

Building a Schooner in Essex: teacher guide

Teacher guide. Keep separate from student materials.

Grade band	Grades K-2
Subjects	Science and Engineering, History and Social Science, Mathematics
Towns	Essex
Duration	Two 35-minute sessions (70 minutes total) (sequence totals 70 minutes)
Prerequisites	Students can sort objects into two groups.; Students have used a simple table with a teacher's help.
Essential question	How did the people of Essex build boats that float, and how can we test materials to build our own?
Version	1.0, 2026-10-05
Review status	Draft: awaiting classroom teacher review
Lesson ID	CAC - LES - 003

Objectives

Students will be able to:

- explain that Essex shipbuilders used wood from trees that grew near the town.
- test at least five materials and record whether each one sinks or floats.
- draw two different boat plans before building.
- build a foil or clay boat, test how many pennies it holds and compare it with a classmate's boat.

Massachusetts curriculum frameworks

Code	Standard (verbatim) and source	How this lesson addresses it
1.T4, standard 1 (shared with grade 2 as 2.T5, standard 1)	Explain the relationship between natural resources and industries and jobs in a particular location (e.g., fishing, shipbuilding, farming, trading, mining, lumbering, manufacturing). History and Social Science Curriculum Framework (2018), Grades 1 and 2. Official framework , page PDF p. 42; grade 2 repeat at PDF p. 48.	Students connect the oak forests near Essex and the river to the town's shipbuilding jobs.

Code	Standard (verbatim) and source	How this lesson addresses it
2-PS1-2	Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.* Science and Technology/Engineering Curriculum Framework (2016), Grade 2. Official framework , page PDF p. 40 (printed p. 37).	Students test wood, foil, clay and other materials and use their results to decide which materials suit a boat that must float.
1.K-2-ETS1-2	Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.* Science and Technology/Engineering Curriculum Framework (2016), Grade 1 (K-2 span standard placed in grade 1). Official framework , page PDF p. 38 (printed p. 35).	Students draw two different boat plans before choosing one to build.
2.K-2-ETS1-3	Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.* Science and Technology/Engineering Curriculum Framework (2016), Grade 2 (K-2 span standard placed in grade 2). Official framework , page PDF p. 41 (printed p. 38).	Partners compare the penny test results of two boats and tell one strength and one weakness of each.

Sink and float is not named in any Pre-K to grade 2 Massachusetts STE standard. The lesson cites 2-PS1-2 and the K-2 engineering standards and treats floating as the intended purpose of the material. Kindergarten teachers can run the same lesson as an introduction; the cited standards are placed in grades 1 and 2.

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

Materials

- A tub or clear bin of water for each group (or one class tub), plus towels
- Test materials for each group: a block of wood, a flat sheet of aluminum foil, a foil sheet squeezed into a tight ball, a ball of modeling clay, a plastic lid, a penny, a cork and a metal spoon
- Aluminum foil squares (about 6 inches by 6 inches) and modeling clay (a piece about the size of a golf ball) for each student
- About 50 pennies or same-size counters per group
- Printed data sheet: Sink or Float and Penny Test
- Pencils and plain paper for boat plans
- Chart paper with two columns labeled SINKS and FLOATS

Setup

Fill the water tubs halfway and set them on towels. Put one set of test materials beside each tub. Prepare the chart paper with SINKS and FLOATS columns. Print one data sheet per student. Before Session 2, cut foil squares and portion the clay. Practice the read-aloud so you can stop at the questions.

Teaching sequence

3 minutes Session 1. Hook: Will it float?

Teacher: Hold up a block of wood and a metal spoon. Say: "I am going to put these in the water. Thumbs up if you think it will float. Thumbs down if you think it will sink." Drop in each one. Say: "Today we will find out why the people of Essex built their boats out of wood."

Students: Predict with thumbs up or down and watch the test.

10 minutes Read-aloud: A Town That Built Boats

Teacher: Read passage R1. Then slowly read the two short quotations in R2 aloud and say: "These words were written in 1884 by a man named Henry Hall. He wrote a report for the United States government about how ships were built. These are his real words." Explain the hard words: framed means the boat's skeleton, planked means its outside boards, decks means the floors. Ask: "What did the Essex builders use to make their boats?"

