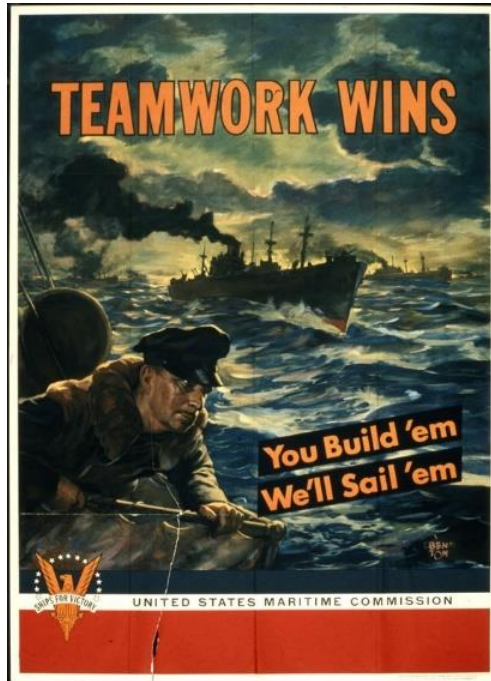


World War II Robotics Challenge: Battle of the Atlantic

Spring 2022



(Teamwork Wins: You Build'Em, We'll Sail'Em, 1943,
Courtesy of the National Archives and Records Administration)

Battle of the Atlantic

The Battle of the Atlantic was the longest continuous military campaign of World War II. The battle was fought between the Allies and the European Axis Powers and lasted from 1939 to the defeat of Nazi Germany in May of 1945. The Germany Navy's (*Kriegsmarine*) main objective was to prevent much needed supplies from North America from reaching the United Kingdom and other European Allies.

On the opposing sides of the battle were the Allies United States Navy and Merchant Marine, the British Royal Navy and the Royal Canadian Navy. Fighting against them were the Axis forces of the German *Kriegsmarine* with their surface warships and U-boats (submarines), the German Air Forces or *Luftwaffe* and, until 1943, the Italian *Regia Marina* or Royal Navy. The Battle of the Atlantic involved thousands of ships in more than 100 convoy battles, in addition to single ship encounters between each side.

Over the course of the war, the Allies slowly and steadily turned the battle to their favor with advancements in technology, including the successful cracking of the German Enigma Machine code, the development of radar and through manufacturing output, building more cargo ships than the Axis were able to sink.

This document contains the background information and mission instructions for the 2022 Robot Game. The instructions for the Robot Game are in **bold**. Instructions on how to set up the mat can be found on the Robot Game Table Set Up pdf and instructions for the Cracking the Enigma Code mission can be found in the separate pdf as well.

Robotics Competition Mission Objectives

Headquarters

Your robot can only launch from the Headquarters area, this is the only area you can touch the robot without getting a touch penalty.



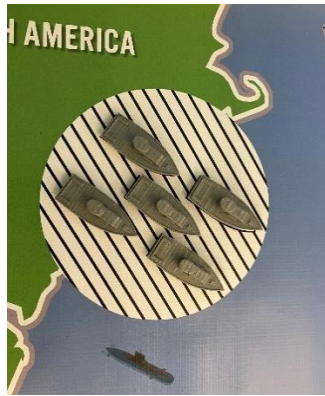
Move the Convoy of Ships

Great Britain, as a small island nation, was dependent on imported goods. The country required more than a million tons of imported food and other resources per week in order to survive and fight. They relied heavily on the shipping of supplies from North America during World War II. The greatest threat to this supply system was German submarines, called *Unterseeboote* ('under-sea-boat'), commonly referred to as 'U-boats'.

With the British dependency on imported resources, as well as the need to supply the Allied armed forces, protecting supply ships from German U-boats and surface ships became essential to the war effort. Convoys consisted of 30 to 70, mostly unarmed merchant ships. The convoys were protected by an escort group of military ships. These groups usually consisted of two or three destroyers and a half dozen corvettes. Later in the war, escort carriers also called "jeep carriers" accompanied convoys. These small aircraft carriers supported 24-30 fighter planes that could be deployed to protect the convoy. Destroyers were fast, maneuverable, long endurance warships intended to escort larger vessels in a fleet or convoy. Corvettes, were smaller than Destroyers, quick to build and had anti-submarine defenses. The Battle of the Atlantic was a long struggle as the Germans developed anti-convoy tactics and the British and the Americans responded with counter-tactics to thwart the Germans.

There were over 300 Atlantic convoy routes during the Second World War. Each route was given a two or three letter Code Prefix to identify them. For example, Convoy HX traveled from Halifax Harbor in Canada early in the War and then from New York City starting in 1942 all the way to Liverpool, England.

