Lesson 1.7 "Mapping New Hampshire"

Unit 1: New Hampshire Geography

Lesson Objectives

- Students will examine images of historic surveying tools and surveyors at work and hypothesize their purposes and connections.
- Students will use simple tools to survey the classroom and convert their measurements to an appropriate scale.
- Students will use collected data to draw a scale map of the classroom.

Lesson Competencies

- I can analyze primary and secondary sources and draw appropriate conclusions. (Moose SS)
- I can fluently add, subtract, multiply, divide and estimate using whole numbers, fractions, mixed numbers and decimals. (Math 3)
- I can analyze, use, and construct maps and other geographic representations to explain relationships between people and the environment. (Moose SS)

Essential Question

How has New Hampshire been shaped by many voices?

Focus Questions

How has the way people have explored and represented New Hampshire changed over time?

Estimated Time

Three 40-minute class sessions

Materials & Equipment

Group sets of Tools and Surveyors images
Two-column chart for projection
"Details on Surveyor Tools" handout for educator
For comparing maps, optional activity:
    Class set of "Map of New Hampshire and Vermont, 1796"
    Class set of "Map of New Hampshire and Vermont, 2019"
    Class set of Venn diagram
Materials for sketch maps: pencils, paper, and clipboards
Partner sets of "Classroom Surveyor: Make a Gunter Chain" worksheet with "Classroom Surveyor: Map Measurement Table" worksheet on the back
Materials for making Gunter chains: rulers, string, scissors, masking tape, and marker
Compass
"Scale Map of My Classroom" Map template (as necessary for support)

Educator Introduction & Rationale

While the many maps of New Hampshire's features were created for showing locations and supporting wayfinding, their purposes were generally more complicated. They have been documents of ownership, change, and movement of people and industry. Today, people take for granted the ease of summoning a map of any location on the planet with a few clicks on a computer or smart device. But how did people get detailed maps of New Hampshire before satellite and GPS allowed them to see the world from above? The work involved in creating maps has changed in significant ways since those early explorers traveled around the land.

This is the seventh lesson in Unit 1: New Hampshire Geography. Achievement of the learning objectives in Lesson 1.1, "Map Vocabulary and Introduction," is recommended before completing this lesson so students are familiar with map vocabulary and skills. This lesson is designed to be completed in three sessions. Please note, lesson vocabulary and definitions are at the end of the document. You may wish to preview these with your students.

In this lesson, students investigate the job of the surveyor, the person who literally measures the earth to provide a mapmaker with the data needed to draw an accurate map. The progression of this three-part lesson builds students' background knowledge about the work and tools of surveyors before students make their own tools to measure the classroom in a manner similar to that used by the early surveyors of New Hampshire. The investigation culminates with students creating scale maps using the data they collected as "surveyors."

Two reinforcement activities are suggested for students who will benefit from more experience with the objectives of the lesson: one provides more practice with scales on maps and the other offers a different entry point for measuring and mapping a specific area of the classroom. Two extension activities are suggested for students who are ready to build on the objectives of the lesson by adding data layers to paper and digital maps. Please adapt all the material in this lesson, as necessary, to meet the needs of the students in your classroom.

Learning Activity

Activation

Essential tools. Distribute sets of the three images of 18th- and 19th-century surveying tools to small groups. Do not tell students what the objects are or what they are for and be sure to cover the credit line when making copies. What do they notice about the images? What do they wonder about the images?

Collect student responses on a two-column chart, either on chart paper or projected. Then, distribute the three images of the surveyors. Ask students to look at the people in the images and the tools they are using. What other observations and questions can they add to the chart? Which of their questions can they answer? Alternatively, project each image and work through the activity as a whole group.

Direct Instruction

Mapmaking long ago. Explain to students that when people first started making maps of New Hampshire in the 16th century, they didn't have access to the kind of technology people use today to make maps.

An accurate map depended on a person, called a **surveyor**, physically being on the land, walking it, and taking measurements using a few essential tools, including the very tools shown in the images they just analyzed: a compass, a level, a tripod, and a Gunter's chain. Surveyors worked in teams, including men who were responsible for clearing paths through the dense forest, if needed, to get accurate measurements with the chain. If students have not fully determined what the tools are or how they were used, provide or read the information from the handout "Details on Surveyor Tools."

Surveyors still do important work today (students may have observed surveyors using their equipment alongside roads or near construction sites). The essential tools of long ago are still part of the work of studying the land before a map is made, though now satellite images provide surveyors and cartographers even more exact data about shape and features of the land.

Teaching tip: If time permits, consider doing the following activity to reinforce the similarity of the work of surveyors past and present. Otherwise, move ahead to Independent Practice.

