

Project Starter

Powering Ocean Vessels

GRADE RANGE

Elementary, primarily grades 3–5

DURATION

Two 50–60-minute class sessions

Overview

Students will investigate the viability of nuclear energy in powering ocean vehicles. After exploring how nuclear energy benefits submarines, students will research another water vessel and then determine if this boat type may also be a good candidate for nuclear power. They will present their findings to the class and ultimately vote on the type(s) of water vehicles that they recommend for nuclear power.

Essential Question

How can nuclear energy benefit water vessels?

Instructional Note

Students will benefit most from this Project Starter if they have already completed **Activity 1: Amazing Atoms** and **Activity 2: Energy Decisions**.

Instructional Delivery Method

This project starter is presented as an in-classroom experience, but it can also be easily completed at home. Feel free to make modifications based on your teaching environment. For example:

- The initial partner discussion and **Nuclear Submarine Handout** may be completed independently.
- Students in each pair may complete their **Boat Research Handout** independently or by using a shared document, and then collaborate virtually to prepare for their presentation.
- Presentations can be held virtually.

NGSS Standards

<p>Next Generation Science Standards</p> <p>Engineering Design</p> <ul style="list-style-type: none"> 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. <p>Energy:</p> <ul style="list-style-type: none"> 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 	<p>ITEEA Standards for Technological Literacy</p> <ul style="list-style-type: none"> Standard 5: Students will develop an understanding of the effects of technology on the environment. In order to discern the effects of technology on the environment, students should learn that: <ul style="list-style-type: none"> C. The use of technology effects the environment in good and bad ways.
--	---

Materials

- Device with Internet access and projection capabilities, one for the teacher
- Devices with Internet access, at least enough for half the class
- **Submarine Image**, to share or project
- [How Do Submarines Work?](#) video (0:42 – 3:52)
- **Nuclear Submarine Handout**, enough for half the class
- Scissors, for the class to share
- Glue, glue sticks, or tape, for the class to share
- **Research Handout**, enough for half the class
- Devices with Internet access, enough for at least half the class
- Presentation Notes, one per student

Procedure

1. Project or share the **Submarine Image**. Encourage students to turn to a partner and discuss: What do I already know about submarines? Once students discuss their answers, invite them to share.
2. Deepen students' understanding of submarines by playing the [How Do Submarines Work?](#) video (0:42 – 3:52). Ask students to listen specifically for information on how submarines float and sink.
3. When the video is complete, explain that power is needed to operate a submarine's ballast tanks, produce air to breathe and to power all of the other equipment on board! Tell the class that some submarines are powered by fossil fuels and some submarines are powered by nuclear power. Today they will be investigating if nuclear energy would be beneficial for other water vessels, too!

Create

1. Explain that in order to determine if nuclear power is a good power option for other water vessels, it makes sense to look at examples that have already used them successfully. Tell the class that the U.S. Navy has over 80 nuclear-powered ocean vessels. Show students what a few different Navy vessels look like. As you do, explain that the Navy's nuclear-powered vessels help keep the nation and its citizens safe. The majority of its nuclear vessels (over 70 of them!) are submarines like this [one](#).
2. Divide students into pairs and distribute one **Nuclear Submarine Handout** to each pair. Read the handout's directions aloud and then encourage pairs to begin.
3. When students have finished, review and discuss their Pro/Con Charts as a class. Ask the class to consider: Based on your chart, does it make sense that nuclear power is used for many submarines? Why or why not?
4. Optional: If you think your students would benefit from observing a diagram of a nuclear reactor, you may:
 - Show what the [inside of a submarine](#) may look like. Point out the nuclear reactor compartment and explain that this is where nuclear power is created!
 - Then display this [nuclear reactor](#). Explain that the nuclear reactor compartment in a submarine would contain a nuclear reactor that looks similar to this. Interesting and/or relevant parts to point out include:
 - The control rods can be pulled out or pushed in to quicken, slow, or stop the power.
 - The containment vessel is an airtight container designed to protect the outside environment from radioactivity. The containment vessel and shield are all made from very strong materials.
 - The core is where the uranium atoms split and create power!
 - The coolant, which helps remove heat from the core, is ocean water.

Connect

1. Once students understand some of the pros and cons of nuclear power, it's time for them to investigate whether other water vehicles would also be good candidates for nuclear power.
2. Distribute one **Research Handout** to each pair and review the directions. Explain that a couple of water vessels on the list already *do* use nuclear power. If they learn during their research that their water vessel already uses nuclear power, they should instead decide if it makes sense for it to continue using nuclear power.