Your robot will move 5 ships from the port in New York City, USA to the GREEN circle in Liverpool Port, UK. If all ships end up completely in the Liverpool Port you will receive 55 points. If 4 ships are completely in the circle you will receive 45. If 3 ships are completely in the circle you will receive 35 points. If 2 ships are completely in the circle you will receive 25 points and if one ship is completely in the circle you will receive 15 points.



Rescue a Soldier

Charles Walter David Jr. enlisted in the Coast Guard in March of 1941. As he was African American, in the racially segregated American military, David was assigned to work in the ship kitchens, and was promoted to mess attendant first class aboard the USCGC *Comanche*. On February 3, 1943 the *Comanche* and three other Coast Guard ships were escorting a convoy of transport ships carrying US troops to Greenland. A German U-boat torpedoed the USAT *Dorchester*, which was carrying more than 900 men. As the boat was sinking, the *Comanche* pulled up to rescue as many survivors as possible from the freezing water and life boats. Witnessing the crisis, David and several other men voluntarily climbed down into the lifeboats where they helped lift the shivering men up onto the *Comanche's* deck. Even though David was one of the lowest ranking men on his ship and his own nation considered him a second-class citizen, he willingly put his life at risk to save his fellow Americans.

During the precarious operation, the *Comanche's* executive officer, Lieutenant Langford Anderson, fell overboard. Without hesitation, David dived into the deadly waters to save Anderson. In addition to the two men whom David single-handedly saved, he and his shipmates successfully rescued 93 survivors from the *Dorchester*. Shortly after David's heroics, he contracted pneumonia from his time in the water. Fifty-four days later, on March 23, 1943, he succumbed to the illness in a hospital in Greenland. The Coast Guard posthumously awarded David the Navy and Marine Corps Medal.

Your robot will rescue the soldier from the water and bring him back to Headquarters and off the table. At the end of the match if the soldier is in Headquarters or off the table your team will receive 25 points.



Build a Liberty Ship

Liberty Ships were a class of cargo ships built in the United States during World War II. Based on a British design, the ships were simple and economical to build. With American men off fighting during the war, shipyards quickly employed women to take their place. The women in these jobs were often called "Rosie's" in reference to the cultural icon "Rosie the Riveter" created during World War II. Rosie the Riveter was seen as representing all women who worked in

factories, shipyards and all other military industries during World War II, many of whom produced munitions and war supplies.

Throughout the war, Liberty Ships came to symbolize the wartime industrial output of the United States. Over 2,710 ships were built between 1941 and 1945. The average length of time to build one of the ships was 42 days. The record for the fastest built Liberty Ship was a one launched in 4 days and 15 and half hours for a publicity stunt. The ships were built assembly line style using prefabricated sections.

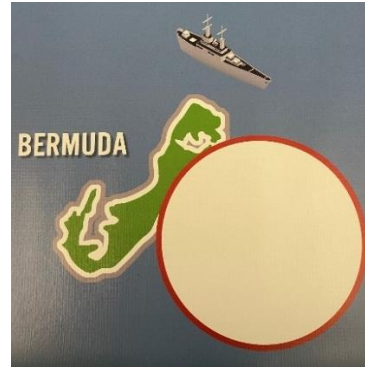
For this mission, your robot will stack the wooden blocks inside the purple rectangle on the mat. If you place 1 block completely in the rectangle you will receive 20 points. If you stack a second block on top of the first and this second block is completely supported by the first block you will receive 20 additional points. If you stack a third block on top of the first two blocks you will receive 20 additional points. The additional two blocks must be completely supported by the first block and cannot be touching the mat. You can earn up to 60 points with this mission objective. If your first block is not completely in the rectangle you will receive 5 points. You can still receive the up to 40 points for the additional blocks.



Capture a U-boat

On May 15, 1944, US Navy Task Group 22.3 set sail from Norfolk, Virginia. Their task was to find and capture a German U-boat using high-frequency direction-finding fixes (Huff-Duff) and air and surface reconnaissance. On June 4th, 1944 using decrypted German messages, the Task Group focused in on an area off of the coast of Africa where U-boats were operating. A U-boat, U-505, was located at 11:09 a.m. and a destroyer from the task group dropped depth charges (explosives, launched overboard into the water, detonating and hopefully destroying or damaging any nearby submarines). The U-boat's Captain, thinking his boat was seriously damaged ordered his crew to abandon the ship. All but one crewman from the U-boat was then rescued by nearby US destroyers, while a boarding party seized the submarine, its charts, codebooks and the U-boat's Enigma Machine. After securing the boat and making sure it would stay afloat, it was then towed 1,700 nautical miles (1,960 miles) to the Navy's Naval Operating Base in Bermuda for study. The ship's capture was a top secret as the Navy wanted the Germans to believe that the ship had sunk rather than been captured. In 1954, the U-505 was donated to the Museum of Science and Industry in Chicago where it remains on display today.

