

Lesson 16:

Topic/skill: Submarines in Warfare

Standards:

- *MST Standard 4—Science*-Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

- *MST Standard 5- Technology*-Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

-*Language Arts Standards 1*- Students will read, write, listen, and speak for information and understanding.

-*Language Arts Standard 3*- Students will read, write, listen, and speak for critical analysis and evaluation.

-*Language Arts Standard 4*- Students will read, write, listen, and speak for social interaction.

Objectives:

1. Students will be able to discuss the workings of the submarine and its significance in the Revolutionary War.
2. Students will be able to evaluate the use and design of the submarine.

Materials:

-modified G. Pararas-Carayannis text about the submarine

-pictures of the early Turtle

-large glass container

-water

-cork

-glass/plastic funnel

-plastic tubing

Advanced Preparations:

-Modify Pararas-Carayannis's text.

-Prepare a handout based on this text.

-Find pictures of the early Turtle.

-Gather the above materials.

-Prepare modifications.

Activating Prior Knowledge:

-Ask the students for suggested properties of submarines.

-How might submarines work?

Procedure:

1. Distribute the modified Pararas-Carayannis's text.
2. Read the text using the start/stop method.
3. Have the students stop when design properties are listed in the text (and list them on their papers) and also when historical information is given (and note this information on paper).
4. Discuss the properties of the submarine and its importance in the war.

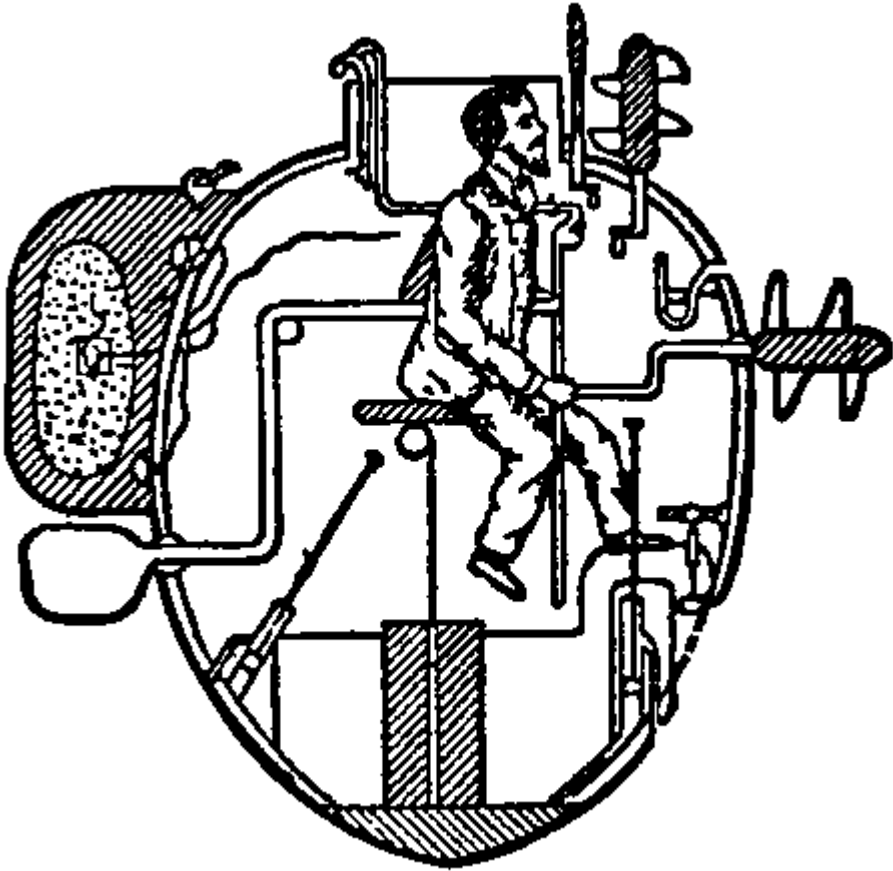
5. Demonstrate the following science exploration:
- Ask the students what they think will happen when a cork is placed on the surface of water that fills a container 2/3 of the way.
 - Place the cork on the water's surface and note the results.
 - Ask the students what they predict will happen to the cork when the funnel is placed over it.
 - Take a funnel, with plastic tubing attached to the smaller end and submerge it in the container (filled 2/3 with water).
 - Place funnel over the cork and note the results.
 - Push the funnel to the bottom of the container and hold it there.
 - Ask the students what will happen when air is blown into the funnel.
 - Blow air into the end of plastic tubing.
 - Pinch tubing or hold thumb over end.
6. Discuss the following questions:
- What will happen to people in an underwater chamber if the air hose leaks or breaks?
 - If the air hose is sealed tightly, will the people suffocate or drown? Why?
 - How do divers get their fresh air?
 - What causes an object to sink or float?
 - Why does air keep the water out of the submarine?
 - What qualities would you put in a submarine?
 - What qualities of Turtle would you change?

