

Storm, Ledge and Rescue: Navigation and the 1892 Gallatin: teacher guide

Teacher guide. Keep separate from student materials.

Grade band	Grades 6-8
Subjects	Science and Engineering, History and Social Science, English Language Arts
Towns	Manchester-by-the-Sea, Gloucester
Duration	Two 50-minute class periods (100 minutes total) (sequence totals 100 minutes)
Prerequisites	Students know that air pressure is measured with a barometer and that low pressure is linked to stormy weather.; Students have read a simple data table and made a line graph.; Students have done at least one engineering design task that used the words criteria and constraints.
Essential question	How did sailors find their way before GPS, and how can engineers design warning systems that still work when no one can see?
Version	1.0, 2026-10-05
Review status	Draft: awaiting classroom teacher review
Lesson ID	CAC-LES-008

Objectives

Students will be able to:

- interpret 1892 weather data to describe how a low-pressure center moving into southern New England produced east gales and snow on the Cape Ann coast, and explain the role of warm and cold air masses.
- build a timeline of the navigation steps the crew took from a primary source and identify, with a quotation, the moment the ship's position was misjudged.
- explain a lighthouse light or sound signal as a communication system, naming its source, encoder, transmitter, receiver, decoder and storage.
- write a design brief for marking or warning of a sunken ledge, with at least three precise criteria and three constraints, including at least one impact on people and one on the natural environment.

Massachusetts curriculum frameworks

Code	Standard (verbatim) and source	How this lesson addresses it
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8.MS-ESS2-5	Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local weather. Science and Technology/Engineering Curriculum Framework (2016), Grade 8. Official framework , page PDF p. 69 (printed p. 66).	Students interpret a table built from the January 1892 Monthly Weather Review to trace a low-pressure center, its falling pressure and the east gales and snow it brought to the New England coast.
6.MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.* Science and Technology/Engineering Curriculum Framework (2016), Grade 6. Official framework , page PDF p. 61 (printed p. 58).	Teams define criteria and constraints for an aid to navigation on a sunken ledge, including impacts on people and the natural environment.
7.MS-ETS3-1(MA)	Explain the function of a communication system and the role of its components, including a source, encoder, transmitter, receiver, decoder, and storage. Science and Technology/Engineering Curriculum Framework (2016), Grade 7. Official framework , page PDF p. 67 (printed p. 64).	Students break a lighthouse light and a sound signal into source, encoder, transmitter, receiver, decoder and storage, using federal rules on light characteristics and sound signals.
RCA-H.6-8.1	Cite specific textual evidence to support analysis of primary and secondary sources, quoting or paraphrasing as appropriate. (See grades 6–8 Writing Standard 8 for more on paraphrasing.) English Language Arts and Literacy Curriculum Framework (2017), Grades 6–8. Official framework , page PDF p. 138 (printed p. 135).	Students quote an 1892 newspaper account and an 1892 Treasury letter as evidence for their navigation timeline and their claims about what went wrong.

The weather data come from a single month's federal summary, so students work with a few readings rather than a full weather map. The lesson treats the 1892 wreck as a navigation and engineering case, not as a disaster story. Teachers who want a history and media literacy focus can pair it with HSS Practice 4 (purpose and point of view) by comparing how sources explained the cause.

Standards checked against the official Massachusetts DESE framework documents on Oct. 5, 2026.

Materials

- Student handout with readings R1 to R5 and activities A1 to A4
- Data sheet (spreadsheet or printed) for the weather table and the navigation timeline
- A flashlight and a bell or any object that makes a clear sound, for the hook
- Optional: computers or tablets to open NOAA's online nautical charts (<https://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml>) and find Manchester Harbor, Eagle Head and the entrance to Gloucester Harbor
- Chart paper or large paper and markers for the design briefs

- Sticky notes for the gallery walk

Setup

Read the teacher background and the sensitive topics note before class. Print the handout and the data sheet, or post them in Google Classroom. If you will use the NOAA chart viewer, open it in advance and practice zooming to Manchester-by-the-Sea; students should look for Eagle Head, Great Egg Rock, Kettle Island off Magnolia and Eastern Point at the entrance to Gloucester Harbor. Plan a simple flashlight code for the hook, such as two short flashes and a pause. Arrange desks in teams of three or four for Session 2.

