

# INTRODUCTION TO GEOMETER'S SKETCHPAD2

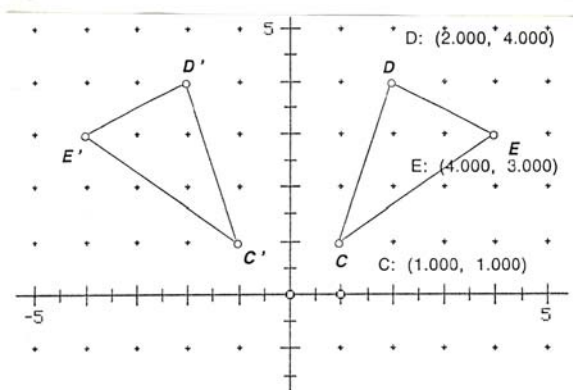
Participants are introduced to the basic applications of Geometer's Sketchpad.

| Lesson Goals  |
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| <ul style="list-style-type: none"> <li>❑ Learn ways to integrate Geometer's Sketchpad software into a mathematics classroom</li> <li>❑ Use Geometer's Sketchpad to explore transformations</li> <li>❑ Use Geometer's Sketchpad to create arcs and 3-dimensional figures</li> <li>❑ Use Geometer's Sketchpad to explore quadratic functions</li> </ul> |

| Word Bank                                     |   |
|---|---|
| <input type="checkbox"/> Geometer's Sketchpad | <input type="checkbox"/> Arc                |
| <input type="checkbox"/> Reflection           | <input type="checkbox"/> Function           |
| <input type="checkbox"/> Translate            | <input type="checkbox"/> Quadratic Function |
| <input type="checkbox"/> Dilate               | <input type="checkbox"/> Motion Controller  |
| <input type="checkbox"/> Rotate               | <input type="checkbox"/> Parameter          |

| ISTE National Educational Technology Standards  |
|---|
| <ul style="list-style-type: none"> <li>❑ I-A: Demonstrate introductory knowledge, skills, and understanding of concepts related to technology</li> <li>❑ II-A: Design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners</li> <li>❑ II-C: Identify and locate technology resources and evaluate them for accuracy and suitability</li> <li>❑ II-E: Plan strategies to manage student learning in a technology-enhanced environment</li> <li>❑ III-A: Facilitate technology-enhanced experiences that address content standards and student technology standards</li> <li>❑ III-B: Use technology to support learner-centered strategies that address the diverse needs of students</li> <li>❑ III-C: Apply technology to develop students' higher order skills and creativity</li> </ul> |
| Mathematics- In Brief   |
| <ul style="list-style-type: none"> <li>● Reflect figures on the coordinate plane</li> <li>● Create and identify geometric figures</li> <li>● Perform operations on quadratic functions</li> </ul>   |

## SKETCHPAD INVESTIGATION: REFLECTIONS



For this investigation, you will need to use Geometer Sketchpad in the computer lab or in almost any math classroom. Once you begin the investigation, if you have any questions, be sure to ask for assistance.

1. In a new sketch, choose *Define Coordinate System* under the **Graph** menu.
2. Draw triangle ABC with vertices on the grid. *Snap to Grid* should be checked in the **Graph** menu.
3. Find the coordinates of each vertex by selecting the point(s) and choosing COORDINATE under the measure menu.
4. Mark the y-axis (the vertical axis) as the mirror by selecting the y-axis and choosing MARK MIRROR under the transform menu. Then select the triangle and choose REFLECT.
5. Find the coordinates of the new triangle image created.

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**Questions...to be answered on a separate sheet of paper in full sentences, paragraphs, etc. Be thorough.**

1. a) Do you see a relationship between the coordinates of the vertices of your original triangle and the coordinates of the reflected triangle's vertices? Explain. Make a conjecture about a point and its new coordinates if it is reflected about the y-axis.  
b) Click on one of the vertices of your triangle and drag it to a new location. What happens?
2. a) If you were to mark the x-axis as the mirror and reflect your original triangle about it, predict what you believe would happen (don't actually do it yet---only predict!!). Explain how you came to your prediction.  
b) Check your prediction by actually marking the x-axis (horizontal axis) as the mirror and reflecting your original triangle about it. You may start a new sketch if you wish. Find the coordinates of this new image. (Be sure to print this out). Was your prediction correct?  
c) Make a conjecture about a point and its new coordinates if it is reflected about the x-axis.

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### Extension (Mandatory)

Start a new sketch (with a grid) and draw the line  $y = x$ . Draw a triangle on your grid and reflect it about the  $y = x$  line (in other words, use the  $y = x$  line as your mirror). What do you notice about the coordinates of the vertices of this new triangle image?

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### Items to be included when handing in this project

1. All printouts of triangles and reflected images. Be sure to scale them to fit the page before printing!
2. Responses to questions (that were written/typed out on a separate sheet of paper).
3. Extension investigation and your findings.

