How Tall is That Tree?

Outdoor Lesson Plan from Urban Adventure Squad for: Friends of the National Arboretum/Washington Youth Garden Summer Institute for Garden-based Teaching

This is a 30-minute lesson plan, and all materials are provided here. This lesson can be adapted for various grade levels; we have used a version of it for grades 1 through 8. This lesson can be an entry point or hands-on activity for units in science, history, engineering, or math.

Materials:

60-inch tape measure
Printed cards:

1. **circle and square shapes**
2. **triangle showing angles**
3. **“Types of Triangles”**
4. **photo of student looking at tree**
5. **drawing of student looking at tree**

Optional: calculators. Students can also calculate the numbers on paper or in their heads.

0:00-0:15 INTRODUCTION: MEASURING THE HEIGHT OF A TREE

If you wanted to measure the height of a tree, how would you do it?

- Listen and respond to student ideas.

Did you know there is a way to measure the height of a tree without climbing to the top? We’re going to practice it today!

Teacher resource: Much of the text below as well as the background info is excerpted and adapted from: https://nrich.maths.org/2434

Early humans started living together, creating communities, and making tools to help them with their daily lives. One thing they needed to measure was the height of tall structures like trees. They needed to know if the wood would be large enough to use as strong beams to support a building, to make a boat, or maybe even to act as a roller for moving large stones for buildings.

Over time, foresters, builders, surveyors, map makers, and scientists have created special tools to help them accurately measure the height of trees, buildings, and other tall structures. But what did they do before those tools were invented?

Some of the early ways of measuring the height of tall structures are still in use today. They require very little equipment and can be used out in forests where special equipment is hard to come by.

METHOD: CREATING A 45-DEGREE ANGLE

Let's talk about shapes (show circle and square example cards).

How is a circle different from a square?

- Listen and respond to students' answers. Guide younger students to using terms like, "sides" and "angles."

How is a square different from a triangle?

- Listen and respond to students' answers.

Did you know there are different kinds of triangles?

- Listen and respond to students' answers.

The Triangle We'll Use Today: The Right Triangle

Using the right triangle card, explain that this is the triangle we'll use today. We'll practice a posture that should help us create a 45-degree angle from our eyes up to the top of the tree. This will help us figure out how tall a tree is!

Native Americans had an interesting and unusual way of seeing how tall a tree was. They would bend over and look through their legs!

They would walk far enough from the tree to find a place where they were just able to see the top of the tree (from their upside down position). The distance from this place to the base of the tree was approximately the height of the tree.

Does it work? Actually it does and the reason is rather simple. The angle that is formed as you look through your legs is approximately 45 degrees. The angle between the tree trunk and the ground is fairly close to 90 degrees and, using what you know about the angles and sides of a triangle, you can work out the height of the tree.

The height of the tree and the distance from the tree to the person is about equal. Therefore, knowing the distance to the tree gives you a good idea about the height of the tree. It certainly saves having to carry heavy surveying equipment around.

0:15-0:30 LET'S TRY IT!

Show the two cards demonstrating the posture.

Students can now test this method using a measuring tape to measure the distance from tree trunk to where they stood looking upside down, between their legs. That distance is about the same distance as the height of the tree.

Ask students to choose trees in the area where you're doing this lesson. Measure at least three trees. Give students rotating jobs: calculator (if you're using one or more), measuring tape, etc.

When measuring trees, use the following steps:

1. **Hypothesis:** How tall do you think this tree will be?
2. **Measurement:** What do you get using the right triangle method?
3. **Discuss:** How close was your hypothesis to the accurate value? Why do you think your hypothesis was close or far away to your measurement?