Teaching sequence

5 minutes Session 1. Hook: Messages in the dark

Teacher: Dim the lights. Flash the flashlight in a repeating pattern, then ring the bell in a different pattern. Ask: "If you were on a ship and saw or heard this, what could it tell you? What if it were snowing so hard you could not see the light?" Record ideas on the board.

Students: Describe what each signal could mean and what could stop it from working.

5 minutes The case in brief

Teacher: Read reading R5 aloud. Say plainly and calmly that one member of the crew, the ship's carpenter, J. Jacobson, died, and that every other person aboard reached the Manchester shore in the ship's boats. Explain that this lesson studies the weather, the navigation and the warning systems, and that we name him to remember him, not to describe his death.

Students: Listen and note three facts about where and when the wreck happened.

17 minutes Weather detectives

Teacher: Introduce reading R1, built from the January 1892 Monthly Weather Review, a federal weather report. Explain that a low area is a center of low air pressure. Model the first row. Circulate while teams answer A1 and make a quick pressure graph on the data sheet.

Students: Complete Activity A1 with a partner.

18 minutes Navigation timeline

Teacher: Read the vocabulary in R4 together: lookout, patent log, soundings, fathom, pilot. Then have students read R2, the 1892 newspaper account, and build the timeline. Remind them to quote the exact words.

Students: Complete Activity A2 on the data sheet timeline.

5 minutes Exit ticket

Teacher: Collect one answer from each student.

Students: Answer: What one piece of information would have changed the pilot's decision at 11 a.m.? Quote R2 to explain why.

5 minutes Session 2. Recap

Teacher: Share two or three exit tickets without names. Tell students today they become engineers who design a better way to warn ships about a hidden ledge.

Students: Reread R3, the Treasury Department words about the ledge.

12 minutes A light is a message

Teacher: Read R3's federal rules aloud. Draw a six-box chain on the board labeled source, encoder, transmitter, receiver, decoder and storage. Work through the flashlight example together, then let teams do the lighthouse and the bell buoy.

Students: Complete Activity A3.

23 minutes Design challenge: mark the ledge

Teacher: Give each team chart paper. Stress that the goal of this task is to define the problem precisely before inventing a device. Check every team's criteria for numbers or clear tests. Remind teams that color cannot be the only signal, because some mariners cannot tell red from green and snow hides color.

Students: Complete Activity A4 as a team.

8 minutes Gallery walk

Teacher: Post the briefs. Each team visits two others and leaves one sticky note: one strong criterion and one missing constraint.

Students: Give and read feedback.

2 minutes Close and assign

Teacher: Assign the individual assessment for homework or the next class.

Students: Write down the assessment task.

Background for the teacher

The U.S. revenue cutter Gallatin was an iron-hulled ship built at Buffalo, N.Y., in 1871 and stationed at Boston (U.S. Coast Guard Historian's Office). On Jan. 6, 1892, she left Kittery, Maine, for Provincetown. The New Haven Morning Journal and Courier wire report (R2) gives the navigation sequence: past the Salvages at 8:50 a.m., weather thick and snow, a course change for Gloucester Harbor, lookouts posted, soundings taken, twelve fathoms found near an island the pilot took to be Kettle Island (off Magnolia), a course due east for Eastern Point, and a strike at 11:15 a.m. on what the Treasury and Congress called a "sunken and unbuoyed ledge off Eagle Head" (Boo Hoo Ledge). The island was Great Egg Rock, off Manchester, west of Kettle Island, so the ship was farther west than the pilot believed. The Monthly Weather Review for January 1892 traces the storm (low area III) from the southeast slope of the Rockies on Jan. 4 to southern New England on Jan. 6, with pressure below 29.30 inches, a drop of .50 inch in 12 hours on the northeastern coast and east gales of 40 to 60 miles per hour on the southeast New England coast, then to the Gulf of St. Lawrence on Jan. 7. It also notes rising temperatures in the middle and south Atlantic states while snow fell farther north, which is the warm and cold air mass contrast students should explain. The Treasury Department letter of Jan. 26, 1892, states that "the carpenter was killed by the falling of the smokestack," and that 28