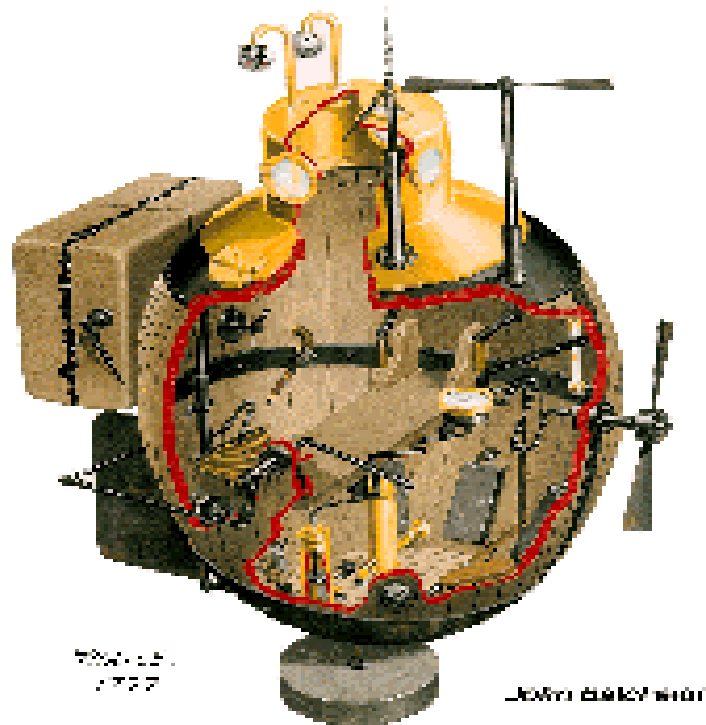
Modifications:

The teacher will enlarge the handout provided to the student with CP and supply him/her with larger tubing and corks to use during the exploration. The teacher will also provide the student with a thick highlighter to highlight important ideas rather than rephrasing them /writing them out. The teacher will provide him/her with notes summarizing class discussion and findings after class.

Assessment:

The teacher will observe the students' reading skills, identification of significant information, responses to the questions posed, and their collaboration.





Turtle: A Revolutionary Submarine
George Pararas-Carayannis

Actual text from

<http://www.geocities.com/Athens/Acropolis/4870/uniter.gif>:

(TO BE MODIFIED; SEE NEXT)

A CHAPTER of early American maritime history that has often been overlooked is that of early submarines and, in particular, the story of the first American submarine in the War of Independence. She was called Turtle and was designed by David Bushnell, who also developed the naval mine. Turtle's first engagement was also the first naval battle in history involving a submarine and took place in New York Harbor in 1776.

While pondering the idea of a vessel to transport and attach timed explosives to enemy warships, Bushnell considered using a submarine. There were, however, many engineering and design problems, which he had to solve with the limited technology of that time—problems such as building a watertight, pressure-proof hull, providing for vertical and horizontal propulsion, vertical stability, variable ballast, steering controls, and a weapons-delivery system, to name a few. Bushnell eventually solved these problems and introduced some innovations. For example, he was the first submarine designer to equip such a vessel with a snorkel breathing device and to use a two-bladed propeller for ship propulsion.