## SKETCHPAD CONSTRUCTIONS: ARCS AND FIGURES

### Constructing an arc

1. Using the Point toolbox along the left-hand side of the screen, create three points in the sketch area.
2. Select all three points, go to the CONSTRUCT menu and choose *Arc through 3 Points*.
3. Adjust any of the points as needed to make your arc as you desire.

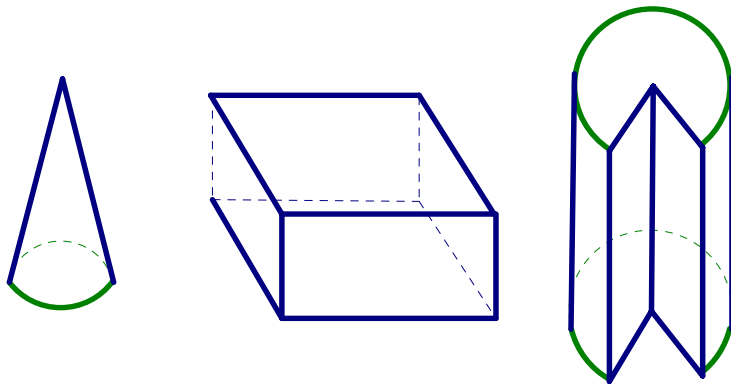
### Constructing an arc that is part of a circle

1. Using the Circle toolbox along the left side of the screen, create a circle in the sketch area.
2. Using the Point toolbox, create three points on the circle.
3. Select all three points, go to the CONSTRUCT menu and choose *Arc through 3 Points* It will look like nothing happened.
4. Selecting only the entire circle, go to the DISPLAY menu and choose *Hide Circle*. Only the arc of the circle should be left.
5. If you want your arc to be dashed instead of solid, go to the DISPLAY menu, choose *Line Width* and choose *dashed*.
6. If you want your arc to be thick instead of thin, repeat the above clicks and choose *thick*.

*Note: Thick lines are better when importing images into Microsoft Word. The images are easier to see after printing.*

### On Your Own

Use Sketchpad to create the figures below.



## FUNCTION FUN

Let's look at some function features of Sketchpad. ☺

1. Open a new sketch by going to the **File** menu.
2. Click on the **Graph** menu, go down to *grid form* and choose *rectangular grid*.
3. Three red points should have shown up. Click and drag the red point that is located on the origin (0,0). See what happens.
4. Click and drag the other two red points, one at a time and see what happens.
5. Go to the **Graph** menu and go down to *Plot new function*. A Calculator should appear, waiting for you to type in it.
6. Click in the Calculator window and type in  $x^2$
7. Still in the Calculator, click on the *Equations* button and make sure  $y = f(x)$  has a check mark by it. Then click back into the window of the Calculator.
8. Click the OK button in the bottom right corner. A graph of  $f(x) = x^2$  should appear. A textbox of the function should appear in the upper left corner of the graph so that you know what function you graphed. Both should be selected (you know they are selected because they appear with a pink color).

**Now what we are about to do is play with the parent graph of  $f(x) = ax^2$ , alternating the value of  $a$  so that students can see what happens. Right now, as we have it, the value of  $a = 1$  (since we just typed  $x^2$  into the window of the Calculator). We want to be able to make it larger and smaller so that students can make a conjecture about how the value of  $a$  affects the graph.**

9. Click into space so that all items are unselected. Then double click on the function textbox in the upper left corner. The Calculator should reappear and say "Edit Function" in the blue bar at the top.
10. Click in the window so that the cursor is directly in front of where you typed  $x^2$ .
11. Click on the *Values* button on the right side of the Calculator and choose *New Parameter*. Under where it says "Name" type the letter  $a$ . Leave the "Value" and "units" alone. Click OK.
12. The window of the Calculator should now read  $ax^2$ . We want it to read  $a * x^2$  so move the cursor after the  $a$  and click on the  $*$  button located on the Calculator. Then click OK. In the upper left corner of the screen it should now have one box with  $f(x) = a \bullet x^2$  and the value  $a = 1.00$  just below it.
13. Click into space so that everything is unselected. Then click on the  $a = 1.00$  in the upper left corner. It should turn pink.
14. Click on the **Display** menu, and go down to *Animate Parameter*. When you look in the  $a = 1.00$  box, the value of  $a$  be changing. In this case, it will be getting larger. The graph of  $f(x) = a \bullet x^2$  will be getting narrower as the value of  $a$  increases. Additionally, a box labeled *Motion Controller* will have appeared on the screen. That box allows you to control if the value of  $a$  increases or decreases. It also allows you to control how fast that increase or decrease will occur. Play with those features a bit.