Students: Listen, answer the stop questions and repeat the key words: oak, pine, schooner, shipbuilder.

17 minutes Material test: Sink or Float

Teacher: Say: "Shipbuilders test their materials. Now you will be material testers." Model with one item: "First I guess. I think the cork will float. Then I test. It floats! I write a mark in the Floats box." Groups test each material, recording a guess and a result on the data sheet. Circulate and ask: "Was your guess right? What surprised you?" Point out the flat foil and the foil ball: "Same material, different shape. What happened?"

Students: Guess, test and record each material as sinks or floats on the data sheet.

5 minutes Session 1 wrap up: Which materials make a good boat?

Teacher: Fill in the class SINKS and FLOATS chart together. Ask: "Which floating material did Essex builders use? Why would wood be a good choice? Did the clay ball sink? Do you think we could make clay float?" Say: "Next time you will be shipbuilders."

Students: Share results, help sort the class chart and make a guess about floating clay.

5 minutes Session 2. Design challenge: plan two boats

Teacher: Say: "Your job is to build a boat that floats and carries as many pennies as possible. Pennies are your cargo. Cargo is what a boat carries. Before Essex builders made a boat, they planned it. You will draw two different plans." Show that a plan can be a simple drawing seen from the top or the side. Remind students that each plan should be different, such as tall sides and low sides or a wide boat and a narrow boat.

Students: Draw two different boat plans and circle the one they will build.

12 minutes Build

Teacher: Hand out one foil square or one piece of clay to each student (or let them choose). Say: "Build the plan you circled. Check: will water get in? Are the sides high enough?" Circulate and ask: "Why did you choose that shape? How is your boat like a schooner?"

Students: Build a foil or clay boat from their plan.

18 minutes Penny test and compare

Teacher: Pair students. Say: "Put your boat on the water. Add one penny at a time, gently. Count out loud. Stop when water comes in or the boat sinks. Write down the last number before it sank." Partners test both boats and record both numbers on the data sheet. Ask each pair: "Which boat held more pennies? What was strong about each boat? What would you change?" Close by asking: "If you built your boat again, what would you do the same as the Essex shipbuilders?"

Students: Test both boats, count pennies, record results and tell one strength and one change for each boat.

Background for the teacher

Henry Hall wrote the shipbuilding report for the 1880 U.S. Census; it was published by the Government Printing Office in 1884 and is a public domain federal work. Hall writes that Essex was formerly called Chebacco and repeats a story that the first Chebacco boat was built in a garret, taken out of the house through a window and dragged to the water's edge by cattle (page 7). He calls it a story, and this lesson presents it that way. He reports that Chebacco boats were framed and planked with white oak from forests around the town and that decks and cabins were white pine. On pages 108 and 109 he writes that Essex "has always lived by ship-building," that nearly all of Gloucester's clipper fishing schooners were built at Essex, that vessels were framed and planked with oak with maple keels and white pine decks and that the most profitable Essex vessels were two- and three-masted schooners of 150 to 260 tons "as the river is not large enough to launch and float out a large hull." On pages 12 and 13 his table shows that of the 475 schooners, sloops and boats owned at Gloucester in the census year, 218 were built at Essex and 133 at Gloucester; the remaining 124 came from other towns in Massachusetts, Maine, New Hampshire, Connecticut, New York and New Jersey. The quotations in R2 were checked against the Internet Archive OCR text of the scan; check them against the page images before printing if you can. Wood floats because it is less dense than water. Foil and clay sink as a ball but can float when shaped into a hollow boat, because the shape pushes aside more water. This is the key engineering idea of the lesson; K-2 students only need to notice that shape matters. Assessment points: one point each for a working boat with a recorded penny count, a strength, a change and an Essex material with a reason.

Handling sensitive topics

This lesson is about building and testing boats and does not discuss accidents or loss at sea. If students ask whether boats ever sank, you may say: "Sometimes people at sea needed help, and that is why builders worked hard to make strong boats." Keep the focus on design and materials.

Discussion prompts

- Why do you think Essex builders used oak trees from near their town?
- The flat foil and the foil ball are the same material. Why might one float and one sink?
- How is your boat like a real schooner? How is it different?
- Why did a small river mean Essex builders made boats that were not too big?
- What jobs do people in our town do because of where we live?