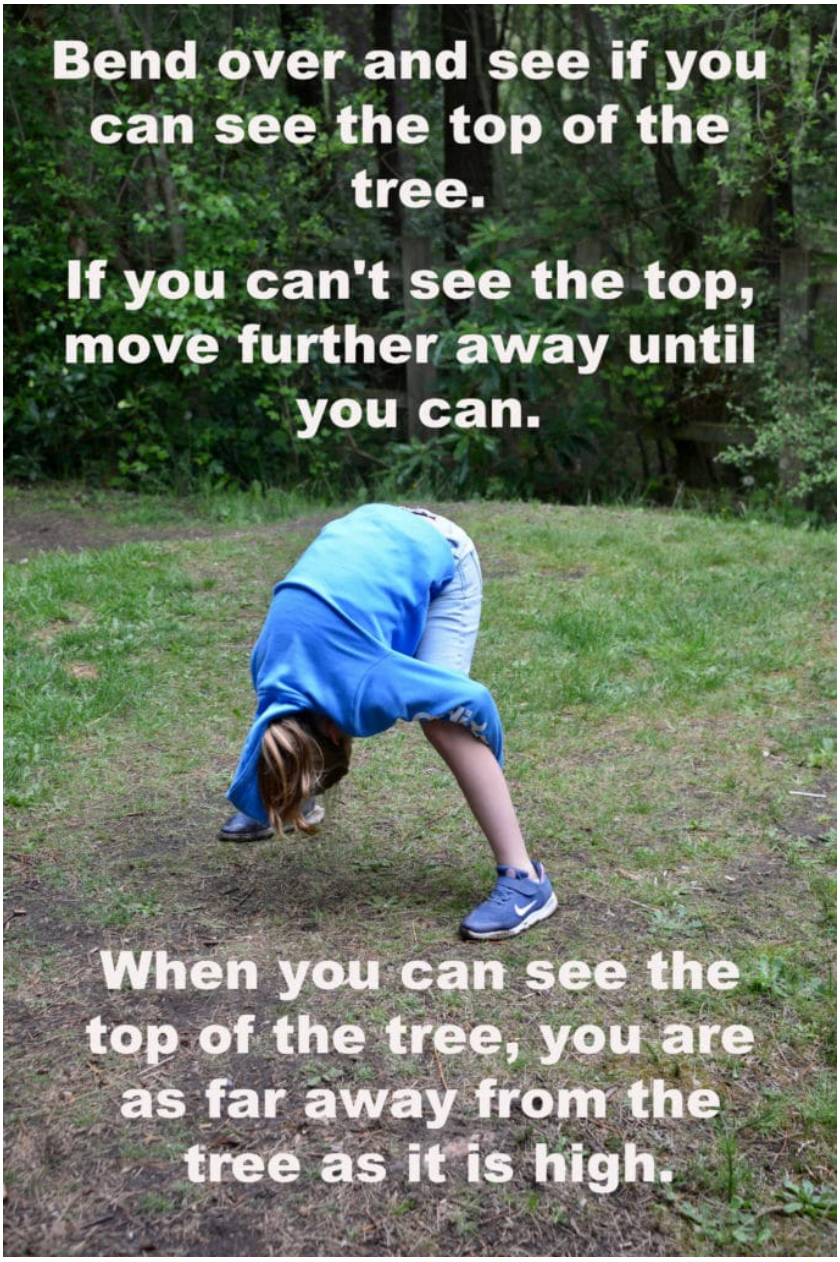


Image from: https://www.science-sparks.com/how-tall-is-a-tree/

