Cartesian Graphs and Polar Graphs

Description: Students compare rectangular graphs and polar graphs for functions in the form $y = a\sin(bx)$ and $r = a\sin(b\theta)$. They find connections between the two types of graphing when they analyze how the period and amplitude of a Cartesian graph correlate with features of the corresponding polar graph. They make predictions as to how changing a and b will affect the polar graph and then check their predictions.

Technology Strength: By having the polar graph and the cartesian graph of a function side-by-side and a pointer that shows the plotted point for a particular value in both systems, students can explore and compare plotting functions in both coordinate systems and make connections between the two types of graphing.

Objectives: Explore and compare various functions plotted in both rectangular coordinates and polar coordinate; use an understanding of Cartesian graphing to better understand polar graphing

Prerequisites: Familiarity with the graphs of sinusoids, and specifically with the concepts of period and amplitude

Suggested Grade Level: 11 to 12

Sketchpad Level: Beginning

Suggested Duration: 20 minutes

Suggested Classroom Setting: Whole Class, Student Pairs. This activity, designed for use by student pairs, can be easily modified for whole-class use.

Preparation: Review the Activity Notes. Preview the student sketch. Work through the steps on the worksheet and make a copy of the worksheet for each student.

Materials: None

Student Worksheet(s): Cartesian Graphs and Polar Graphs

Student Sketch: Cartesian Polar.gsp
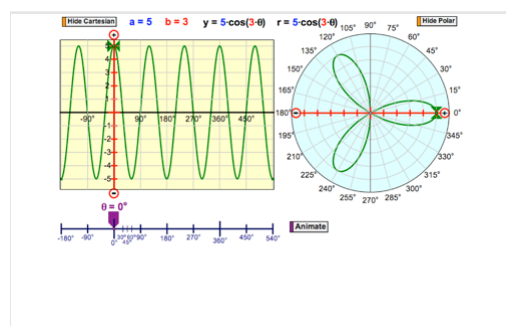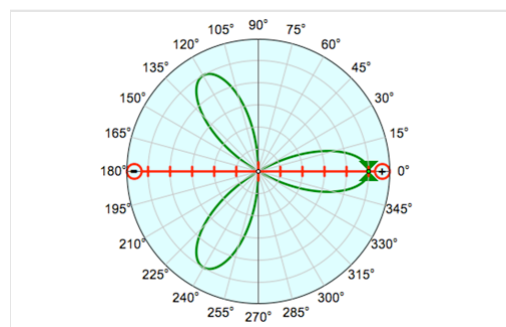
Presentation Sketch: None

Vocabulary: Cartesian plane, polar plane

Sketchpad Version: GSP5

Using the Sketch:

On page 1 of this sketch, students compare rectangular graphs and polar graphs for functions in the form $y = a\sin(bx)$ and $r = a\sin(b\theta)$ where a and b are parameters and the independent variables (x and θ) are controlled by a single slider. The coordinate systems are side-by-side and the point corresponding to the current value of θ (or x) is plotted and marked on both systems with a red bar for the independent variable and a green bowtie for the dependent variable. Students find connections between the two types of graphing by adjusting the value for θ and comparing the locations of the red bar and bowtie for the two graphs. They then make predictions as to how editing the parameters a and b will affect the polar graph and then check their predictions.

In the Explore More section, students use page 2 of the sketch to investigate the polar graph of $r = 2\sec(\theta)$ and on page 3, students are challenged to use the parameters a and b and make up their own functions and try them out in both systems.

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 2: Change the value of a number (parameter)	Changing Parameters
Question 10: Edit a function by double-clicking with the **Arrow** tool	Creating and Editing Functions
Question 10: Click a value in the sketch to enter it into the Calculator	Using the Calculator