

# Unit Circle and Right Triangle Functions

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**Description:** Students explore the relationships between the unit circle definitions of trigonometric functions and the right triangle definitions. They then combine the two models and examine the similarities and differences that emerge.

**Technology Strength:** By working with two dynamic models, a unit circle and a right triangle, to define the three primary trigonometric functions, students can easily investigate the trigonometric functions and their properties. By then merging these two models into one, students can easily compare the results from the two models and discover they are essentially the same, except for signs.

**Objectives:** Use a unit circle to define the trigonometric functions; use a right triangle to define the trigonometric functions; compare the unit circle and right triangle definitions of trigonometric functions

**Prerequisites:** Preferably, exposure to both right-triangle and unit-circle definitions of the trigonometric functions

**Suggested Grade Level:** 9 to 12

**Sketchpad Level:** Intermediate

**Suggested Duration:** 30 minutes

**Suggested Classroom Setting:** Whole Class, Student Pairs

**Preparation:** Review the Activity Notes. For a student-pairs activity, preview the student sketch, work through the steps on the worksheet, and make a copy of the worksheet for each student. For a whole-class presentation, use the presentation sketch.

**Materials:** None

**Student Worksheet(s):** Unit Circle and Right Triangle Functions

**Student Sketch:** Unit Circle Right Triangle.gsp

**Presentation Sketch:** Unit Circle Right Triangle Present.gsp

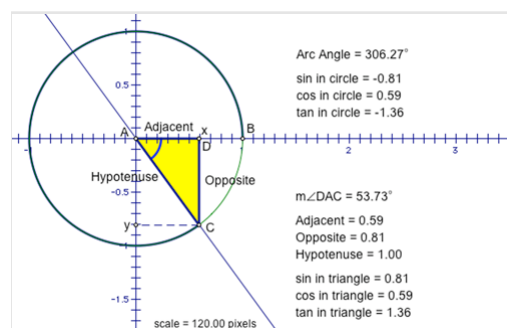
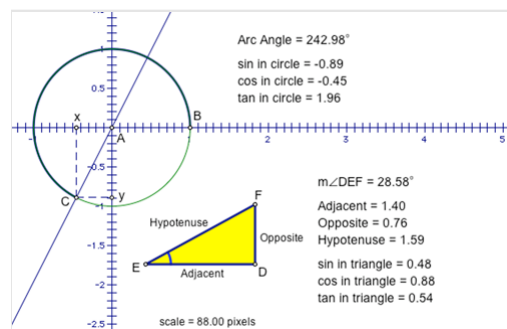
**Vocabulary:** Unit circle

**Sketchpad Version:** GSP5

## Using the Sketch:

Students are given both a unit circle and a right triangle. The unit circle has center  $A$  at the origin and passes through the point  $(1,0)$ . Students measure the  $y$ - and  $x$ -coordinates of an arbitrary point  $C$  on the circle, along with the slope of the line through points  $A$  and  $C$ , then label these measurements *sin in circle*, *cos in circle*, and *tan in circle*, respectively. Students drag point  $C$ , observe these calculations, and determine the smallest and largest values possible for each one and where these maximums and minimums occur.

Next, students measure the lengths of the three sides in a right triangle, labeled  $DEF$ , calculate three ratios with these measurements, and label them *sin in triangle*, *cos in triangle*, and *tan in triangle*. Students drag point  $F$ , observe these ratios, and again determine the smallest and largest values possible for each one. They now use the Merge command to merge these two models together, and use the merged model to compare the two methods for defining trigonometric functions. Students drag point  $C$ , observe the measurements, determine why the trigonometric functions agree in some quadrants but not in others, and then discuss the possible advantages and disadvantages for each method.



## Sketch Tips:

Sketch Tips show skills needed in this activity, and the step at which the skill is first used.

Sketch Tip	Tip Sheet or Tip Video
Step 1: Change an object's label with the <b>Text</b> tool	Using the Text Tool
Step 2: Measure the coordinates of a point using <b>Measure   Abscissa</b> , <b>Measure   Ordinate</b> , or <b>Measure   Coordinates</b>	Measuring Coordinates
Step 4: Measure an angle by selecting three points and using <b>Measure   Angle</b>	Measuring Angles
Step 6: Click a value in the sketch to enter it into the Calculator	Using the Calculator