
Early Surveying Experiences: Locating Witness Trees

Activity Overview

Students practice early land survey methods using compasses and tape measures.

Objectives

Students will:

- Develop skills in use of geometric measurements
- Practice compass proficiency and taking bearings of objects
- Experience how early surveyors surveyed the land

Subjects Covered

Science, Math, and Social Studies

Grades

3 through 12

Activity Time

1 hour

Season

Any

Materials

Survey markers (surveyor's flags or stakes), site map, compasses, 100 foot measuring tape, d.c.h. tape (see "Measuring Tree Size"), clipboards, tree field guides, student field sheets - Field Notes and Instructions, and pencils

State Standards

Science:

Identify how technology is used in someone's job (G.4.1)

Use scientific equipment (C.4.4)

Determine how science discoveries change technology (G.4.3)

Social Studies:

Map physical, natural, or human features (A.4.2)

Identify & examine sources of information about history (B.4.1)

Use & evaluate primary sources of information (B.8.1)

Explain different interpretations of events (B.8.4)

Background

The public lands of the United States are primarily surveyed in uniform rectangular square, six-mile tracts called townships. Townships are further subdivided into thirty-six square, one-mile tracts called sections. The chief purpose of the public surveys is to establish permanent corners of the public lands to physically mark the location of the described townships and sections. Principal corners are established at township corners, sections corners, quarter-section corners, and meandering corners are established around lakes and rivers.

However accurate the surveyors measured and divided the land, if the corners were not durable, confusion and disputes over land ownership would surely result. This was particularly important when the number of American farms increased from one-and-a-half million to nearly six million between 1850 and 1900. Surveyors utilized two strategies to insure corners would remain fixed. They installed sturdy corner markers or monuments and made use of nearby objects as witnesses.

Four-sided stones and posts, or trees—all with specific size requirements were used as monuments. If neither stones nor trees were available, corners were marked with mounds of earth erected around posts. Charcoal or charred sticks had to be deposited twelve inches below the surface and against the north side of the post. This type of mound monument is common in the prairie lands.

Whenever possible two or more nearby trees "witnessed" a corner monument. The process of establishing a witness tree involved identifying the species, taking its bearing, and measuring its diameter and distance from the corner marker. In prairie regions, two-foot square rectangular pits were dug near the corner. Surprisingly, these pits worked well because the grass sod grew down into the pits preserving them from obliteration.

Pre-activity preparation:

1. Discuss how early surveyors surveyed townships and located witness trees for survey markers.
2. Place the survey markers along north-south, east-west lines for a mock township or section, or integrate survey markers into the school base map.

Alternative idea: Don't set up the survey markers ahead of time, instead choose a point to begin and have the students place survey markers at regular intervals on north/south and east/west lines. At each marker have students identify and record the witness trees. This option will take more time but is also more realistic.
3. Practice using a compass and reviewing compass parts. (See Earth Partnership for Schools activity, "Compass Basics.")

Early Surveying Experiences: Locating Witness Trees (cont.)

Math:

Recognize & describe measurable attributes & units (D.4.1)

Demonstrate understanding of measurement (D.4.2)

Read & interpret measuring instruments (D.4.3)

Determine measurements by using standard tools (D.4.4)

Demonstrate understanding of measurement facts, principles, techniques (D.8.2)

Determine measurement directly by using standard units (D.8.3)

Work with data in real-world situations (E.4.1, E.8.1)

Activity Description

See student handout, “Locating Witness Trees: Field Notes Instructions.”

Extensions

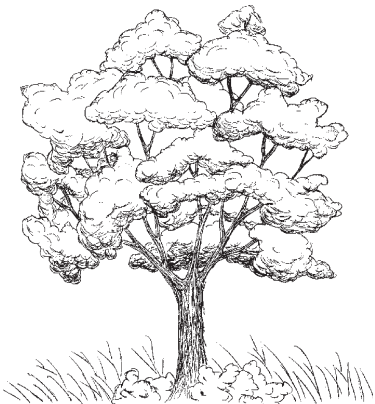
- Don’t set up the survey markers ahead of time, instead choose a point to begin and place survey markers at regular intervals on north/south and east/west lines.
- Survey a mock township. After completing the activity ask students from a different class to locate corners using field notes.
- Invite a land surveyor to the classroom to learn about modern day surveying techniques and equipment.

Additional Resources

- Estopinal, S. V. (1992). *A guide to understanding land surveys*. Wiley; 2 edition.
- Penson, M. (2004). *Billy Bardin and the witness tree*. Texas Christian University Press.
- Robillard, W. G., Wilson, D.A. (2001). *Evidence and procedures for boundary location*. Wiley; 4 edition.