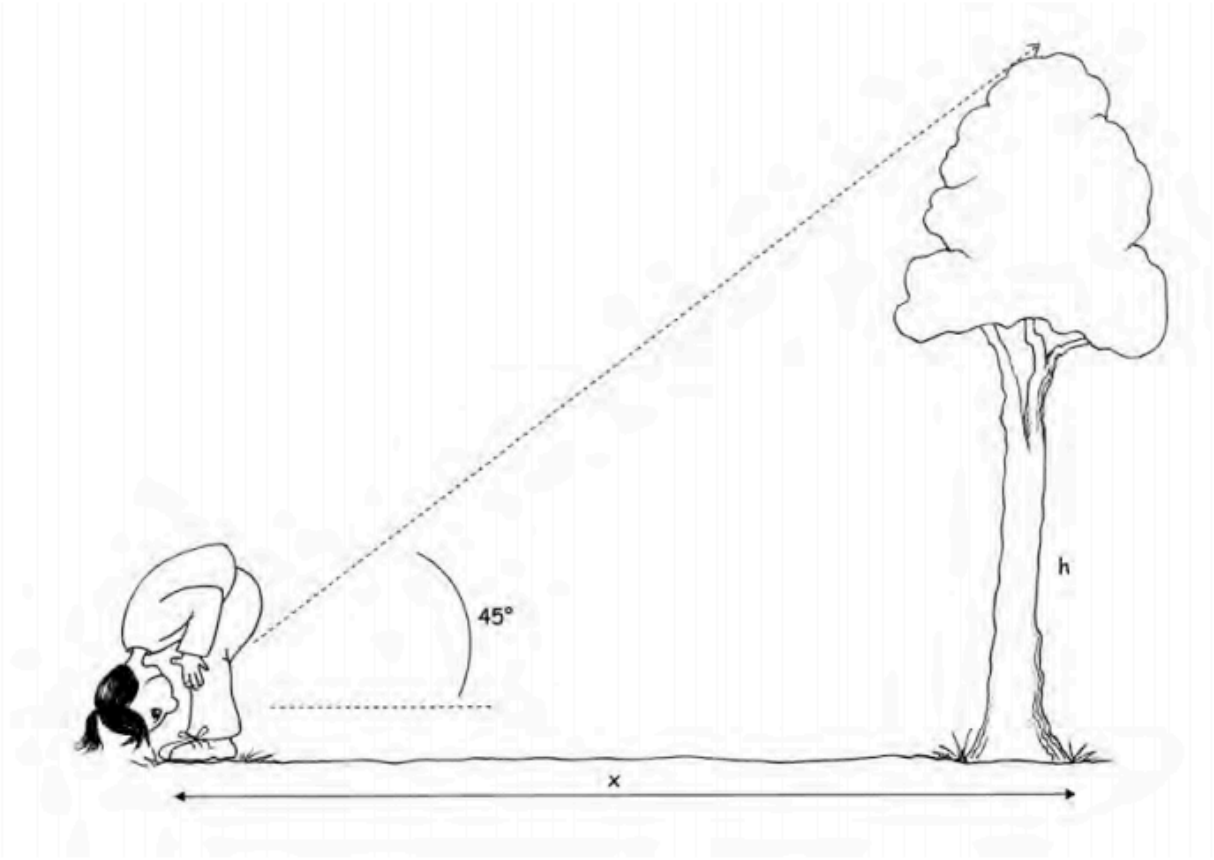
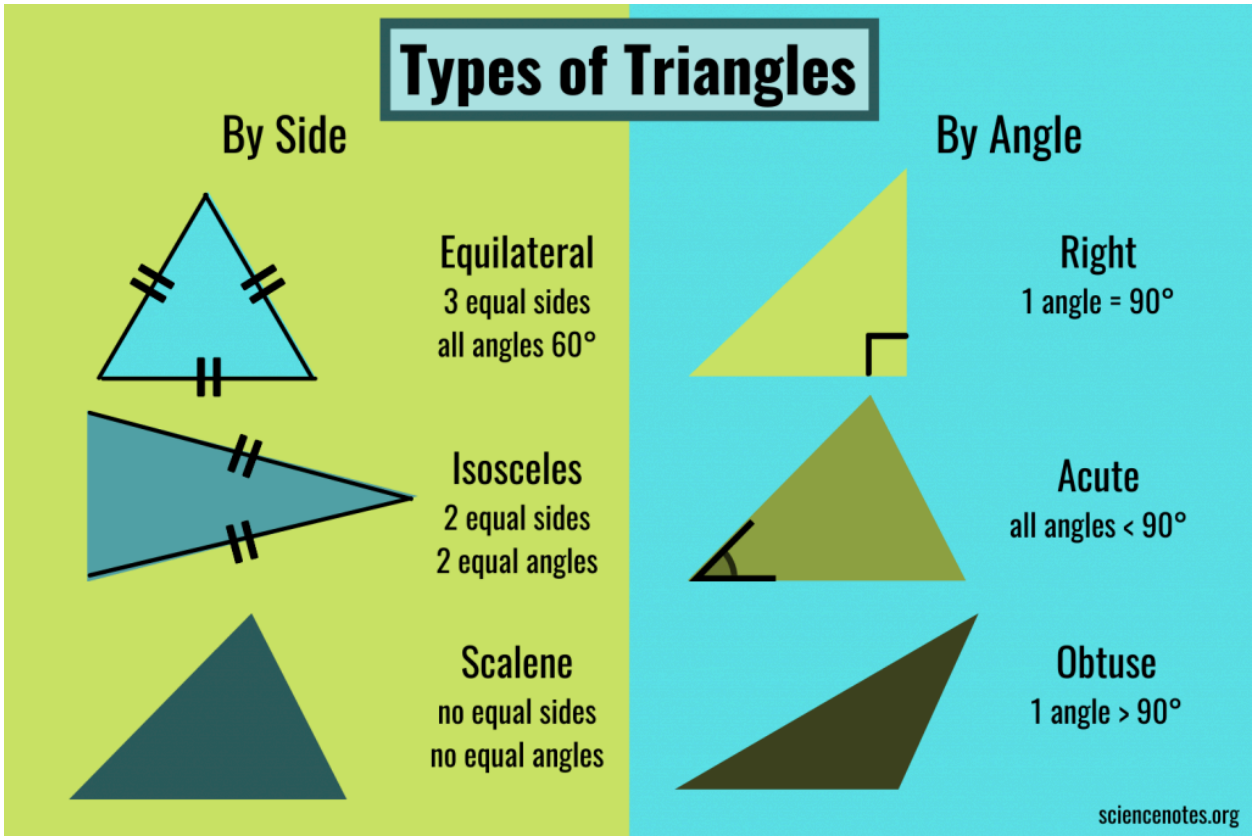


