

NAVAL HISTORY STEM-H LESSON PLAN

LESSON PLAN: Freedom from Fossil Fuel, Operation Sea Orbit and the Nuclear Navy

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ACTIVITY ONE: Navy Nuclear Power and the Navy's World Cruises: The Great White Fleet, "Operation Sea Orbit" and the Great Green Fleet.

OBJECTIVE: Compare the Navy's Great White Fleet, Nuclear Task Force ONE, and the Great Green Fleet as the U.S. Navy strives to maintain freedom of the seas while becoming free from traditional fossil fuels.

MATERIALS: internet access to read/view and investigate your ideas:

<http://www.history.navy.mil/shiphist/e/cvn-65/1964.pdf> The 1964 history of USS *Enterprise*.

http://usnavymuseum.org/Ex1_NuclearPropulsion.asp The Nuclear Navy (1967) Operation Sea Orbit: the first three nuclear powered surface ships USS *Enterprise*, USS *Long Beach*, USS *Bainbridge* sail around the world together as Nuclear Task Force One.

<http://www.navalhistory.org/2012/08/01/operation-sea-orbit/> The Navy History and Heritage Command summary of Operation Sea Orbit.

<http://www.history.navy.mil/faqs/faq42-1.htm> The "Great White Fleet" sent around the world by President Theodore Roosevelt from 16 December 1907 to 22 February 1909 (14 months) consisted of sixteen new coal powered battleships of the Atlantic Fleet. The battleships were painted white except for gilded scrollwork on their bows.

<http://www.youtube.com/watch?v=j1nHT8fezbo> A short 5 minute student produced video using source documents, chronicling the 14 month voyage of the Great White Fleet.

<http://www.navy.mil/viewLdrVideo.asp?id=505&v=17305> The Secretary of the Navy discusses The Great Green Fleet demonstration, being done during the 2012 "Rim of the Pacific" exercise.

<http://www.navy.mil/viewVideo.asp?id=17226> USNS Henry J. Kaiser prepares for RIMPAC Great Green Fleet demonstration; the Great Green Fleet will sail in 2016.

INSTRUCTIONS:

For the past half century, one ship has served as the backbone of the U.S. Navy. On 25 November 2011, USS *Enterprise* (CVN 65) celebrated the 50th anniversary of her commissioning. *Enterprise* is the oldest aircraft carrier in the U.S. fleet, and was also the first nuclear-powered aircraft carrier in the world. From her involvement in the U.S. naval blockade during the Cuban Missile Crisis, to launching air strikes against

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the Viet Cong during the Vietnam War, to her support in Operations Enduring Freedom and Iraqi Freedom, *Enterprise* has lived up to her motto of "We are Legend." *Enterprise* is on her final deployment. From there, the "Big E" will begin the deactivation process in November 2012 with a decommissioning date of 2015.

To paraphrase Secretary of the Navy John B. Connally Jr. at the Big E's commissioning ceremony, **she has reigned a long, long time as queen of the seas.**

1. Review the 1964 source document, the annual ship history report from the "Big E" above, plus view the short history of Task Force ONE in "Operation Sea Orbit" (video and naval history blog above).
 - a. What is the source of energy, propelling the ships of Task Force ONE? Nuclear energy, from the controlled fission of uranium in the core of the nuclear reactors of the three ships: USS *Enterprise*, USS *Long Beach* and USS *Bainbridge*. Fission produces heat within the reactor core, which is transferred to the primary coolant (fresh water flowing through the core) as it flows through the core flow channels. This hot coolant then transfers heat to a secondary system in the steam generators. The steam flows to electrical turbine generators and propulsion turbines, providing mechanical energy to produce electrical energy and also to spin the ships' propellers. See the nuclear propulsion video in the Cold War Gallery website (http://www.usnavymuseum.org/Ex2_Power.asp) and from the Cold War Gallery You Tube Channel at http://www.youtube.com/watch?v=6wWhxbgSrTQ&feature=player_embedded.
 - b. What limits a nuclear ship's endurance (surface ship or submarine)? The amount of food and supplies the ship can carry. Operation Sea Orbit was the idea of Adm. John S. McCain, Jr., the father of Senator John McCain. Adm. McCain was not a navy nuclear officer, but he recognized the advantages offered by nuclear energy. He used Operation Sea Orbit to demonstrate to the world that nuclear power was safe, reliable, and full of potential. The USS *Enterprise* is a testament to the durability, safety and reliability of nuclear power plants. The ship has eight Westinghouse pressurized water reactors that provide all the energy required for the equivalent of a small city generating electricity, launching aircraft, distilling water, (submarines also make their own oxygen), and driving that massive ship through the water at speeds in excess of 30 knots. The reactors have operated day in and day out for over fifty years with five thousand sailors living and working within a few hundred feet of the reactors all the time.
 - c. When USS *Seawolf* (SSN 575) joined the *Enterprise*, *Long Beach*, and *Bainbridge* in a May 1964 exercise, what "first" was established in naval operations? It was the first time a nuclear submarine was a member of a carrier strike force.