Assessments

- In what ways, both positive and negative, did surveying affect the development and use of the land?
- How are ecologists and botanists able to decipher the composition of the original Wisconsin vegetation based on the early surveys?
- Briefly explain how the land is divided into townships and sections?
- What were the motivations and the reasoning behind dividing the land into townships and sections?



Locating Witness Trees: Field Notes Instructions

You are surveying your school grounds and need to identify permanent witness trees for the survey markers. The survey posts are installed. You will choose the two closest trees that are north and south of the survey marker. These trees will be the witness trees.

Directions for establishing the north witness tree:

Step 1. Stand at the survey marker. Hold the compass level and a little higher than waist high. Rotate the dial to line up the letter N (for north) with the direction arrow.

Step 2. Turn your entire body, while holding the compass stationary, and line up the magnetic needle with the letter N. In other words, put “Fred” (the magnetic needle) into the “red shed” (the red arrow painted on the compass housing). You are now facing north. Locate the closest tree north of the survey marker. Identify the tree.

Example: bur oak (BO).

Step 3. Next, determine the bearing (degrees away from north) of the bur oak. Again hold the compass level and a little higher than waist high. While holding the compass stationary, turn your entire body so that you are facing the witness tree. Rotate the dial until you line up the magnetic needle with the letter N. The direction arrow is now pointing to the tree, and the magnetic needle is pointing to the letter N. Record the bearing number that lines up with the direction arrow.

Example: N 13^oE (N = the north witness tree, 13^o = the compass bearing for the tree, E = that the tree is east of the survey marker.)

Step 4. Measure the distance from the marker to the tree.

Example: 15 feet.

Step 5. Measure the d.c.h. (diameter at chest height) with a d.c.h. measuring tape.

Example: 34 inches.

Step 6. Record this information in the format surveyors used in their field notes.

Surveyors recorded:

- 1) species,
- 2) d.b.h. ins. diam.
- 3) bears N #^o E (identifies north witness tree bearing in degrees),
- 4) # feet dist. (distance from survey marker)

Example: bur oak, 34 ins. diam., bears N 13^o E, 15 feet dist. Some surveyors wrote a simplified version that read: BO 34 N 13E 15 feet.

Directions for establishing the south witness tree:

Step 1. Stand at the survey marker. Hold the compass level and a little higher than waist high. Rotate the dial to line up the letter S (for south) with the direction arrow.

Step 2. Turn your entire body, while holding the compass stationary, and line up the magnetic needle with the letter N. In other words, put “Fred” (the magnetic needle) into the “red shed” (the red arrow painted on the compass housing). You are now facing south. Locate the closest tree south of the survey marker. Identify the tree.

Example: white oak or WO.

Locating Witness Trees: Field Instructions

Step 3. Next, determine the bearing (degrees away from south) of the white oak. Again, hold the compass level and a little higher than waist high. While holding the compass stationary, turn your entire body so that you are facing the witness tree. Rotate the dial until you line up the magnetic needle with the letter N. The direction arrow is pointing to the tree and the magnetic needle is pointing to the letter N. Record the bearing number that lines up with the direction arrow.

Example: S 230°W.

Step 4. Measure the distance from the marker to the tree.

Example: 22 feet distance.

Step 5. Measure the d.c.h., diameter at chest height with a d.c.h. measuring tape.

Example: 18 inches diameter.

Step 6. Record your information in the format surveyors used in their field notes.

The surveyors recorded:

- 1) species,
- 2) d.b.h. ins. diam,
- 3) bears S #° W (identifies the south witness tree),
- 4) # feet dist. (distance from survey marker).

Example: WO, 18 ins. diam., bears S 230°W, 22 feet dist. or WO 18 S 230W 22.

Locating Witness Trees: Field Notes

Directions: Follow the attached "Field Notes Instructions" to identify and locate witness trees for each survey post. Fill out one Field Note sheet per survey post.

Surveyor's names: _____

Survey post: _____

Location: _____

Describe surroundings including topography and vegetation: _____

North Witness Tree:

1. Species: _____

2. d.c.h. _____

3. Bearing (degrees away from north): _____

4. Distance from marker: _____

Record as a field note entry: _____

South Witness Tree:

1. Species: _____

2. d.c.h. _____

3. Bearing (degrees away from south): _____

4. Distance from marker: _____

Record as a field note entry: _____