When you are done playing around, stop the animation. Let's add in the value of  $c$  to our parent equation  $f(x) = a \bullet x^2$  so that it becomes  $f(x) = a \bullet x^2 + c$ . Then we can explore how the value of  $c$  affects the graph. To do this, follow these steps:

15. Click into space so that everything is unselected. Then double click on the function  $f(x) = a \bullet x^2$  in the upper left corner so that it takes you back to the Calculator window again.
16. Click so that the cursor is in the window of the Calculator. We want to change the function so that it reads  $a * x^2 + c$  so you will first need to move the cursor to the end of our function and type in the  $+$ . Then click on the *Values* button on the right side of the Calculator and choose *New Parameter*.
17. Under where it says "Name" type in the letter  $c$ . Under where it says "Value" type in 0.00. Leave the "units" as none and click on OK.
18. Click OK on the Calculator.
19. Select the parameter  $c$  (to do this, click in space first so that everything else is unselected. Then click on the  $c = 0.00$  that appears in the upper left corner of the screen).
20. In the *Motion Controller* box still located on the screen, click the arrow. This will start the animation. You will see the value of  $c$  increasing in the top left corner. You will see the graph changing as the value of  $c$  increases.
21. Use the *Motion Controller* box to switch directions and have the value of  $c$  decrease. Watch what happens to the graph.
22. Click on both the  $a=$  and the  $c=$  at the top left corner of the screen. Then use the *Motion Controller* to animate both values at the same time by clicking on the arrow in the *Motion Controller* box.

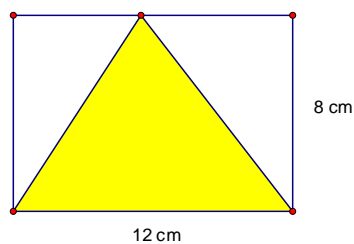
Now create a new sketch and explore the parent function  $y = |x + h| + k$  where you animate the parameters  $h$  and  $k$  to see how they affect the graph.

## **QUIZ RECREATION ASSIGNMENT**

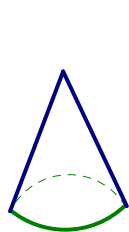
On the other side of this you will find a made up quiz. The figures were first created using Geometer Sketchpad and then copied and pasted into the test document that was created using Microsoft Word. The option of hiding points and circles was used quite a bit when using Sketchpad. The title, name, and date items at the top of the quiz utilize the “heading” feature of Microsoft Word.

Your assignment is to recreate this document. Be sure that when you use Sketchpad to create all figures, you save the file(s). Why? Because when you finish your assignment, you must email both the completed Microsoft Word document as well as the Sketchpad file(s) to your instructor.

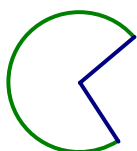
1. Find the area of the shaded region below.



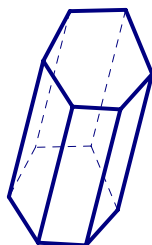
2. Match the figure with the correct name for the figure.



A



B



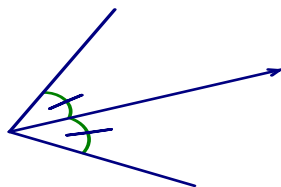
C

Sector \_\_\_\_\_

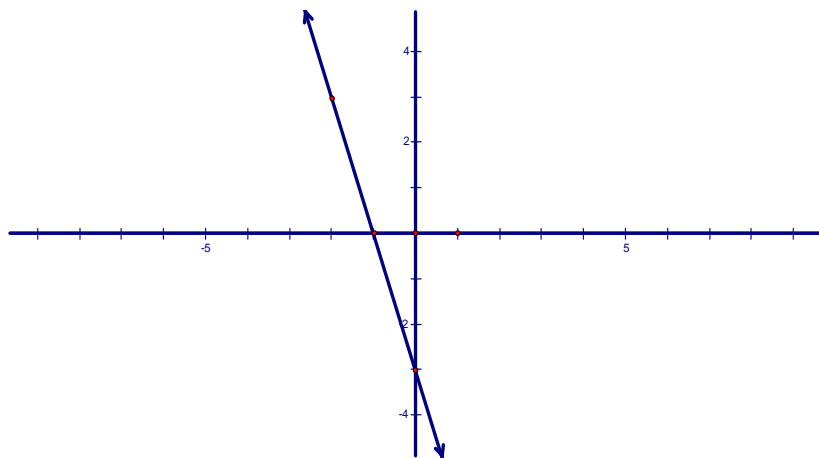
Hexagonal Prism \_\_\_\_\_

Cone \_\_\_\_\_

3. What construction is represented by the diagram below?



4. What is the equation of the line below? Axes are scaled by 1's.



## My Geometer's Sketchpad Notes and Pictures

### Shading the Inside of a Triangle

- Select the three points that make up the triangle
- On the drop down menu: **Construct** → **Triangle Interior**

### Creating a Ray

- Create the endpoint and another point that you want the ray to go through (highlight them in that order)
- On the drop down menu: **Construct** → **Ray**
- When you cut and paste it into a Word document the arrow end of the ray will be seen