Guided Practice

Optional activity: compare maps. Project and/or distribute the maps "Map of New Hampshire and Vermont, 1796" and "New Hampshire and Vermont, 2019." Ask students to compare the maps and complete a Venn diagram either in pairs or as a whole group. Provide the following questions to guide the comparison:

- Which map seems older, and what makes you think that?
- What do both maps show? How do they show that information?
- What kind of technology or tools do you think were used to create the maps?

Possible response: Discuss student responses and reinforce that although the way maps are created have changed over time, the purpose of maps has remained the same: to provide information about the characteristics of physical space and how people see and use that space.

Independent Practice

Sketch a map of the room. Ask students to turn and talk to a neighbor about how they would make a map of their classroom without having a satellite beaming an image from above.

Confirm that they will do this just as 18th- and 19th-century mapmakers mapped New Hampshire: on foot with pencil, paper, and the essential tools they examined in the photographs. Explain that they will start with just the first two: pencil and paper. Provide students with a sheet of 8.5" x 11" paper, pencils, and clipboards, if available. Partners should travel the room together, drawing the outline created by classroom walls, doors, and windows, as if seen from above. Features of the room (e.g. meeting area, desks, tables, and sink) should be drawn in their relative locations. To aid students, make a list of required features on the board.

Teaching Tip: This is a good place to pause if teaching the lesson in three sessions.

Direct Instruction

Making tools and taking measurements. Remind students that mapmaking is a process with many steps. They will now improve on their sketches by gathering data about measurements in the room. Explain to students that they will make a version of one of the tools they examined in the photographs to measure and map their classroom: a Gunter chain. Provide pairs of students with string, a ruler, scissors, tape, markers and the directions for making a Gunter chain. When chains are complete, discuss the unit represented by the chain.

Possible outcome: Students should determine that if each "link" in the chain is twelve inches or one foot, the entire chain is equal to six feet.

Demonstrate how partners should use the chain with a staff (either a yardstick or other long pole) to measure length:

1. One person inserts the staff in the loop at one end of the chain and holds the staff steady.
2. The other person gently stretches out the chain as far as it can go and makes a tally mark to keep track of the number of lengths that make up a particular distance.
3. The partner holding the staff carefully lifts the looped end of the chain and brings it to the other end of the chain.
4. The process repeats until a measurement is complete.

Ask students how they think they should notate a measurement if the entire chain isn't used. What fraction would represent the remaining amount?

Possible outcome: Students should recognize the chain is divided into six links, or sixths. So, portions of the chain can be shown as fractions with a denominator of six. If students are able to reduce these fractions, they should do so. A tip for students is to mark the spot where the chain folds in half so they can better work with portions of the chain.

Guided Practice

Measure the room. Direct students to use their sketches to travel around the room. This time, however, they should measure the lengths they sketched on the map using the staff and chain and then notate the measurements on the map. (For example, the length of one wall might be written as 3 ½ chains.) They should remember to do interior measurements (e.g. door to table) as well as the perimeter, depending on the features they drew on the sketch.

Teaching Tip: This is a good place to pause if teaching the lesson in three sessions.

Direct Instruction

Create a scale. When pairs have completed taking measurements they are ready to make a map to scale. If your class is unfamiliar with a map scale, take some time to look at one of the maps used earlier, such as "Map of New Hampshire and Vermont, 1796." Project or distribute copies. Explain that this map's actual size is about 8 inches by 10 inches. It uses a bar scale to show how to calculate distance on the map. Ask students to find the bar scale and turn and talk to a neighbor or partner about how they think someone looking at the map would use the scale.

Possible outcome: Students, with support, should determine that the bar would be measured by the person using the map, probably with a ruler or protractor. The length of the increment on the page represents that many miles on the map. It's difficult to tell without seeing the actual map, but the scale is likely about 1 inch for every 5 miles. Consider showing students ways to notate scale such as 1 inch:5 miles or 1 inch = 5 miles.

Decide if you will create one scale of measurement for the whole class or if you will have each partnership calculate their own scale. The scale will depend on the size of paper students use for their final maps; 1 inch = 1 foot may be too large.

Once the scale has been determined (e.g. 1 inch = 3 feet), provide students with the "Map Measurements" chart to convert their chain length measurements in preparation for drawing their final maps.

Guided Practice

Draw maps to scale. With their completed "Map Measurements" chart, students can use rulers to draw final drafts of their classroom maps to scale. Remind them that their final drafts need other important map components: a title, a key, a scale, and a compass rose. A template is provided for students who need support with organizing these features. When students are ready to create a compass rose that accurately reflects the orientation of the map, show them how to hold the compass so that the arrow lines up with north and provide guidance as they fill in the directions on the compass rose.

Reflection

Share maps. Create a gallery wall of the completed maps alongside their drafts. Give students time to examine their work and the work of their classmates. Afterward, provide students with two sticky notes on which to write their responses to two questions:

- What did you notice about how the maps changed after measurements were taken?
- What did you learn about making a map?