For this mission your robot will capture the U-Boat from the match. If you bring it back to base you will receive 10 points. If at the end of the mat it is completely in the RED circle you will receive 25 points. If it is partially in the red circle you will receive 15 points.



Cracking the Enigma Code

During the Battle of the Atlantic, both the Allies and the Axis sought to keep their communication a secret. They did this through using secret codes and ciphers. The German military used the Enigma Machine throughout all branches of its military. The machine used a set of wire connections and mechanical rotors to create codes for messages that changed regularly. The security of the machine relied on both the person sending the message and the person receiving it. The receiving station had to know and use the exact settings employed by the transmitting station to successfully decrypt a message. Code settings were changed daily during the war, based on secret key lists that were distributed in advance.

The Allies managed to design a system that simulated the Enigma Machine, but they also needed a way to figure out exactly how the machine worked in order to crack its code quicker. In practical terms, there were about 1023 possible outcomes or variations of an encrypted Enigma code. In order to calculate all those possibilities, the British Government Code and Cypher School (GC&CS) at Bletchley Park built Colossus, a giant computer of thermionic valves (also called tubes). Colossus was the first programmable digital electronic computer.

This mission has two parts. In the first, your robot will retrieve the coded message from Bletchley Park and return it to HQ for 15 points. In the second your teammates will decode the message during the match and if correctly decoded at the end of the match your team will receive 40 additional points.



<p>-----</p> <p>Decoded Message:</p> <p>_____</p>

Firing a Torpedo

Torpedoes are self-propelled underwater weapons. They contain explosives that are set to detonate either on contact or in close proximity to an enemy surface ship or submarine. They can be launched from surface ships, submarines or airplanes. During World War II and the Battle of the Atlantic, all Axis and Allied nations had torpedoes. This included but was not limited to, the United States, United Kingdom, Canada, Brazil, Germany and Italy. Torpedoes were the main weapon of submarines. By the end of the war, almost 3,000 Allied ships (175 warships; 2,825 merchant ships) had been sunk by U-boat torpedoes.

Take the ball from Headquarters and drop it in the Mardi Gras cup to receive 35 points.

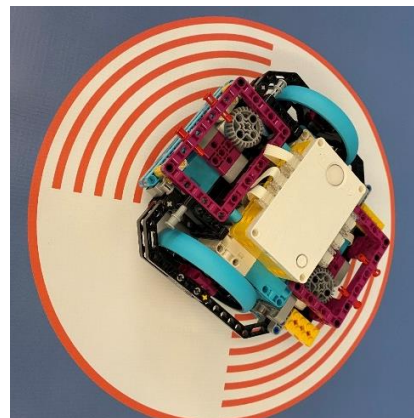


ASDIC/Sonar

ASDIC, later known as sonar, was a secret device for locating submerged submarines using sound waves. Named after the Anti-Submarine Detection Investigation Committee, it consisted of an electronic sound transmitter and receiver and was a type of active sonar. The device was housed in a metal dome beneath the ship's hull. High-frequency beams - audible 'pings' - were sent out and bounced back when they hit a submerged object such as a submarine. The time that passed before an echo was received showed the distance between the ship and its target. The pitch of the echo revealed if the submerged object was approaching or moving away.

It took a highly trained operator to effectively use the ASDIC equipment. As the war progressed technology improved, making ASDIC easier to use and improved its success rate.

For this objective, your robot will enter the ORANGE circle and make a sound. Your robot must be stopped, and completely in the circle when it makes the sound. If your robot is stopped and completely in the circle you will receive 20 points. If your robot is partially in the circle you will receive 10 points.



Leigh Light

The Leigh Light (L/L) was a British anti-submarine device used in the Battle of the Atlantic. It was a powerful searchlight 24 inches in diameter and fitted to the British Royal Airforce Coastal Command patrol bombers to help them spot surfaced German U-boats. The new Air to Surface Vessel radar had a minimum range of about .62 miles or 1 kilometer. Wing Commander Humphrey de Verd Leigh proposed using a search light on airplanes that would be switched on just as the target was about to disappear on the radar. U-boats that were at the surface at night to recharge their batteries, would not have enough time to dive, giving the airplane a clear view of the target. Introduced in June 1942, the Leigh

Light was so successful that for a time German submarines were forced to switch to charging their batteries during the daytime, when they could at least see aircraft approaching.