surviving crew members filed claims for lost belongings. The muster roll names him J. Jacobson, carpenter. Every other person aboard reached the Manchester shore. Sources disagree on some details, such as the landing place, the number aboard and whether the inquiry blamed anyone; the 1892 newspaper blamed the pilot, a later Boston Herald report said responsibility was placed on the captain and a congressional committee said the wreck was not caused by any fault or negligence of officers or crew. Manchester's 1895 town history describes the man who died as "one seaman, a Dane" who drowned; the official record calls him the carpenter and says he was killed by the falling stack. That conflict is not the focus here. This lesson does not claim that any particular light or buoy was or was not visible that morning.

Handling sensitive topics

One person died in this wreck: the ship's carpenter, listed in the official record as J. Jacobson. Mention his death once, plainly, and do not describe injuries or speculate about his final moments. Sources disagree on whether he was killed by the falling smokestack or drowned after it knocked him into the sea, and newspapers say his body went into the sea; there is no record that it was recovered. If students ask, say that the records disagree and that we do not know more. Nothing found ties him to Cape Ann. Refer to the 28 others as surviving crew members, not victims, and remember that the people of Manchester helped them. If a student in your class has lost a family member at sea, let them sit out the discussion of the death without explanation.

Discussion prompts

- The crew used a lookout, soundings and a log, and still struck the ledge. What does that tell us about relying on a single piece of information?
- The 1892 newspaper blamed the pilot the same day. Why might a reporter write that so quickly, and what should a careful reader do with that claim?
- Modern ships have GPS. Why do lighthouses, buoys and sound signals still matter today?
- Who should pay for warning systems on the coast: the government, shipowners or harbor towns? Why?
- How do we remember people who die in accidents like this one in a way that is respectful to them and their families?

Formative checks

- Weather check: each pair states the direction the storm moved and what happened to the pressure.
- Exit ticket (Session 1): one piece of information that would have changed the pilot's decision, with a quotation from R2.
- During A3, ask each team to name the decoder in the lighthouse system before moving on.
- Gallery walk sticky notes show whether students can spot a missing constraint.

Assessment

Write a one-page engineer's report on your own. Part 1 (4 points): Use two facts from the weather table to explain why visibility and wind were dangerous off Cape Ann on Jan. 6, 1892, and how the meeting of air masses caused

snow. Part 2 (4 points): Quote the 1892 account to identify the moment the ship's position was misjudged, and explain what information was missing. Part 3 (6 points): Give your final design brief for marking the ledge, with three testable criteria and three constraints, including one impact on people and one on the environment. Part 4 (6 points): Explain your warning system as a communication system, naming and describing all six parts, and explain how it works without relying on color alone.

