

# Trigonometry

## Math Lessons for Grades 9-12

### Topic: Sine

#### Discovery Approach

Students may feel confused when introduced to concepts of sine, cosine, tangent and cotangent. If introduced individually, these definitions can seem arbitrary, meaningless, abstract and unnecessarily redundant. One approach that may help is to establish an environment in which students can discover why and how these concepts relate through interactive demonstrations.

One specific example - how to indirectly measure the height of a tree - is used to illustrate the main points. Click on the "Tree Example" Rich Media link to start the visual module. As shown, it is not an easy task to directly measure the height of the tree. However, it is relatively easy to directly measure the distance between the base of the tree and a chosen point on the ground. Drag the vertical side of the initial right triangle to form more similar triangles. A "ratio pattern" should be revealed as more similar right triangles are formed. Most students can "see" the measure of the height without doing any complicated computations.

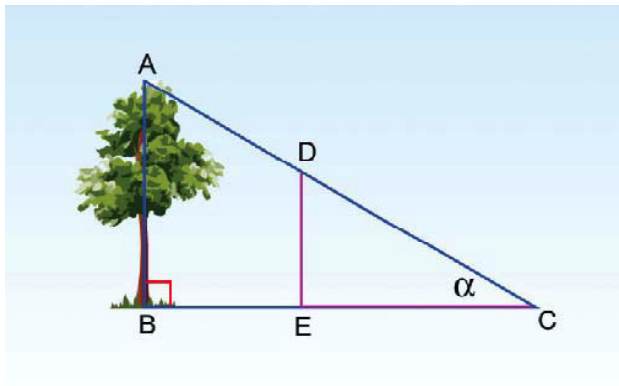
If we follow the steps shown above to determine the height of a tree, we need to measure three different distances that involve the triangle formed by the tip of tree, the base of the tree and a chosen point on the ground as well as a corresponding similar triangle. Is there an easier way to accomplish the same task? Start the interactive Tangent Experiment to see.

- Launch the rich media "Tree Example" found under Trigonometric Functions > Functions of Acute Angles > Tangent (abbr. tan).

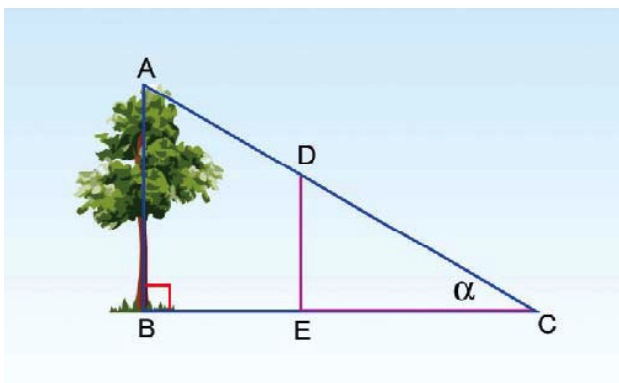
- Launch the rich media "Tangent Experiment" found in the same location.

After conducting the experiment, answer the following questions:

- 1) Can we determine the ratio of the length of the opposite side to that of the adjacent side once the angle is determined? Do you see why the table of trigonometric functions was created?
- 2) Would it be easier to measure the distance BC and the angle  $\alpha$  instead of the three distances DE, EC and BC? Which is easier to measure, the length of the vertical side DE or the angle  $\alpha$ ?



- 3) Does the following set up another alternative for measuring the height of a tree?



- 4) Why do we provide multiple ratios in the table of trigonometry functions? When one is accurately determined for a given angle, all the ratios can be calculated. Why do we still list all of them? (One ratio is more convenient than others depending on which angle and side are available at the moment. That is why we made all ratios readily available.)