Note: The research websites on the handout are listed approximately in order of reading difficulty, from easiest to hardest. Encourage students at lower reading levels to consider one of the first two sources. The last source will be particularly good for the strongest readers. Try to ensure that all or most water vessels are being researched.

3. When students have completed their research, it's time to apply what they learned! Distribute a **Water Power Rubric** to each pair and review it together. Be sure students understand what is expected of them before they begin working on their presentations.

Note:

- If you would like students to incorporate technology into their presentation, explain this to them now.
- You may also challenge students to create a 3D model of their water vessel using materials available in the classroom or their home. This could help them and their peers better understand their water vessel.

4. When groups are ready to present, distribute one **Presentation Notes Handout** to each student. Explain that in the U.S. government, the Department of Transportation's Maritime Administration is in charge of boats, ships, and water vehicles. Encourage students to pretend they are members of the Maritime Administration and they are in charge of deciding which type(s) of water vessels should consider using nuclear power. To make an informed decision, students should use this handout to take notes on their peers' presentations.
5. When the presentations are complete, lead them in a vote to determine which water vessel type would benefit from nuclear power, based on the information they just learned.

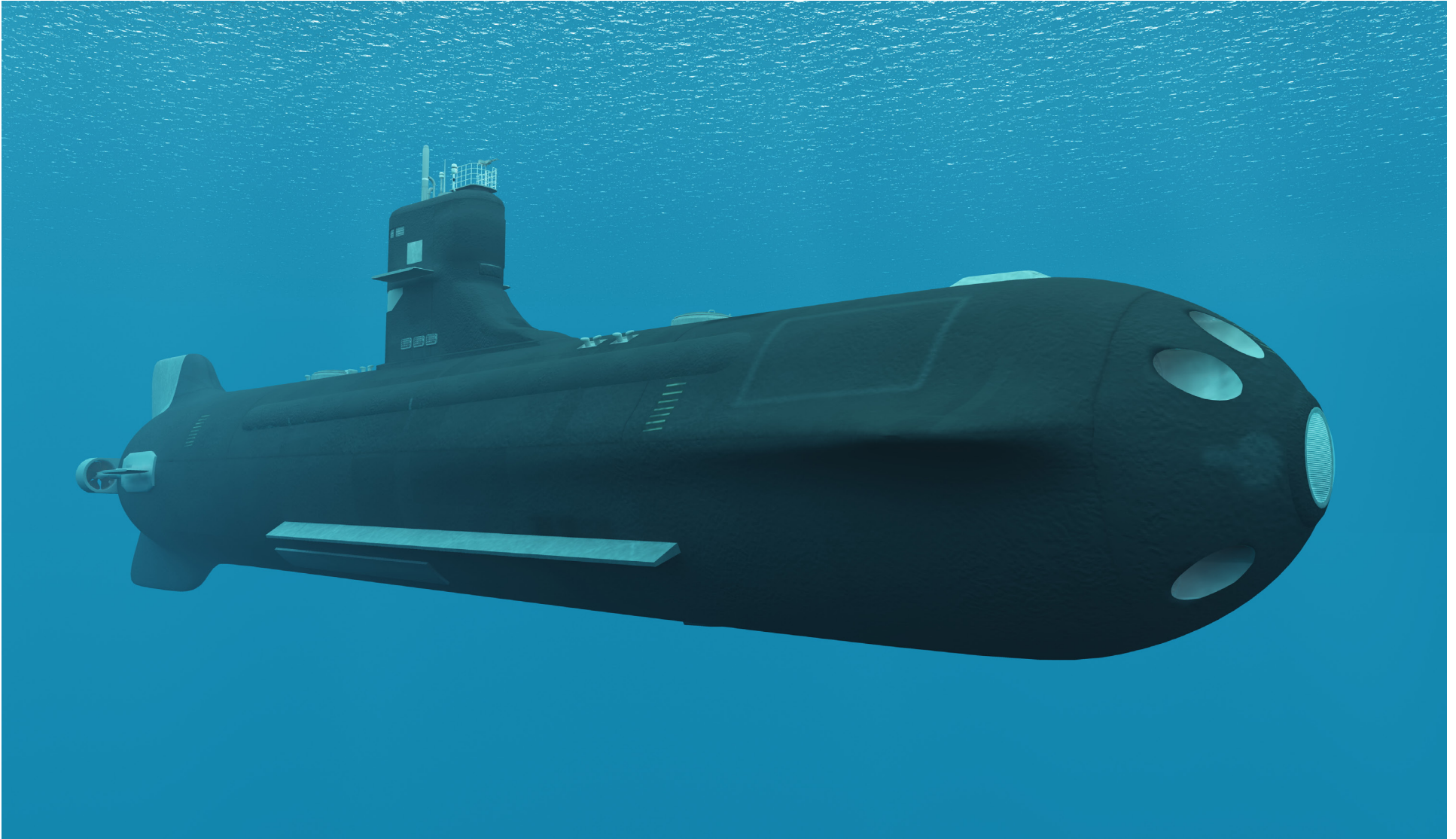
For instance:

- "Those in favor of cruise ships using nuclear power, raise your hands."
- "Those against cruise ships using nuclear power, raise your hands."