Do their responses answer or relate to any of the "notice" and "wonder" comments from earlier? If so, add them where appropriate. If not, create a third column labeled "Our Discoveries" for the remaining notes.

Reinforcement

1. **Practice scales.** Provide students with multiple maps of different scales. Ask them to measure distances between specific places and then use the scale to convert the map measurements to the actual measurement.

2. **Jigsaw the classroom.** Make copies of one of the completed classroom maps. Cut the copies into nine equal squares and discard a square from each map. Give the remaining sets of eight pieces to pairs or small groups. After they sort the pieces to show the classroom, they need to map the missing space using the staff, chain, and scale.

Extension

1. **Add data to tell a story.** Examine the map, "Forest Cover, 1896" (available in the Media Library) and ask students to determine what story the map is trying to tell and who the map would be useful for. Maps are often created to explain something about the characteristics or uses of a certain place. Provide students with a blank map of the school and brainstorm different ways that data could show how the school is used. Would you gather data about 4th grade traffic flow? Which rooms are used the most in the school, and which are used the least? All the possible ways to get to the playground from the entrance? Have students gather this data and display it on the map using colors, symbols, or layers of tracing or tissue paper.

2. **Explore an Interactive MapMaker.** National Geographic's free Interactive MapMaker allows students to add layers to maps of nearly every spot on the globe. Choose a layer that is relevant to your students' interests. Guide them to make observations and create questions for their classmates about the data provided in the layer. Visit mapmaker.nationalgeographic.org to learn more about this learning tool.

Supporting Materials

New Hampshire Historical Society Resources

1. Gunter Chain, circa 1750
2. Surveyor's Compass, circa 1770
3. Surveyor's Tripod, circa 1739
4. Surveying the Land, circa 1923
5. Surveying the Boundary, 1891
6. Map of New Hampshire and Vermont, 1796

Other Resources

Screenshot of New Hampshire and Vermont was taken using Google Earth Pro. See www.google.com/earth/ for more information.

"Surveyor in Woods," commons.wikimedia.org/wiki/File:-BLMcareers_(21678771368)_crop.jpg

Standards

"Moose on the Loose" Content:

- ✓ Students will understand that New Hampshire has a diverse geography, with mountains, seacoast, and farming land. They will understand it has been inhabited for thousands of years and has a variety of resources. (3-5.T1.1)

"Moose on the Loose" Skills:

- ✓ Gathering, Interpreting, and Using Evidence (3-5.S1.1, 3-5.S1.2)
- ✓ Effective Historical Thinking (3-5.S3.1)
- ✓ Comprehensive Geographic Reasoning (3-5.S4.1)

New Hampshire Social Studies Frameworks:

- ✓ Geography: The World in Spatial Terms (SS:GE:4:1.1, SS:GE:4:1.2)
- ✓ Geography: Places and Regions (SS:GE:4:2.5)

NCSS Themes:

- ✓ Theme 2: Time, Continuity, and Change
- ✓ Theme 3: People, Places, and Environments
- ✓ Theme 8: Science, Technology, and Society

C3 Frameworks:

- ✓ Geographic Representations: Spatial Views of the World (D2.Geo.1.3-5, D2.Geo.3.3-5)
- ✓ Historical Sources and Evidence (D2.His.11.3-5)

Common Core ELA:

- ✓ Comprehension and Collaboration in Speaking and Listening (SL.4.1c)

Common Core Math:

- ✓ Use place value understanding and properties of operations to perform multi-digit arithmetic (4.NBT.B.4, 4.NBT.B.5, 4.NBT.B.5)
- ✓ Extend understanding of fraction equivalence and ordering in Number and Operations—Fractions (4.NF.A.1, 4.NF.A.2)
- ✓ Build fractions from unit fractions by applying and extending previous understands of operations on whole numbers in Number and Operations—Fractions (4.NF.B.3, 4.NF.B.3a, 4.NF.B.3b, 4.NF.B.3c, 4.NF.B.3d, 4.NF.B.4, 4.NF.B.4a, 4.NF.B.4b, 4.NF.B.4c)
- ✓ Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit in Measurement and Data (4.MD.A.1, 4.MD.A.2, 4.MD.A.3)

Lesson Vocabulary

compass	(noun) A tool used to determine directions by following a metal needle drawn toward magnetic north
compass rose	(noun) A symbol that represents a compass showing cardinal and intermediate directions
Gunter chain	(noun) A tool used by surveyors, this chain of 100 equal links is 66 feet in length and is stretched across the land to calculate distances
key	(noun) An explanation of abbreviations or symbols used on a map, sometimes called a legend
scale	(noun) A tool, printed or drawn, to show how distances should be measured on a map
surveyor	(noun) A person who takes measurements of the land in order to determine boundaries or provide data for a map of an area