Squares Everywhere

Overview

Squares are important shapes for archaeologists. With four equal sides and four equal angles, squares are easy to make, easy to use, and easy to replicate. In this lesson, students figure out why archaeologists use squares and then practice making perfect squares of their own.

Objectives

Students will:

- locate squares in the world around them
- hypothesize why archaeologists use squares
- use geometry to make squares of their own

Core Standards of Kit

2.2 Problem Solving Process
6.4 Historical Connections
6.6 Being a Historian

Additional Standards

2.6 Reasoning and Problem Solving/Application
3.10 Teamwork
7.7 Geometric and Measurement Concepts

Age Level

Grades 6-12 / Ages 11-18

Time

1 hour

Materials

Each group needs:

- compass (not in kit)
- roll of masking tape (not in kit)
- 2 measuring tapes (not in kit)
- protractor (not in kit)

Background

Look around. How many squares can you see? There are squares everywhere – on calendars, on maps, on chessboards, and on tile floors. Squares are easy to make and easy to use because they have four equal sides and four equal angles. Archaeologists dig sites in squares that align with a large grid of the site. Like cartographers, archaeologists assign coordinates to the squares that coincide with their location on the grid.

In addition to using squares, archaeologists use compass directions to orient their pits. Archaeologists start with a single datum point. All other points, often marked with nails, are relative to this starting point. This system of organization allows archaeologists to create a large grid in the field, regardless of the terrain.

There are many ways to create perfect squares. One method was explained in detail in the "History Under Their Feet" lesson plan. This lesson introduces another method, called triangulation, that archaeologists often use in the field. The students will work in teams to create a 1-meter x 1-meter square in the classroom.

Procedure

1. Ask the students to look around the classroom for squares. How many do they see? Where are squares outside of the classroom? Have students list places where multiple squares are used in a pattern such as a chessboard, tile floor, calendar, bingo game, quilt, or computer keyboard.

2. Hypothesize why squares are often repeated. When squares are the same size, they can be stacked top-to-bottom or side-to-side in a neat, orderly manner. Squares can be combined to make a larger square. Squares can fit together without leaving a gap in between. Squares can be flipped over or spun around and still be a square. And squares are easy to make!

3. Ask the students to define what makes a square. A square is a quadrilateral (four-sided figure) with four equal sides and four equal angles. Each angle must be 90°, a right angle.

4. Divide the class into groups with 3 or 4 students each. Push desks aside so there is room on the floor for each group to mark a 1-meter x 1-meter square. With a small, round sticker, mark a starting point for each group.

These dots represent the nails that archaeologists use to lay out their grid. The dots should be on the same large axis so that the measured squares can be part of one grid but do not overlap. (If the classroom floor has tiles, use the lines to help lay out the starting points.)

5. Give each group:
   - a compass
   - a roll of masking tape
   - 2 measuring tapes (with meter markings)

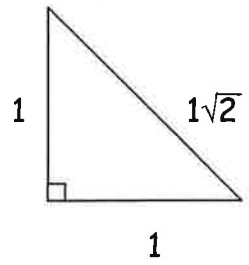
6. Challenge the students to mark a 1-meter x 1-meter square on the floor with the masking tape, starting with one of the dots. The square should be to the <u>north</u> and <u>east</u> of the starting point. Measure the inside edge of the masking tape. (Archaeologists use string in the field.)

7. Allow students time to work out the problem. If necessary, offer suggestions about using the compass to orient the first side of the square. (Measure one meter from the starting point to the north.)

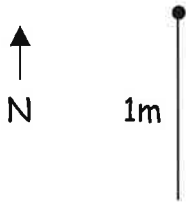
8. For older students who have studied some geometry, you may want to offer the clue that $\sqrt{2} = 1.41\overline{4}$. Archaeologists use this calculation in the field, as explained in full below.

9. When all groups have finished, ask each group to explain how they made their square. Examine the squares. Are they all on the same grid? Why or why not? Is a handheld compass a truly scientific instrument on which to base the squares? Do all of the squares look square? How could the students check if their square is a perfect square? One method is to use protractors to measure the angles and tape measures to check the sides.

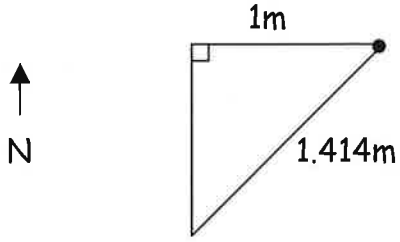
10. Demonstrate how many archaeologists mark out the squares in the field using the mathematic principle of triangulation. The measurements are made based on a 45°-45°-90° triangle where the sides measure 1-1-$1\sqrt{2}$. ($\sqrt{2} = 1.41\overline{4}$)



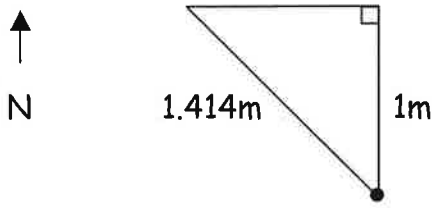
First, measure and mark one meter to the north of the starting point.



Next, measure 1 meter to the right of the northern point while measuring 1.414 meters diagonal from the starting point. The place where these two measurements intersect is the northeast corner of the square.



Follow the same method to locate the southeast corner of the square.



Connect the southeast corner with the starting point. The distance between the two points should be 1 meter.

The end result should be a perfect square with four equal sides and four equal angles!

11. Have the students check their floor squares using the diagonals. Each diagonal should measure 1.414 meters. If necessary, have the students adjust their squares.

Evaluation

Ask the students to make perfect squares of different sizes, like 50cm x 50cm, or 2m x 2m. Check the corner angles with protractors.

What Next?

Once archaeologists have mastered making squares, they need to break the large squares into smaller squares in order to map the artifacts. Use the "Big Square, Little Square" lesson to work with coordinates and mapping.