Keep a tally on the board as students vote. Then thank the class for their hard work and announce which water vessels the Maritime Administration has decided would benefit from nuclear power!

Optional Extension:

You may also explore additional ways uranium, carbon, and other elements can benefit the ocean. For instance, students may be interested to learn how radioactive dating can help scientists determine the age of underwater fossils, coral, and even shipwrecks. Students can apply what they learn from [this video](#) to consider what could be investigated on the ocean floor!




Nuclear Submarine Handout

Directions:

- 1. Cut out the squares below. Each square explains how nuclear energy affects submarines.
- 2. Read each square and decide if it is a pro (positive detail) of nuclear-powered submarines or a con (negative detail).
- 3. Place it in the pro or con column in the chart below.

Pros (+)	Cons (-)



Runs for years without stopping. (Other kinds of submarines must come up every few days to refuel.)	Is strong and very powerful. It can move larger crews and more equipment <i>and</i> move more quickly than other kinds of submarines.
Has room on board for another type of back-up power, if needed.	Releases no greenhouse gases, so it is friendly to the environment.
When uranium atoms create power, they also create radiation. Radiation can be harmful to humans. Nuclear submarines can safely store radiation, so it does not hurt human or animal life.	Its reactor, which is where the nuclear power is created, needs to be cooled down by the ocean water. When the submarine moves forward, it can leave this warm water behind. If the submarine is trying to be secretive, this may make it easier for others to tell where the submarine has been!

Research Handout

Directions:


1. Select one water vessel from the list below.
2. Read about your water vessel using the website provided.
3. Answer the research questions. If the website does not answer the question, try to *infer* (or make an educated guess) using the website's text and pictures.

Water Vessel Options:

- Cruise ships: kids.kiddle.co/Cruise_ship
- Yacht: kids.kiddle.co/Yacht
- Aircraft carrier: kids.kiddle.co/Aircraft_carrier
- Ice breaker: kids.kiddle.co/Icebreaker
- Container or cargo ships: kids.kiddle.co/Container_ship

Research Questions:

1. What does your water vessel look like? What is it used for?

_____ 
2. Does the article mention if your water vessel has ever used nuclear power before?

3. Would it be helpful if your water vessel could go long distances without needing more fuel? Why or why not?

4. Does your water vessel need to be powerful and strong? Why or why not?

5. When large and powerful water vessels use fossil fuels (like diesel fuel) for power, they can create a lot of pollution. Do you think your water vessel would create a lot of pollution if it used fossil fuels? Why or why not?

6. What else can you learn from the text or pictures that makes you think your water vessel may be a good or bad fit for nuclear power?

Water Power Rubric

Could nuclear power be beneficial (or good) for your type of water vessel?

Create a presentation that:

- Teaches the audience about your type of water vessel and uses a visual to help your audience understand.
- Clearly states if nuclear power would be (or is) good for your type of water vessel and explains at least three reasons why.
- Gives one counterargument (or reason against your argument) and explains why your side is still better.

Content Criteria:

	3	2	1
Background	Helps your audience understand your water vessel by explaining several key details and sharing a visual that supports your description.	Briefly explains what your water vessel is used for and shares a visual.	Either explains what your water vessel is used for <i>or</i> shares a visual.
Claim	Clearly states if nuclear power should be considered for your water vessel and gives three clear reasons.	States if nuclear power should be considered for your water vessel and gives three somewhat clear reasons or two clear reasons.	States if nuclear power should be considered for your water vessel but only provides one or two unclear reasons why.
Counterclaim	Provides one strong reason against your argument, but clearly explains why your argument is still better.	Provides one strong reason against your argument.	Provides one weak or unclear reason against your argument.

Presentation Notes

Directions: As your peers present, take notes in the chart below. You will use these notes to decide whether each type of water vessel should use nuclear power!

Water Vessel Type	Should it use nuclear power?	Why or why not? Take notes on the most convincing reasons!
Cruise Ships	Yes No	
Yacht	Yes No	
Aircraft Carrier	Yes No	
Icebreaker	Yes No	
Container or Cargo Ships	Yes No	