Lesson Plan: Tug Boat

Summary

This lesson explores how tugboats evolved from muscle-powered ships using warping and kedging to modern diesel and electric vessels capable of moving massive freighters with precision. Students learn about the role of tugboats in maritime history, the concept of bollard pull as a measure of strength, and the many types of tugboats used in ports and harbors today.
https://www.youtube.com/live/aN-JRiq3wvc?si=dvYFNVLCtsfs_JyX

Objective

Students will describe how early sailors used warping and kedging to move ships, explain what bollard pull measures, and identify modern tugboat types and their uses in maritime industries.

Standards

- NGSS: MS-ETS1-2 – Evaluate competing design solutions using a systematic process.
- CCSS.ELA-LITERACY.RST.6-8.1 – Cite specific textual evidence to support analysis of science and technical texts.
- C3.D2.His.2.6-8 – Classify and analyze patterns of change and continuity in history.

Materials

- 9 Fun Facts: Tug Boat
- Worksheet: Tug Boat
- Optional: harbor and tugboat images, white board, paper, markers

Introduction

Ask students how a large ship moves in and out of port when there is no wind or when the ship's own engines are shut down. Introduce the historical problem of maneuvering large vessels safely, and discuss how sailors once relied on ropes, tides, and teamwork before the first steam towboats appeared.

Activity

1. Read and discuss the 9 Fun Facts as a group.
2. Have students identify the differences between warping, kedging, and powered towing.
3. Talk about the term "bollard pull" as the measure of how strong a tug is when pulling at full power.
4. Compare the roles of old towboats, diesel tugs, and electric or hybrid tugs.
5. Discuss how tugboats serve in multiple capacities such as fire, rescue, and icebreaking.

Assessment

Students demonstrate understanding through class discussion and written responses explaining how tugboats evolved, what bollard pull measures, and why these vessels remain essential to maritime operations.

Rubric

Criteria	Excellent (4)	Proficient (3)	Developing (2)
Understanding of early methods	Clearly explains warping and kedging	General understanding with minor gaps	Limited explanation
Comprehension of bollard pull	Accurately describes what bollard pull measures	Mostly correct description	Partial understanding
Recognition of tugboat types and uses	Identifies several types and their functions	Identifies some correctly	Identifies one or two
Engagement and participation	Active and thoughtful participation	Participates when prompted	Limited participation

9 Fun Facts

1. Warping and kedging: Sailors rowed an anchor out ahead of the ship in a small boat, dropped it, and then hauled the ship toward it using the capstan and ropes. This "kedging" method was slow but precise, like winching a mountain up a hill. Warping used a similar principle, pulling the ship along from fixed points such as bollards or posts onshore.
https://sailmagazine.com/cruising/the-lost-art-of-kedging-how-to-set-a-kedge-anchor/

2. Capstans and dock labor: Once close to shore, capstans, massive hand-cranked drums, helped pull ships into position with thick hemp lines. Whole teams of dockworkers, often singing or chanting to keep rhythm, powered these things like a giant merry-go-round of muscle and sweat.
https://www.britannica.com/technology/capstan

3. Use of tides and current: Experienced captains timed entries with the tide. They used tidal flow to nudge their ships into or out of port, steering with the rudder and sails as best they could.
https://www.boatingeducation.org.nz/news/tidalflow/

4. Towboats (before tugs): Early steam-powered boats, called "towboats," appeared in the late 1700s. They were coal-fired and often side-wheelers or paddle-wheelers. Before those, small rowing boats or sailing boats would tow larger vessels in and out of harbor using long ropes.
https://www.hrmm.org/history-blog/the-towboats

5. Modern diesel engines and bollard pull: Diesel power took over in the mid-20th century, giving tugs more torque and reliability than their steam ancestors. Tug performance is measured in *bollard pull*, the static force they can exert when tied to a fixed point and pulling at full power. A typical harbor tug can produce 30 to 80 tons of bollard pull, while ocean-going monsters can exceed 200 tons, enough to haul massive oil tankers or reposition stranded ships.
https://www.marine-pilots.com/articles/687253-what-is-tugs-bollard-pull-and-how-it-is-calculated

6. Types of tugs: The industry now includes deep-sea rescue tugs, harbor assist tugs, river pushers, offshore anchor-handling tugs, icebreakers, and tractor tugs equipped with azimuth thrusters that can spin a ship in place. Each type specializes in power, maneuverability, or endurance depending on its environment.
https://dexteroffshore.com/what-are-tugboats/

7. Fire and rescue tugs: Many modern harbors rely on multipurpose tugs fitted with firefighting monitors (water cannons), foam systems, and rescue equipment. These tugs can tackle shipboard fires, assist in oil spills, or evacuate crews when disaster strikes.
https://ral.ca/designs/fire-fighting-tugs/

8. Electric and hybrid tugs: Recent advances have produced battery-electric and hybrid tugboats designed to reduce emissions and fuel costs in busy ports. The first fully electric tug, *Sparky*, launched in New Zealand in 2022, marked a major step toward cleaner maritime operations.
https://breakbulk.com/articles/damen-delivers-first-all-electric-tug

9. Workforce of the tug industry: Globally, the tug and towboat sector employs tens of thousands of people. In the United States alone, roughly 35,000 mariners, mechanics, and dockside workers are directly involved in tug operations, with many more in manufacturing, logistics, and support roles. Worldwide estimates top 100,000 when factoring in port and offshore work.
https://www.americanwaterways.com/initiatives/jobs-economy/industry-facts

Worksheet

Name: _____ Date: _____

Review Questions

1. What are the two manual methods sailors once used to move ships before engines?

2. What role did capstans play in early harbor work?

3. What does bollard pull measure in modern tugboats?

4. Name three specialized types of tugboats.

Discussion Questions

5. Why do modern ports still depend on tugs even though ships have their own engines?

6. What might be the advantages of hybrid or electric tugs for ports and the environment?

Data Analysis

7. Compare the difference in power between a harbor tug with 30–80 tons of bollard pull and an ocean-going tug with over 200 tons. What does that tell you about their work?

Reflection

8. What does the evolution from rope and tide to diesel and electric power say about human creativity and progress?