Image from
https://www.wildaboutvancouver.com/outdoor-learning/tech-free-way-to-measure-the-height-of-a-tree


Types of Triangles
By Side
By Angle
Equilateral
3 equal sides
all angles 60°
Isosceles
2 equal sides
2 equal angles
Scalene
no equal sides
no equal angles
Right
1 angle = 90°
Acute
all angles < 90°
Obtuse
1 angle > 90°
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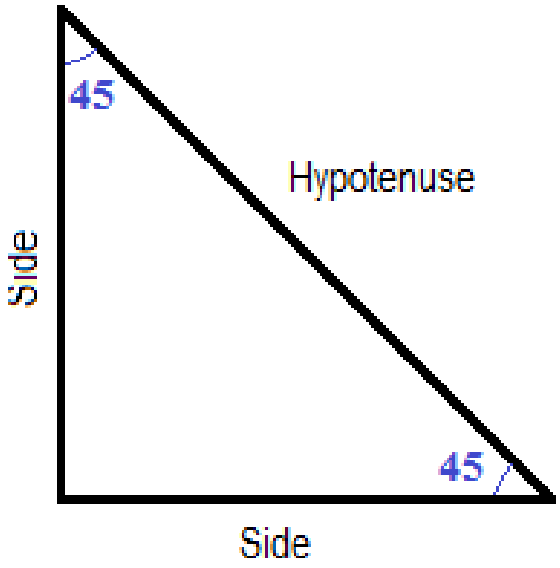
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