Although the submarine that Bushnell designed and built has been called many different names by historians, Turtle is the one most commonly used. Turtle had an

unusual appearance, resembling two upper tortoise shells of equal size, joined together. She measured 7 feet in depth from the bottom of her detachable keel to the top of her upper "shell," and was constructed of oak timbers, which were carefully shaped, joined together, and caulked at the joints. To insure watertightness, the vessel was bound with iron bands and entirely covered with pitch on the outside.

A LITTLE EGG-SHAPED wooden submarine held together by iron straps, Turtle bobbed like a cork in rough surface winds and seas even though she was lead weighted at the bottom. In this hand- and foot-operated contraption, one person could descend by operating a valve to admit water into the ballast tank and ascend with the use of pumps to eject the water.. Two flap-type air vents at the top opened when the hatch was clear of water and closed when it was as not. The air supply lasted only 30 minutes.

The submarine was capable of carrying one person who sat upright on a seat resembling that of a bicycle. Turtle's supply of air, in the submerged state, would last about 30 minutes. Located at the bottom of the submarine were a lead weight for ballast and an aperture with a valve to admit water for descent. Two brass forcing pumps served to eject the water from within for ascent. In front of the seated operator was a screw type oar for propelling the vessel forward or backward while, above him, there was a similar oar for ascending, descending, or maintenance of depth. The rudder, located behind the operator, was operated by foot. Furthermore, Turtle was equipped with a depth gauge, a compass to direct the course, and a ventilator to supply the vessel with fresh air at the surface.

Turtle was built at Saybrook, Connecticut, by David Bushnell and his brother, Ezra. After the vessel's completion in 1775, they tested her in the Connecticut River. Unfortunately, the tests indicated that Turtle was not ready to be used against the ships of the British fleet which were blockading Boston Harbor. Problems ranged from the failure of a ballast pump to the need for phosphorescent fox-fire to light the interior of the submarine.

In the spring of 1776, Turtle was ready to be transported by a sloop to Boston to fight the British fleet. By that time, however, the news was received that the British had broken off their blockade there and had moved their ships north to Halifax, Nova Scotia. Since there were still British warships in New York Harbor, Turtle was secretly transported there and stationed at The Battery in Manhattan, which was still under the control of America's General Putnam, with his army of about 9,000 men.

The waters of New York Harbor, between The Battery and Governor's Island, had complex patterns of currents and tides, presenting navigational problems completely different from those in the Connecticut River. Ezra, who operated Turtle, trained through June, 1776 until he and David were satisfied that he was familiar with the tidal conditions. General Putnam gave them permission to attack the 64-gun British warship Eagle at the first opportunity.

The opportunity presented itself on July 12 when Lord Howe, the commander of the British naval forces, anchored Eagle off Staten Island, but one adversity followed another. Ezra Bushnell became ill with fever and was unable to operate Turtle. Since General Putnam and George Washington agreed that the submarine should be tried against the enemy, Sergeant Ezra Lee of Old Lyme, Connecticut was selected from a

group of volunteers to operate her. For the next two months, Ezra Lee trained intensively.

Near midnight of September 6, the moon and the tide were favorable for attack. Turtle was towed by a small rowboat toward Eagle. Halfway to Staten Island, the rowboat stopped, and Lee entered Turtle and fastened the hatch over his head. For the first time in the history of naval warfare, a submarine was engaged in a war against an enemy ship.

After diligent pedaling, Lee brought Turtle on the side of Eagle. After taking some ballast, he submerged completely. When he thought he was under his target, he pumped out a small quantity of water from the ballast tank, until a jarring bump indicated he was beneath Eagle. For the next few minutes, Lee vainly tried to attach a torpedo to her hull. When the air in his little cabin was almost used up, Lee had no choice but to abandon his attempt and surface. After replenishing the air in the cabin and resting, he again descended underneath Eagle to try to affix a torpedo on her hull. He failed. A metal plate covered the area where he was trying to drill. Having consumed his air, he was forced to abandon his goal and surface.

An Inglorious Victory

Lee was exhausted, and the outgoing tide threatened to take the small craft out to sea. Desperately, he ejected all the ballast water and began pedaling with all his remaining strength. With the ballast water pumped out, one third of Turtle's hull stuck out of the water, making it clearly visible in daylight. In fact, as dawn broke, two British soldiers set out from Governor's Island in a patrol skiff to investigate the floating object. To divert the patrol and to lighten his craft, Lee released a time operated 250-pound (250 pounds = 113 Kilograms) torpedo and, picking up speed, reached The Battery and safety.

