



Arctic Preparation

Setting the Stage

Fridtjof Nansen knew that it would be impossible to fulfill his goal of reaching the North Pole without a proper vessel, one that could withstand freezing temperatures and extensive sea ice. To that end, Nansen and architect Colin Archer designed a ship (the *Fram*) such that each structure served a specific function. In this lesson, students will tour the *Fram* via Google Expeditions to identify and describe the *Fram's* unique structures and functions. Students will then compare and contrast Arctic vessels of the past (*Fram*) and present (*Polarstern*).

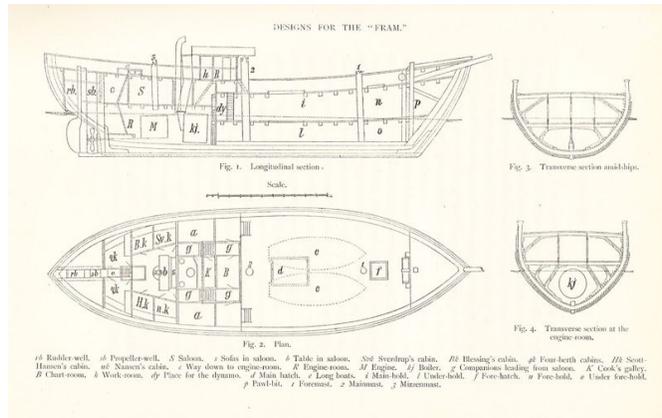


Photo Credit: Public Domain

Lesson Overview

- **Part 1 – (15 minutes) Arctic Preparation - Designing an Arctic Vessel**
Students will be provided with background information and a warm up to engage with the Fram expedition's planning and preparation.
- **Part 2 – (35 minutes) The Fram: Structure and Function**
Students will view the *Fram* through a Google Expedition to identify and describe the structure and function of the ship.
- **Part 3 – (25 minutes) Modern Icebreakers**
Students watch a video to learn more about the structure and function of modern icebreakers before engaging with a virtual tour of the *Polarstern*.
- **Part 4 – (15 minutes) Exit Ticket/Update Summary Table**
Students will update the summary table to include information about both the *Fram* and MOSAiC expeditions preparations.



Instructional Overview	
Grade Level	Middle/High School
Instructional Time	90 minutes
Standards Alignment	<p>NGSS: <u>Science is a Human Endeavor</u>:</p> <ul style="list-style-type: none"> Advances in technology influence the progress of science and science has influenced advances in technology <p>NGSS Science and Engineering Practices:</p> <ul style="list-style-type: none"> Asking questions and defining problems Constructing explanations and designing solutions <p>NGSS Crosscutting Concepts:</p> <ul style="list-style-type: none"> Structure and Function
Unit Driving Question	<ul style="list-style-type: none"> How have scientific questions, methods, technologies, and our knowledge of the Arctic changed over time?
Driving Question(s) For This Lesson	<ul style="list-style-type: none"> How are past and present Arctic ship designs similar? Different?
Learning Goals	<ul style="list-style-type: none"> Identify and describe structures and functions characteristic of Arctic vessels, <i>Fram</i> and <i>Polarstern</i>
Materials	<ul style="list-style-type: none"> <input type="checkbox"/> Arctic Preparation PPT <input type="checkbox"/> Arctic Preparation student worksheet (1 per student) <input type="checkbox"/> Exit Ticket Rubric <input type="checkbox"/> Answer Key <input type="checkbox"/> Icebreaker video <input type="checkbox"/> Virtual tour of Polarstern <input type="checkbox"/> “Explore the Arctic Aboard the Fram” Google Expedition <input type="checkbox"/> Computer/ipad for Google Expedition (1 per student) <input type="checkbox"/> Summary Table - <i>if using entire unit</i> (large butcher paper or digital copy, 1 per class) <p>Optional:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Follow these instructions to view the “Explore the Arctic Aboard the Fram” Google Expedition with Iphone/Android phone + Google Cardboard glasses. <input type="checkbox"/> Video interview with <i>Polarstern</i> baker, Maren Zahn <input type="checkbox"/> Video interview with <i>Polarstern</i> Captain, Stefan Schwarze <input type="checkbox"/> Text interview with MOSAIC polar bear guard, Michael Ginzburg <input type="checkbox"/> MOSAIC preparation story from National Geographic <input type="checkbox"/> MOSAIC Preparation Video <input type="checkbox"/> “Design and Build a Polar Ice Drifter” lesson
Material Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Print student worksheets <input type="checkbox"/> Cue and test web links