Your robot must turn on the push light, and the light must remain on, for 35 points.

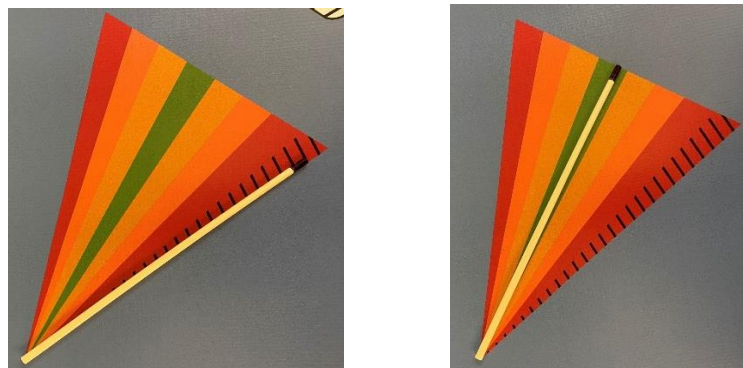


Huff Duff Set - High-frequency direction-finding

High-frequency Direction Finding (HF/DF) also known as huff-duff, is a type of radio direction finder (RDF) that was introduced in World War II. High frequency is a radio band that can effectively communicate over long distances, such as the distance between U-boats at sea and their land-based headquarters. Huff-duff sets were used to catch enemy radio signals while they transmitted. With multiple sets, ships and planes could zero in to where enemy submarines were located.

By 1942, improved sets were introduced that included continuously motor-driven tuning, to scan the likely radio frequencies and sound an automatic alarm when any transmissions were detected. Operators could then rapidly fine-tune the signal before it disappeared. These sets were installed on convoy escorts, enabling them to get fixes on U-boats transmitting from over the horizon, beyond the range of radar. This allowed hunter-killer ships and aircraft to be dispatched at high speed in the direction of the U-boat, which could be located by radar if still on the surface or with ASDIC if submerged.

For this mission, you will move the chopstick from it's starting position, as marked on the mat, and point it towards the submarine. If the black point of the chopstick is in one of the red sections you will receive 10 points. If the black point of the chopstick is in one of the orange sections you will receive 15 points. If the black point of the chopstick is in one of the yellow sections you will receive 20 points. If the green section you will receive 30 points.



United States Merchant Marine Academy Graduation

With the passage of the Merchant Marine Act in 1936, Congress established the U.S. Merchant Marine Cadet Corps which would turn into the United States Merchant Marine Academy in 1943 with the construction of its campus in Kings Point, New York. World War II and The Battle of the Atlantic required the Academy to forgo its normal operations by increasing enrollment and reducing the course length from 4 years to 18 months. From 1942 to 1945, the academy graduated 6,865 officers. The Merchant Marine Academy still exists today as a four-year, college level program to meet the peacetime requirements of the merchant marine. The Merchant Marine suffered a higher casualty rate than any branch of the military, losing over 9,300 men, with most of the losses occurring in 1942, when most merchant ships sailed U.S. waters with little or no protection from the U.S. Navy.

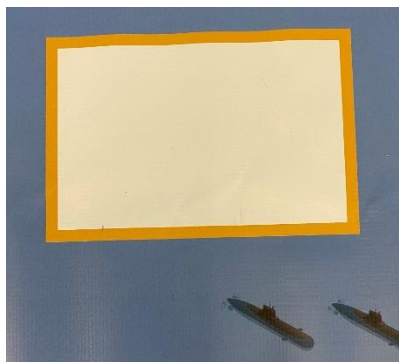
For this mission your robot will flip a graduation cap. If the cap lifts off the Robot Game table, regardless of where it lands you will receive 15 points.



The Mid-Atlantic Gap and Air Cover

The Mid-Atlantic Gap, also called the Black Pit or the Gap, was a vast area of the Atlantic Ocean, beyond the reach of coastal based aircraft patrols. Aircraft played an important role in the Battle of the Atlantic as they were able to limit the places U-Boats could safely hide, waiting to attack merchant ships. Aircraft could spot U-boats shadowing convoys, making it harder for the Germans to launch an attack, thereby greatly reducing the number of ships lost. Aircraft could also attack enemy ships and could move quickly through the convoys to help the limited military escorts protect the merchant ships. Early in the war, the lack of air cover throughout the gap led to heavy merchant shipping losses. It wasn't until May of 1943 when the gap was closed as more VLR Liberators (Very-Long-Range models of the aircraft), escort carriers, and convoy ships who could launch air planes, became available to the Allies.