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- d. What significance does USS *Enterprise's* operation of 8 nuclear reactors for five decades have for future energy decisions?

It clearly demonstrates the safety and reliability of nuclear propulsion. The nuclear industry enjoys the benefits of a fantastic amount of accumulated knowledge and wisdom about how to design, build, and operate nuclear plants safely and reliably. In fact, we're now in the third and fourth generation of nuclear power scientists, engineers, operators, and technicians who are benefiting from thousands of reactor-years of operating experience all the way back to long before Operation Sea Orbit, a perfect example of the same basic technology going strong well past 50 years – safely, reliably, and without contributing to air pollution.

- e. Why do you think some people are opposed to nuclear energy, in particular Japanese people? (Individual ideas will vary). Japan is the only country to date, on which a nuclear weapon has been used in wartime, resulting in hundreds of thousands of deaths and casualties.

NOTE: As related to the U.S. Navy at the forefront of nuclear propulsion, Japan's allergy to nuclear energy was revealed in heated student demonstrations sparked by the visit of the first nuclear-powered surface ship, the USS *Enterprise*, to Japan in January 1968. Although the nuclear issue remained contentious, the Japanese knew that their security depended on the United States, including its nuclear capabilities. With Communist China now a nuclear power and a menacing neighbor, and with instability in Korea, particularly in 1968, and the heightened conflict in Southeast Asia, Japan grappled with the realities of a nuclear world, even as it sought to maintain its pacifism.

2. Review the short history of the Great White Fleet in the link above, and the student video produced from Navy source documents, also above.

- a. Prior to coal, what were the main sources of energy for ship propulsion? Prior to coal energy (making steam in boilers to turn paddle wheels or turn propellers) ships of sail were the predominant seagoing vessels throughout history. The tides, currents, and manual power (rowing & paddling) also propelled vessels. See our oldest commissioned Navy ship "Old Ironsides", at <http://www.history.navy.mil/ussconstitution/index.html> . It is the oldest commissioned navy vessel afloat in the world today.
- b. How does the voyage of the Great White Fleet compare to the voyage of Task Force ONE in Operation Sea Orbit?

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	Great White Fleet	Sea Orbit
Number of Ships	16 Battleships & Cruisers	One each Aircraft Carrier, Cruiser and Frigate
Flag Ship	USS <i>Connecticut</i> (BB-18)	USS <i>Enterprise</i> (CVAN-65)
Officer In Charge	Rear Admiral Robley D. Evans Rear Admiral Charles S. Sperry (after San Francisco)	Rear Admiral Bernard M. Streaan
Total Crew Size	14,000	6,075
Distance Sailed	43,000 nm	30,500 nm
Time to Complete	14 months	64 days (57 underway days)
Idea Of:	President Theodore Roosevelt	Admiral John S. McCain Jr.
Source of Energy	Coal	Nuclear
Purpose:	Diplomatic Mission to Pacific Impress Japan Show the U.S. Flag Show Americans our Navy's preparedness, strength, range	Nuclear Power for Peace Test capability without replenishment Demo mobility, flexibility, strength Show the flag in remote areas Familiarize Navy folks w/remote areas Demo readiness to fight far from home Enhance military/political image
Starting Point	Norfolk, VA 16 Dec 1907	Gibraltar, 31 July 1964
Ending Point	Norfolk, VA 22 Feb 1909	Norfolk, VA 3 Oct 1964
Port Visits	Trinidad, Rio de Janeiro, Sandy Point Chile, Callao Peru, Mexico, Honolulu, Auckland NZ,	20 "Underway Visits" of people to Big E plus Rio de Janeiro, Sydney, Pakistan

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Sydney, Melbourne, Albany AUS,
Manila, Yokohama, Columbo,
Suez, Constantinople, Messina,
Naples, Gibraltar.

Support Ships	Tender, Supply, Refrigerator, Hospital (<i>Arethusa, Celtic, Glacier,</i> <i>Panther, Culgoa, Yankton, Relief</i>) and many U.S. & British auxiliaries for coal and supplies	None
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- c. Between the Great White Fleet's 14 month cruise around the world on coal power and Task Force ONE's cruise on nuclear power, what was the main type of fuel used for ship and submarine propulsion? **OIL**
- d. Other than our nuclear powered submarines and aircraft carriers today, what type of propulsion do you think is predominant in today's Navy? Why? **Gas turbines, operating from a variety of fuels with low toxic emissions. They are very efficient propulsion systems, very responsive, and high power similar to aircraft engines. Current research has produced gas turbines with nearly 60% thermal efficiency.**