	<ul style="list-style-type: none"> <input type="checkbox"/> Review presenter notes within the Arctic Preparation PPT <input type="checkbox"/> Reserve computer lab or ipad cart <input type="checkbox"/> Display summary table - <i>if using entire unit</i>
Vocabulary	<p><u>Bow</u>: Front of a ship <u>Hull</u>: Main body of a ship <u>Engine</u>: Machine that converts energy into motion <u>Icebreaker</u>: Ship that moves through ice-covered waters</p>

Part 1 - Arctic Preparation - Designing an Arctic Vessel (15 minutes)

Driving Question: How are past and present Arctic ship designs similar? Different?

Refer to Part 1 slides included in the [Arctic Preparation PPT](#). See PPT presenter notes for additional information.

1. Read the excerpt from Fram expedition leader Fridtjof Nansen's diary (See PPT).
2. Students complete the warm up prompt, "Imagine you were Fridtjof Nansen, leader of the Fram expedition. What factors must you consider when designing a ship that must first sail to the Arctic, and then drift with ocean currents, frozen in sea ice?"
 - a. Students share responses with the class
3. Display the initial design of the *Fram* (drawn by Fridtjof Nansen and ship architect Colin Archer) to introduce students to different parts of a ship (See PPT).

Part 2 - The *Fram*: Structure and Function (35 minutes)

Driving Question: How are past and present Arctic ship designs similar? Different?

Refer to Part 2 slides included in the [Arctic Preparation PPT](#). See PPT presenter notes for additional information.

1. Students use the "[Explore the Arctic Aboard the Fram](#)" [Google Expedition](#) to learn more about the ship, *Fram*. Students will only use the "Structure and Function" scene within the Google Expedition.
 - a. Students will gather information from the "Structure and Function" scene to complete the structure and function data table.
 - b. Review structure and function data table as a whole class
 - c. Discussion Prompt:
 - i. In what ways do you think a modern-day icebreaker might be different from the *Fram*?



Part 3 - Modern Icebreakers (25 minutes)

Driving Question: How are past and present Arctic ship designs similar? Different?

Refer to Part 3 slides included in the [Arctic Preparation PPT](#). See PPT presenter notes for additional information.

1. Watch the [Icebreaker video](#) to learn how an icebreaker works.
 - d. Students complete the icebreaker structure and function table while watching the video.
 - e. Review the icebreaker structure and function table as a whole class.
 - f. Create a public record of student-generated icebreaker questions.
 - i. Optional - Ask students to research one or more of the questions on their own and share their findings with the class.
2. Students explore the *Polarstern* with this [virtual tour](#).

Part 4 - Exit Ticket/Update Summary Table (15 minutes)

Driving Question: How are past and present Arctic ship designs similar? Different?

Refer to Part 3 slides included in the [Arctic Preparation PPT](#). See PPT presenter notes for additional information.

1. Exit Ticket - Students provide a short explanation and create an annotated sketch to answer the question, "In what way(s) are modern-day icebreakers different from older expedition ships like the *Fram*?"
 - a. Project and describe the [Exit Ticket Rubric](#) to the class before they begin the assessment as this is what you will use to grade their exit tickets.
2. Update Summary Table (**if using entire unit**) - Gather student ideas to update MOSAIC and Fram Preparation boxes in the summary table (see [Answer Key](#)).



Optional Extension Activities

Optional Extension: Design an Icebreaker

- Once students are familiar with the structural elements of Arctic vessels, have students design and build their own! Our partners at Oregon State University have put together [this 2-day lesson](#) in which students will design a drifter that meets criteria similar to current sea ice drifters that sense various aspects of the polar environment; and go through the engineering and design process to design, build, test and improve their sea ice sensor.

Optional Extension: Meet the *Polarstern* crew

- Watch the [MOSAiC Preparation video](#).
 - Discussion Prompt:
 - What kind of crewmembers do you think are aboard the *Polarstern*?
- Meet the *Polarstern* Crew - Introduce students to different members of the crew aboard the *Polarstern*.
 - Optional: Watch/read interviews with various crew members.
 - Video interview with baker, [Maren Zahn](#)
 - Video interview with *Polarstern* Captain, [Stefan Schwarze](#)
 - Text interview with MOSAiC polar bear guard, [Michael Ginzburg](#)
 -
- Read [National Geographic's](#) story about scientists and crew preparing for the MOSAiC expedition