Points: 20

Answer guidance

A1

- Path: from the southeast slope of the Rocky Mountains (Jan. 4) to the Louisiana and Arkansas border (Jan. 5 morning), the upper Tennessee River valley (Jan. 5 evening), southern New England (Jan. 6) and the northern Gulf of St. Lawrence (Jan. 7). General direction: northeast.
- Graph: pressure readings fall from below 29.60 to below 29.50 to below 29.30. Students should note that the values are upper limits ('below') and that the storm deepened as it moved northeast.
- A fast pressure drop signals a strengthening storm and rising winds, so a captain would expect worse weather soon.
- East gales of 40 to 60 miles per hour on the southeast New England coast; the Pawtucket Tribune reported an east southeast wind, fresh and rising. The crew saw the weather turn thick and snow begin after 8:50 a.m.
- Air masses: the low drew warm, moist air north on its east side, where temperatures rose, while cold air lay to the north. Where the moist air rose over the cold air, precipitation fell as snow; farther south it fell as rain.
- Counterclockwise flow: north of a low centered over southern New England, air moves from east to west, so Cape Ann gets east winds blowing off the ocean toward the shore, which pushes ships toward the rocks.

A2

- 8:50: passed the Salvages heading south (landmark, compass course). 9:55: patent log set; weather thick, then snow (log starts measuring distance). Course changed for Gloucester; part of sail in; lookout posted. 10:45: all sail in; extra lookout; quartermaster sees land; engine slowed; soundings taken. 11:00: land sighted again; sounding of 12 fathoms; engine stopped and backed; pilot misidentifies Great Egg Rock as Kettle Bottom island; ship steered due east for Eastern Point. 11:15: struck a sunken ledge; ship held fast.
- Tools used: lookout, compass course, patent log, soundings, landmark recognition. In snow the lookout and landmarks are least reliable, and dead reckoning drifts when the starting point or speed is uncertain.

- Key quotation: 'Here the mistake was made. The pilot took the land to be Kettle Bottom island, but instead it was Great Egg Rock.'
- If the island were Kettle Island off Magnolia, a course due east would lead toward Gloucester's outer harbor and Eastern Point. Because the ship was actually off Manchester near Great Egg Rock, farther west, the same course took her across Boo Hoo Ledge.
- Pilot at fault: the newspaper says he 'lost his reckoning' and misidentified the island. Not at fault: the committee and Treasury describe an unbuoyed, sunken ledge in a snowstorm with poor visibility. Strong answers say the claims come from different sources with different purposes.

A3

- Flashlight: source is the teacher with a message; encoder is the chosen flash pattern; transmitter is the flashlight; receiver is the students' eyes; decoder is the students' knowledge of the code; storage is the code written on the board.
- Lighthouse: source is the light station marking a place or danger; encoder is its distinctive light characteristic (rhythm and color); transmitter is the lamp and lens; receiver is the lookout's eyes; decoder is the navigator matching the pattern to a place; storage is the printed Light List and chart (also the ship's logbook).
- Bell buoy: source is the agency marking a danger; encoder is the bell's tone; transmitter is the bell struck by the motion of the sea; receiver is the lookout's ears; decoder is the navigator using the chart; storage is the chart. Weakness from R3: buoy sound signals do not give a regular pattern because the sea rings them, and a calm sea may ring them little.
- Snow and fog block or scatter light, so a visual signal may not reach the receiver; sound travels through snow and fog, so it can still warn of danger nearby.

A4

- Look for testable criteria, for example: detectable by sound at a stated distance in fog or snow; identifiable by a pattern that repeats a stated number of times per minute; works for a stated number of days without a visit; survives a stated wind or wave condition.
- Strong constraint lists name cost, power supply, ice and storm damage, upkeep, federal rules, noise for nearby residents, light at night for neighbors, effects on birds or marine life and anchoring on the seafloor.
- Accessibility: identity carried by rhythm, timing, sound or shape, with color as an extra cue only.