The first U.S. gas-turbine powered ship was the U.S. Coast Guard's *Point Thatcher*, a cutter commissioned in 1961 that was powered by two 750 kW (1,000 shp) turbines utilizing controllable pitch propellers.^[40] The larger *Hamilton*-class High Endurance Cutters, was the first class of larger cutters to utilize gas turbines, the first of which (USCGC *Hamilton*) was commissioned in 1967. Since then, they have powered the U.S. Navy's *Perry*-class frigates, *Spruance*-class and *Arleigh Burke*-class destroyers, and *Ticonderoga*-class guided missile cruisers. USS *Makin Island*, a modified *Wasp*-class amphibious assault ship, is to be the Navy's first amphibious assault ship powered by gas turbines.

Advantages of gas turbine engines:

- Very high power-to-weight ratio, compared to reciprocating engines;
- High operating speeds;

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- Smaller than most reciprocating engines of the same power rating.
 - Moves in one direction only, with far less vibration than a reciprocating engine.
 - Fewer moving parts than reciprocating engines.
 - Greater reliability, particularly in applications where sustained high power output is required
 - Waste heat is dissipated almost entirely in the exhaust. This results in a high temperature exhaust stream that is very usable for boiling water in a combined cycle, or for cogeneration.
 - Low operating pressures, and low lubricating oil cost and consumption.
 - Can run on a wide variety of fuels.
 - Very low toxic emissions of carbon monoxide and hydrocarbons due to excess air, complete combustion and no "quench" of the flame on cold surfaces.
3. What is the Navy's Green Hornet and the Great Green Fleet? View the internet for clues, and see the last two video links above. The Green Hornet is a modified Navy Hornet (F/A-18C) using advanced biofuel blends and certain energy efficient technologies in an operational setting. The Green Fleet incorporates five aggressive energy goals to reduce the Navy's consumption of energy, decrease its reliance on foreign sources of oil, and significantly increase its use of alternative energy. The purpose of these energy goals is to improve our combat capability and to increase our energy security by addressing a significant military vulnerability: dependence on foreign oil. For more details see <http://greenfleet.dodlive.mil/energy/great-green-fleet/> and http://greenfleet.dodlive.mil/files/2012/09/20120906_GreatGreenFleetFactSheet.pdf and http://greenfleet.dodlive.mil/files/2012/06/20120620_SECNAVEnergyGoals.pdf and <http://greenfleet.dodlive.mil/files/2012/06/20120610-N45-Biofuel-FactSheet.pdf> and http://greenfleet.dodlive.mil/files/2012/06/ONR-Innovation-Newsletter_Spring2012_Vol.8.pdf.
- a. How does the **Green Navy** compare to today's Navy fleet of nuclear powered and gas turbine ships? The Green Navy includes the efficient and non-carbon-polluting nuclear powered ships, plus the gas turbine ships and aircraft using advanced biofuel blends and certain energy efficient technologies in an operational setting.
 - b. When will the Navy's Great Green Fleet "set sail"? **2016**
 - c. How do you think the Great Green Fleet will compare to the Great White Fleet? **Answers will vary.**
4. What do you think happens to a ship when it reaches its end of useful life? Sometimes the ships are stripped, made environmentally "safe" and then sunk as a target or to become an underwater reef or haven for sea life. More frequently (and for all nuclear powered ships), they are defueled and recycled for their valuable materials. All methods are carefully monitored and environmentally friendly.

For example, USS *Long Beach* (CGN-9) from Operation Sea Orbit: The post-World War II U.S. Navy nuclear-powered guided missile cruiser is set to be scrapped starting August 2012, by the Defense Department. Defense Department contractor Government Liquidation LLC on July 12

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auctioned the *USS Long Beach* for its scrap assets. The ship is being sold for its non-hazardous and demilitarized base materials and includes 7.35million pounds of steel, aluminum and copper wiring, along with galley equipment, fixtures and furnishings like tables, chairs, lockers and bunks. A three-year term contract at Puget Sound Naval Shipyard was awarded to the winning bidder, with the price per pound adjusted every month beginning with the first full month after the start of the contract. The contract consists of heavy steel, light steel and ship hull structural sections with attachments. Attachments can include nonferrous alloys such as aluminum, stainless steel, copper, cupronickel, and brass and bronze, among others. *USS Long Beach* was commissioned in 1961 as the first nuclear-powered surface vessel. In1964, it joined two other nuclear warships for Operation Sea Orbit, the first all-nuclear cruise around the world. After the Vietnam War, the ship was used in the western Pacific and Indian Oceans. Decommissioned in 1995, the superstructure of the *USS Long Beach* was removed and the reactors were defueled. The ship was later towed through the Panama Canal to Puget Sound Naval Shipyard, where it is now being recycling.