In this mission your goal is to move the airplane from Headquarters to the YELLOW box in the Mid-Atlantic Gap.



*Actual Airplane may look different from the one pictured.

Touch Penalties

When the robot is running on the game field, the less you touch the robot or interrupt it, the better. If you don't have to interrupt your robot during the match you will receive 10 points.

Benefit of the Doubt

Teams will receive the benefit of the doubt when it comes to mission objective points if there is any doubt to scoring in regards to the Robot Game.

Robotics Competition Rules

Teams must be registered online with The National WWII Museum to compete in the Robotics Challenge. Registered teams will receive the season's game mat and missions by mail.

Teams will compete in one qualifying event, virtually. Teams will have the opportunity to advance to the Championship from the virtual qualifier. The top 40 teams will advance to the Championship event held at The National WWII Museum.

Teams must participate in both the Robot Game and the Engineering Project.

Teams will consist of a minimum of 2 and a maximum of 10 team members.

Team members must be in the 4th through 8th grade at the time of competition, unless provided with written approval from The National WW2 Museum.

All work presented at the Robotics Challenge Competition must be by the team members, adults cannot take part in building or programming of the robot, or with the design and construction of the engineering project. Adults are not permitted to interact with a team's robot, this includes at competitions.

Only LEGO Mindstorms (any generation) or LEGO SPIKE Prime robots can be used for the competition.

Teams, coaches, volunteers, staff and spectators are expected to exhibit good sportsmanship throughout the competition season.

Consequences

Teams and individuals that fail to follow the Robotics Competition Rules may be ineligible for awards and/or advancement at a Robotics Competition.

Robotics Project

There were many different technological advancements developed during World War II that helped the Allies ultimately succeed in winning the Battle of the Atlantic. These innovations helped save countless lives and allowed for much needed supplies to reach their overseas destinations.

For this season's engineering project, your team will choose one invention or application used during the Battle of the Atlantic and develop a working attachment for your robot modeled after the historical example.

You won't be able to display your modified robot at the competition, because your robot will be competing in the matches. Instead you can display attachments, use photos and videos or diagrams to explain how your attachment works. You can also use materials other than LEGO pieces for your attachment for this part of the competition.

Your team will need to create a trifold board display to communicate and display your design process and the research that went into what invention or application your attachment is based on.

Make sure to cover what invention or application you chose, how it was used and the overall effect it had on the Battle of the Atlantic. These advances can include technology to help locate submarines, crack the Enigma code, protect ships and more. Your goal is to educate your audience about the innovation and how it helped the Allies win the Battle of the Atlantic. Make sure to include the sources for your research on your display.

Engineering Project Requirements

- Make sure to address all areas of the Judging Rubric.
- Must include your information sources on the tri-fold poster.
- Clearly Identify your teams chosen historical invention or application.
- Include how your chosen invention or application helped the Allies win the Battle of the Atlantic.
- Prepare a brief 3-5-minute video presentation talking about your chosen invention or application, your robot attachment and your trifold board display for the judges. Be prepared to upload your video to YouTube as a private link.
- Teams can use items other than LEGO pieces for their Engineering Project robot attachment.
- Teams need to show a bibliography on their trifold board showing a list of the sources they used that relate to the content of their Engineering Project.

How your Engineering Project will be Judged

Virtual Qualifier

For the virtual qualifier event, judges will review team's YouTube videos using the Judging Rubric. Make sure to address all areas of the rubric in your presentation as Judges will not be able to ask follow up questions!

Championship

Your Engineering Project presentation will be presented to judges in person. Judges will use the rubric provided here to evaluate your engineering project and ask questions. This will still be the 3-5-minute presentation from the qualifier.

Virtual Qualifying Event

This season The National WWII Museum will host a virtual qualifier for all Robotics Competition teams on April 15th. Teams will submit 2 robot game videos via private YouTube links. Teams will also submit a video presenting their engineering project and associated display. Teams will be required to submit all video links by 5pm central on April 14th, 2022.

Championship at The National WWII Museum

The National World War II Museum is currently planning to hold an in-person Championship event for May 14th, 2022. We will be paying close attention to the local, state and national Covid-19 regulations. All safety requirements will be sent to teams prior to the event.

Advancement to Championship

To qualify for advancement to the Championship, teams must be in the top 75 % of the Robot Game scores. They must also have performed well in the Engineering Project category.

The top 40 teams from the Virtual Qualifier will be invited to the in-person Championship at The National World War II Museum. Champions 1, 2 and 3 will automatically advance from the qualifier to the Championship event.