Rubric

Criterion	4	3	2	1
Interpreting weather data	Uses two or more accurate data points and correctly explains the air mass contrast and the east winds.	Uses two accurate data points and gives a mostly correct explanation.	Uses one data point or the explanation has an error.	No data used or explanation is incorrect.
Evidence from the 1892 account	Quotes the account exactly, identifies the misjudgment and explains the missing information clearly.	Quotes the account and identifies the misjudgment.	Paraphrases without a quotation or the moment is unclear.	No evidence from the account.
Criteria and constraints	Three or more testable criteria and three or more constraints, including impacts on people and the environment, all precise.	Three criteria and three constraints with both impacts, mostly precise.	Fewer than three of either, or impacts missing.	Criteria and constraints are missing or not related to the problem.
Communication system	Names and accurately describes all six parts and explains how the signal works without color alone.	Names all six parts with minor errors.	Names three to five parts correctly.	Names fewer than three parts.

Differentiation

Multilingual learners

- Pre-teach lookout, sounding, fathom, ledge, pilot, gale and pressure with quick sketches or gestures.
- Give R2 with the times bolded and let students build the timeline in a home language with key English terms.
- Provide sentence frames: 'At ___ the crew saw ___, so they ___.' and 'The ___ is the encoder because ___.'
- Pair the R1 table with a short oral summary before students read it.

Students with disabilities

- Provide the weather table and timeline as a partially completed data sheet.
- Offer audio of R2 and R5, and allow speech-to-text for written answers.
- Use tactile or large-print versions of the six-box chain; never rely on color to separate the boxes.
- Allow the design brief to be presented orally or as a labeled list instead of a paragraph.
- Give the hook as a description in words for students who are blind or have low vision, and describe the sound pattern for students who are deaf or hard of hearing.

Advanced learners

- Compare the times in R2 with the distance from the Salvages to Eagle Head on a NOAA chart and estimate the ship's average speed through the water.
- Research how modern aids to navigation, such as automatic fog signals with fog detectors, change the communication system.
- Read a second 1892 account in *Chronicling America* and note which details it adds or leaves out.

Print, low-bandwidth and extension options

Print: Print the data sheet and the handout, which contains all readings, activities and the assessment. The lesson runs fully on paper. Draw the six-box chain on the board.

Low bandwidth: Skip the NOAA chart viewer and use the place descriptions in R4 with a simple sketch you draw on the board, labeled with words: Eastern Point to the east, Kettle Island off Magnolia, Great Egg Rock and Eagle Head off Manchester to the west.

Extensions:

- Use NOAA's online charts to find Eagle Head, Great Egg Rock and Kettle Island, and measure the distance between the two islands the pilot confused.
- Find today's light characteristic for Eastern Point Light in the U.S. Coast Guard Light List and decode it.
- Write a short memorial note for the Gallatin's carpenter that sticks to what the records show.

Google Classroom: ready to paste

Assignment title: Storm, Ledge and Rescue: Engineer's Report

Student instructions:

Open your copy of the student handout and the data sheet. In Session 1, complete the weather table questions and the navigation timeline. In Session 2, complete the communication system chain and your team's design brief. Then write the one-page engineer's report on your own, following the four parts in the assessment section.

Suggested points: 20

Attach:

- **student-handout.docx:** Make a copy for each student
- **slides.pptx:** Students can view file
- **data-sheet.xlsx:** Make a copy for each student

Never attach the teacher guide to student work. See [how to use this lesson in Google Classroom](#).

Citations and rights

- U.S. Weather Bureau, Monthly Weather Review, vol. 20, no. 1 (January 1892), pages 4 and 17.
https://archive.org/details/sim_monthly-weather-review_1892-01_20_1. Public domain (U.S. federal government work, published 1892)
- "Wreck of a Cutter," Morning Journal and Courier (New Haven, Conn.), Jan. 7, 1892, page 3.
<https://www.loc.gov/resource/sn82015483/1892-01-07/ed-1/?sp=3>. Public domain (published 1892); Library

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- Pawtucket Tribune (Pawtucket, R.I.), Jan. 7, 1892, page 1 (wind report, from Cape Ann Current's checked research notes). <https://www.loc.gov/resource/sn92064071/1892-01-07/ed-1/?sp=1>. Public domain (published 1892); Library of Congress, Chronicling America
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