Soon thereafter, the torpedo exploded, shattering the silence of the early morning and arousing the British fleet. Quickly, the British raised their anchors and hurriedly moved their ships to the safer waters of lower New York Bay.

Although Turtle's original mission was unsuccessful, some historians claim that the venture was not a complete failure. They suggest that the incident drove the British ships to a new location from which they could not maintain an effective blockade of New York. Also, although Turtle inflicted no damage to any British vessel, an intangible psychological victory might have been attained, simply through her use as a weapon.

Turtle was equally unsuccessful in two subsequent efforts against Eagle and another British frigate. In both instances, the tides and tricky currents of New York Harbor frustrated the ventures. In an effort to move the submarine to areas where attacks could occur under more favorable conditions, Bushnell loaded Turtle aboard a fast sloop, hoping that the sloop could slip unnoticed past the British into Long Island Sound and back to Connecticut. A British frigate discovered the sloop, however, and, according to the British, sank her and her precious cargo. The Americans claimed that she was dismantled and moved inland to keep her out of enemy hands. Whatever the final fate of Turtle, as the first American war submarine, she came to a premature end and closed a not-so-glorious chapter of maritime history in the American Revolution.

REFERENCE

Pararas-Carayannis, George. Turtle: A Revolutionary Submarine. Sea Frontiers, Vol 22, No. 4, pp. 234, July-August, 1976.

<<http://www.geocities.com/Athens/Acropolis/4870/uniter.gif>>

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Excerpts from: Pararas-Carayannis, George. Turtle: A Revolutionary Submarine. Sea Frontiers, Vol 22, No. 4, pp. 234, July-August, 1976.

“TURTLE”

Part of American history that has often been overlooked involves submarines- especially the first American submarine in the War of Independence. She was called “Turtle” and was designed by David Bushnell, who also developed the naval mine. Turtle’s was first used in the first naval battle in history using a submarine. This battle took place in New York Harbor in 1776.

Bushnell thought about a using submarine to carry and attach timed explosives to enemy warships, but there were design problems that he had to solve with limited technology. At the time, he had trouble building a watertight, pressure-proof hull, steering controls, and other things. Bushnell solved these problems and came up with new ideas. He was the first to equip a submarine with a snorkel-breathing device.

Though it has been called many names, “Turtle” is the most common name for the submarine. It had an unusual appearance and looked like two upper turtle shells joined together. It was seven feet long from the top of the shell to the bottom of the sub. The top of the shell was made out of shaped oak timbers that were joined together. To make sure that “Turtle” was watertight, it was bound with iron bands and covered with a pitch on the outside.

“Turtle” bobbed like a cork in rough surface winds and seas even though it was lead weighted at the bottom. One person could control it with his or her hands and feet. The person could move the submarine under water by pulling a valve and move up by pumping water out of the submarine’s tank. Two air vents at the top opened when the hatch was clear of water and closed when it was as not. The air supply lasted only 30 minutes....

....In the spring of 1776, “Turtle” was secretly moved to New York Harbor, where there were British warships. The confusing tide patterns in the Harbor created navigating problems. Ezra Bushnell trained through June of 1776 until he felt ready to face the tides. He was given permission by General Putnam to attack the British warship....

....When Ezra Bushnell got sick, George Washington allowed Sgt. Lee trained to operate “Turtle” instead. On September 6, 1776, the tide allowed for attack. That night, for the first time, a submarine faced an enemy ship in war. When Lee was

close to the enemy ship and went under water, he tried to place a torpedo, or bomb, to it. He had trouble and almost used up the air in the submarine before coming up for air. After refilling the air, he tried again to move the submarine under water and put the weapon on the other ship. A metal plate covered the area he was trying to drill.

When the submarine resurfaced, British soldiers were sent to investigate the object in the water. To distract them, Lee sent off a torpedo and sped away. After the torpedo exploded, the British moved their ships to the safer waters of Lower New York Bay.