p>Slide 10.</p> 	<p>Clip Run Time: 1:37</p>
<p>Slide 11.</p> 	<p>Because nuclear submarines can stay underwater for months at a time, serving good food is very important to keep the crew happy and motivated. Life on a submarine is considered one of the toughest jobs in the military, therefore having delicious meals can really boost everyone's spirits. The Culinary Specialist Submarines (CSS) are specially-trained chefs with impressive skills and backgrounds. They are responsible for planning and preparing menus for the entire crew, managing food orders and supplies to last months under water.</p> <p>Imagine you are a CSS for an Ohio class sub preparing for a 3 month tour. What kind of food would you put on your menu? What would your shopping list look like?</p> <p>Because all food must be purchased and stored before the start of the tours, fresh produce is enjoyed in the early days of each patrol. But Pizza, spaghetti, turkey and dressing, ham and sweet potatoes, rolls, cakes and pies are possible– all made from scratch! A common grocery inventory for a 3 month tour with 150 submariners on board would include things like: 530 pounds of coffee, 22,140 eggs, 800 pounds of butter, and 504 bags of microwave popcorn.</p> <p>CSS's work long hours in shifts, serving 4 meals a day: breakfast, lunch, dinner, and midrats, a late evening meal. These cooks are specially trained to work with limited resources, cook for all types of dietary needs, and work in very tight quarters. A galley kitchen on a submarine is small space around 8x10 ft with only enough space for 1 or 2 people to work in at a time, with no open flame equipment. Cooks make almost everything from scratch, and will often have to deal with unique challenges such as the walls closing in from the pressure of the hulls during a dive, or cooking without the use of mechanical equipment if they are ordered to work quietly to avoid detection.</p> <p>But this is partly why submarine chefs are known to be some of the best in the world. The Navy sends their cooks to train at the nation's top chef schools and the finest restaurants in the country. After leaving the Navy, some submarine cooks have gone to teach at the Culinary Institute of America in New York, become chefs at top restaurants in the US, and even work at the White House.</p>

PROCEDURE PART 2: ACTIVITY



Cookie Calculations

To begin, pass out a worksheet to each student. Each student will need their own writing utensil.

<p>Slide 12.</p> 	<p>The class STEAM activity today will touch on your math skills. We're going to do a quick game called Cookie Calculations!</p> <p>Imagine you are a submarine chef, and you have been tasked with making cookies for your hungry crew. The dilemma? You have 150 mouths on board! Put your chef hat on and get ready to do some math!</p> <p>[Pass out Module 3 Submarine Activity: Cookie Calculations worksheets.]</p> <p>Culinary Specialists in the Navy have an entire cookbook of approved recipes like this one shown here on your screen. In fact, there are over 1600 recipes!</p> <p>Take a close look at this recipe for Chocolate Chip Cookies. Do you notice anything special? This recipe is made for 100 portions! But what do you do when you need cookies or meals for 150 people? Or just 25? Chefs on submarines often adjust recipes to yield the number of portions needed for their crew, to avoid waste, or to use the amount of ingredients available.</p> <p>Today you're going to take this recipe and just like a real submarine culinary specialist, calculate your adjusted recipe for 150 portions instead of 100.</p> <p>I want you to first list all of the ingredient amounts from the original recipe in the blanks in the left hand column, then think about how you can recalculate the amounts so that there's enough to make 150 portions of cookies. Rewrite the recipe with the adjusted amounts for 150 portions in the column on the right.</p>
<p>Slide 13.</p> 	<p>And go! I'll give you 15 minutes to finish. Be sure to show your work, explain your strategies, and double check your calculations!</p> <p>[allow independent work for 15 minutes]</p>
<p>Slide 14.</p> 	<p>Did everyone get finished? Great! Here is the answer key. Check your work and see how you did.</p> <p>Did anyone use the conversion chart on the back of your worksheet to convert the cups into quarts and vice versa?</p>

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	<p>Did everyone use fractions or did some simplify their numbers into decimals?</p> <p>Were there any that were tricky that mixed you up?</p> <p>Navy Chefs do this math all the time, and the way they do it is they have a formula called the working factor formula.</p>
<p>Slide 15.</p> 	<p>What they do is they take the number of portions they need, in this case it would be 150, and divide that by the number of portions from the recipe they have, in this case, 100, to get the working factor, which would be 1.5. Then they would just multiply the amount of each ingredient by 1.5 to get the new adjusted amounts.</p> <p>Does anyone want to share how this is similar or different than your strategy for coming up with your answers?</p>
<p>Slide 16.</p> 	<p>Closing Discussion Optional Questions</p> <ul style="list-style-type: none">• What is the single most important factor affecting how long submarines can stay operational underwater? (answer: food)• What is the nickname for a type SSBN ballistic missile submarine? (answer: boomer)• In what ways are submarines similar to spaceships?• Is it important to follow measurements in a recipe? Why or why not?• How does knowledge of measurements and units assist you in cooking?

GO DEEPER *(optional activities for students, printed on back of worksheet)*

- Search online for more recipes from the Armed Forces Recipe Service. You can find them here <https://www.marines.mil/Portals/1/Publications/MCO%20P10110.42B.pdf> or by searching online (be sure to search safe sites ending in .mil or .gov). Think of some of your favorite foods and see if they are included. Did you find them? Are the ingredients similar or different from other recipes you may find online or in cookbooks you have at home? Does anything surprise you?
- With permission, find a recipe to make at home for your family. You may use a recipe from the Armed Forces Recipe Service directory or choose any recipe you like. Look at the portion (serving) size of your recipe, and if you need to adjust it for the number of people in your home, use the strategies you learned from the Cookie Calculations activity. Make your grocery list and shop for your ingredients. Prepare the recipe according to the directions. Do you have all the necessary tools? Will you have to make any accommodations? What did you learn? How did it go?