

Name: _____ Date: _____ Period: _____

Now that you are familiar with Geometer's Sketchpad, let's take a look at how to find the tangent line and slope value for any point on a given curve.

Graph an Equation

First, start by opening up a new sketch pad under the **File** tab click on New Sketch.

- Under the **Graph** tab, click on the first option that should say Define Coordinate System.
- Now that you have your x and y axis, locate the two red points on the x-axis. The point on the origin allows you to re-center your grid and the point at $x = 1$ allows you to zoom in and out. Play around with both points so you can get familiar.

- Go to the **Graph** tab again and click on Plot New Function. In the pop-up screen, type the function you want to graph, for this activity we will graph x^2 which means x^2 . However, click on the other options on the side so you can see what other types of equations you can graph. Once you type the equation, click okay. You should end up with a parabola with the vertex at the origin.

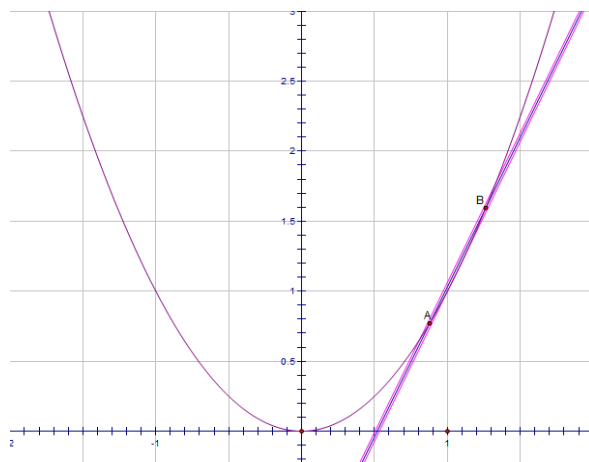
- Re-center so you can see more of the positive y-axis and zoom in/ out so you can get the values $[-4, 4]$ on the x-axis (it does not have to be exact).

- Now create two distinct points on the graph by clicking on the toolbar at the left of the screen. Put the point on the graph by dragging somewhere on the curve and left click the mouse once the curve is highlighted (this is letting you know the point is on the curve).

Label this point A by going to the text icon on the toolbar. Follow the same directions to create the second point (different from point A) on the curve, but label this second point

B.

- Once you have your two points on the curve, create a line connecting both points by clicking on the line icon on the toolbar on the left and then highlight both points. Click on the Straight edge Tool until the other options appear to make sure that you create a line and not a line segment. Your picture should look like this.



Tangent line and Slope

Now that you have created a secant line, you can move around the points and the line follows the points.

- To calculate the slope of the line, highlight the line and click on the **Measure** tab. Under the options, click on slope. A box should appear on the top with the value of your slope.
- Notice that that you can create a tangent line by bringing the points very close to each other, if the points overlap, then the line disappears but leaving the points very close to each other gives you a close approximation of the slope of the tangent line.
- Try to create tangent lines at various points on the curve and record the x value and the slope you get from the tangent line on the table below.

X- value	Slope
1	≈ 1.99

Do you think there is a way that all these slope values are related?

Is there a relationship between the slope value and the x-value?

Graphing the Derivative

The slope of the tangent line created can be calculated with the use of a derivative, which is what you were looking at once you created your tangent line. The derivative is the equation you can use to find the slope of the tangent line at any given x-value.

We will learn how to find a derivative mathematically in class after this activity, but Geometer's Sketchpad can also find the derivative for you.

- Click on your parabola equation ($f(x) = x^2$) and a pink box will highlight the equation. Now go to the **Graph** tab and click on Derivative.
- A new equation will appear and it will be $f'(x) = 2x$. Right click your mouse on the equation and click on Plot Function.
- Now go back to your previous table and find the y-values (from your derivative) associated with the x-values from your table. Did you see how close your slope values were from the actual values found from the derivative?

Congratulations! You have learned a very important concept in calculus called derivatives. Now complete the following exercises using the steps we used in this activity.

Exercises

1. Graph the equation $f(x) = \sin(x)$.

- Create a tangent line and record the slope at various x-values.
- Plot the derivative and record the y-values from x-values you recorded.

X-value	Slope	Y-value from derivative

2. Plot the following equations and find the derivative.

Equation **Derivative**

$f(x) = x^3$ $f'(x) =$

$f(x) = 4x^3$ $f'(x) =$

$f(x) = 5x^2 + 2x$ $f'(x) =$

$f(x) = 8$ $f'(x) =$

$f(x) = \cos(x)$ $f'(x) =$

3. Look closely at the relationships between the equations and the derivatives. Is there a pattern that you can see? Hint: Look at the coefficient and the exponents.