Plotting the Derivative

Description: Students approximate the derivative by constructing a secant line between two points on the graph of a function and graphing the value of the secant's slope. They improve the approximation by moving the points that determine the secant closer together. They edit the original function and practice predicting the shape of the derivative graph from the shape of the function graph.

Technology Strength: By using the slope of a dynamic secant line to graph approximate derivative values, student master the relationship between the secant's slope and the function's graph. By moving this line, students can explore how to create an approximate graph of the derivative.

Objectives: Explore the relationship between a function and its derivative; graph the approximate derivative values using the slope of the secant line; relate the shape of the function's graph to the slope of the secant line; approximate a graph of the derivative; predict and trace a given function's derivative

Prerequisites: Familiarity with the concept of the derivative of a function at a point

Suggested Grade Level: 11 to 12

Sketchpad Level: Intermediate

Suggested Duration: 45 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. See the presentation sketch for an example of completed student work.

Materials: None

Student Worksheet(s): Plotting the Derivative

Student Sketch: PlotDerivative.gsp

Presentation Sketch: PlotDerivative Work.gsp

**Vocabulary:** Derivative function, locus

Sketchpad Version: GSP5

Using the Sketch:

In this sketch, students construct a dynamic secant line to a cubic function and plot a point whose *y*-value is the slope of the secant line. By dragging the secant line along the function, the plotted point traces out the average rate of change of the cubic function.

By placing the points of the secant line very close together and animating them to move them smoothly along the function plot, students can trace a very good approximation of the plot of the derivative.

Students further improve their plot of the approximate derivative function by fixing the distance between points *P* and *Q*, making that distance very small, and constructing the locus of the plotted slope as point *P* moves along the function. They use this locus to examine the relationship between the function and their approximate derivative.

In the Explore More section, students make a button to hide the locus, adjust some sliders to change the cubic function, and then use their discoveries to predict the shape of the new cubic's derivative. They press the *Show Locus* button and check their prediction. On page 2, they predict what the derivative will look like for several given non-polynomial functions.
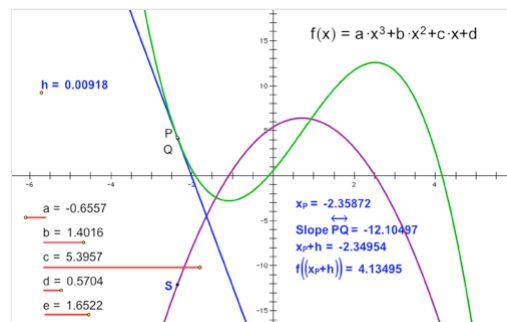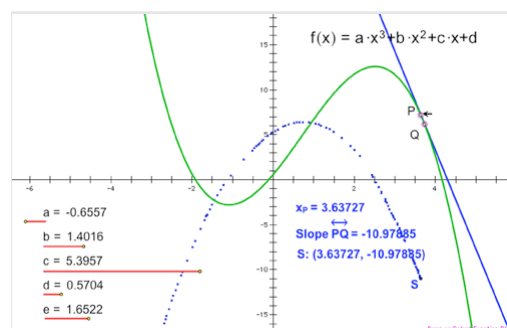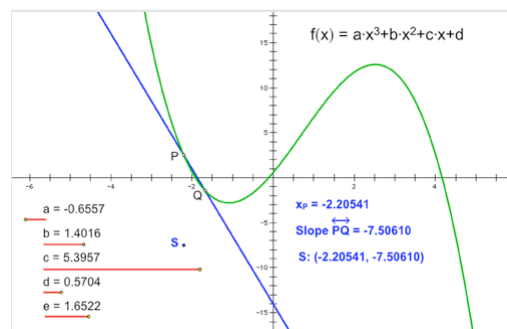
Sketch Tips:
Sketch Tips show skills needed in this activity, and the step at which the skill is first used.

Sketch Tip	Tip Sheet or Tip Video
Step 2: Label an object with the **Text** tool	Using the Text Tool
Step 3: Measure the coordinates of a point using **Measure | Abscissa, Measure | Ordinate,** or **Measure | Coordinates**	Measuring Coordinates
Step 5: Plot a point by selecting two values and using **Graph | Plot as (x,y)**	Plotting Points
Step 6: Trace an object using **Display | Trace**	Tracing
Step 8: Animate an object using **Display | Animate**	Animating
Question 4: Show the Motion Controller using **Display | Show Motion Controller**	Animating
Step 9: Split a point from a path using **Edit | Split**	Splitting and Merging Points
Step 10: Calculate an expression using **Number | Calculate**	Using the Calculator
Step 12: Merge two points using **Edit | Merge Points**	Splitting and Merging Points
Step 13: Construct a locus using **Construct | Locus**	Constructing a Locus
Explore More 1: Create a Hide/Show button using **Edit | Action Buttons | Hide/Show**	Making Hide-Show Buttons