Formative checks

- Before testing, can the student make a guess and tell why?
- Does the student record each result in the right column?
- Are the student's two plans clearly different?
- Can the student read their penny number aloud and say which boat held more?

Assessment

Show your boat and your data sheet. Tell how many pennies your boat held, one thing that was strong about it and one thing you would change. Tell one material Essex builders used and why.

Points: 4

Answer guidance

A1

- Usually floats: block of wood, flat sheet of foil (if laid gently), plastic lid, cork.
- Usually sinks: ball of clay, penny, metal spoon. A tightly squeezed foil ball may float or sink depending on air trapped inside; accept the result students observe.
- Good boat materials: wood, cork, plastic and shaped foil, because they float. Look for because it floats or because it stays on top of the water.

A2

- Look for two plans that differ in a clear way: shape, side height, width or length.
- Accept simple drawings from the top or the side; labels are welcome but not required.

A3

- Penny counts will vary widely. Wide, flat boats with sides tall enough to keep water out usually hold the most.
- Strengths might be wide bottom, tall sides, no holes. Changes might be make the sides taller, make it wider, fix a leak.
- The partner comparison should name which boat held more and use the numbers.

A4

- Essex built the most boats (218).
- More boats were built in Essex than in Gloucester (218 is more than 133).

Rubric

Criterion	4	3	2	1
Tests materials and records data	Guesses, tests and records all materials accurately and explains a surprise.	Tests and records most materials accurately.	Tests materials with help; some records are missing or in the wrong column.	Tests materials but does not yet record results.
Plans more than one solution	Draws two clearly different plans and explains the choice.	Draws two different plans.	Draws one plan or two plans that are nearly the same.	Builds without a plan.
Compares two designs using data	Uses both penny counts to tell which boat did better and names a strength and weakness of each.	Uses both penny counts to tell which boat held more and names one strength or change.	Tells which boat held more without using the numbers.	Does not yet compare the two boats.
Connects materials to Essex shipbuilding	Tells that Essex builders used oak (or pine) from nearby and explains why wood suits a boat.	Names wood or oak as an Essex boat material.	Names a material when given a choice of two.	Does not yet connect materials to Essex.

Differentiation

Multilingual learners

- Pre-teach and post five words with gestures: float (hand flat, gliding), sink (hand dropping), wood, plan, test.
- Use sentence frames: I think the ___ will ___. The ___ floated. My boat held ___ pennies.
- Let partners talk in a shared home language while testing and share results in English or with gestures.

Students with disabilities

- Use a data sheet with fewer materials (four instead of eight) and larger boxes.
- Offer pre-softened clay or extra-wide foil for students with fine motor needs; a partner may help shape while the student directs.
- Students may mark results by placing the object on a SINKS or FLOATS mat instead of writing.
- Read every data sheet heading aloud; never rely on colors to show sinks and floats.

Advanced learners

- Challenge students to make a clay boat that holds more pennies than their foil boat, then explain the difference.
- Ask grade 2 students to find how many more boats were built in Essex than in Gloucester (218 minus 133).
- Have students add a mast and sail and test whether a fan or their breath moves the boat.

Print, low-bandwidth and extension options

Print: Print the read-aloud, the R2 quotations, the R3 table and the data sheet. Everything else is hands-on.

Low bandwidth: No screen needed. Use the printed passages and data sheet; the scan of Hall's report is optional for the teacher.

Extensions:

- Visit Essex and look at the river and the shipyards from public places with families.
- Build a class fleet and line the boats up from most pennies to fewest.
- Try the penny test in salt water and fresh water and compare.
- Draw a picture plan of a schooner with two masts and label the parts.

Google Classroom: ready to paste

Assignment title: Building a Schooner in Essex: Sink, Float and Build

Student instructions:

Open your data sheet. In Session 1, write your guess for each material, test it and mark Sinks or Floats. In Session 2, draw two boat plans, build one and write how many pennies your boat and your partner's boat held. Grown-ups at home can help by reading the questions aloud.

Suggested points: 4

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

- Henry Hall, Report on the Ship-Building Industry of the United States (Government Printing Office, 1884), Tenth Census. <https://archive.org/details/reportonshipbui00hallgoog>. Public domain (U.S. federal government work, published 1884)

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