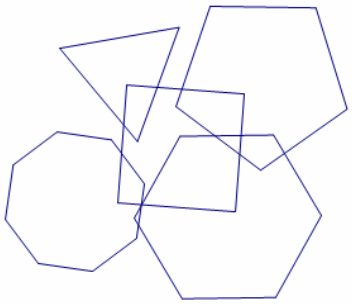
Polygons Rule: Data Collection



Using the polygons provided, measure in ***centimeters*** attributes and fill in the data on the appropriate table.

Triangles Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Squares Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Pentagons Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Hexagons Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Octagons Rule

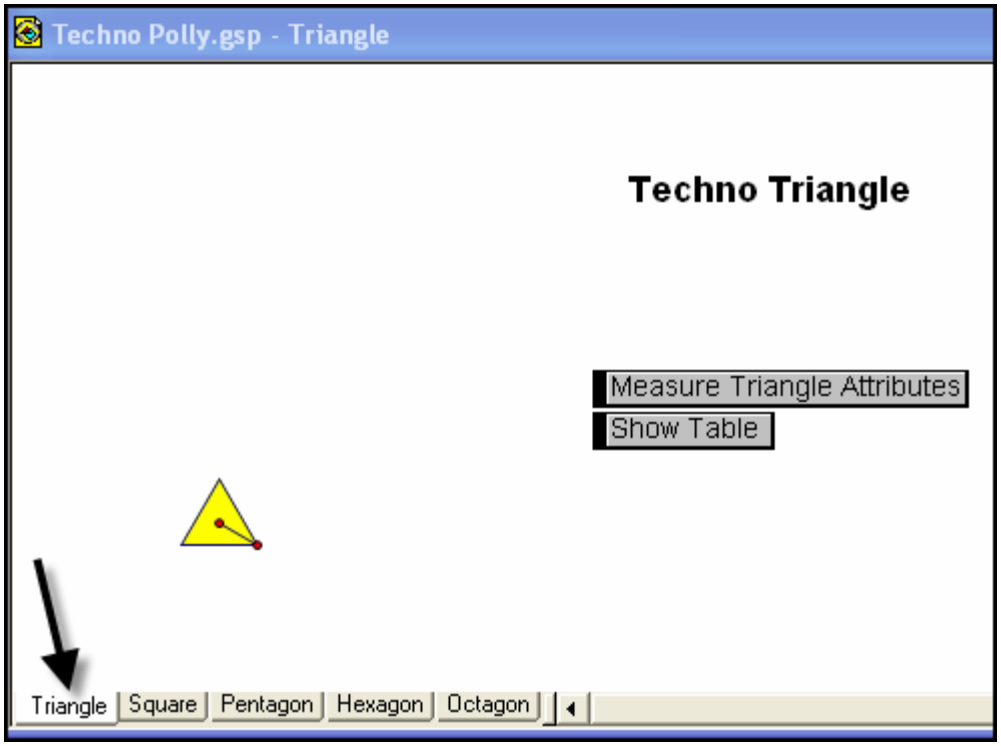
	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Polygons Rule: Questions About Data

Data Source	Rulers
How would you describe this set of data? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data extend what students already understand about our course content?	

Techno Polly: Data Collection

Open the sketch, **Techno Polly.** Notice the tabs at the bottom of the sketch that say **Triangle**, **Square**, **Pentagon**, **Hexagon** and **Octagon** respectively. Use the same set of direction for each tab, working through them sequentially.



1. Click on the Measure Attributes button. What happens?

2. Click on the Show Table button.

3. Double click on the table to add another row, and then drag the vertex of the polygon increasing the length of the side to approximately 2 cm. What do you observe?

4. Double click on the table again to add another row, and then drag the vertex of the polygon, increasing the length of the side to approximately 3 cm. What do you observe?

5. Repeat this process until you have 8 rows in your table, increasing the side length of the polygon by approximately 1 cm each time.

6. Repeat the above steps for each polygon.

7. To view your data use the tabs at the bottom to transfer from data set to data set.

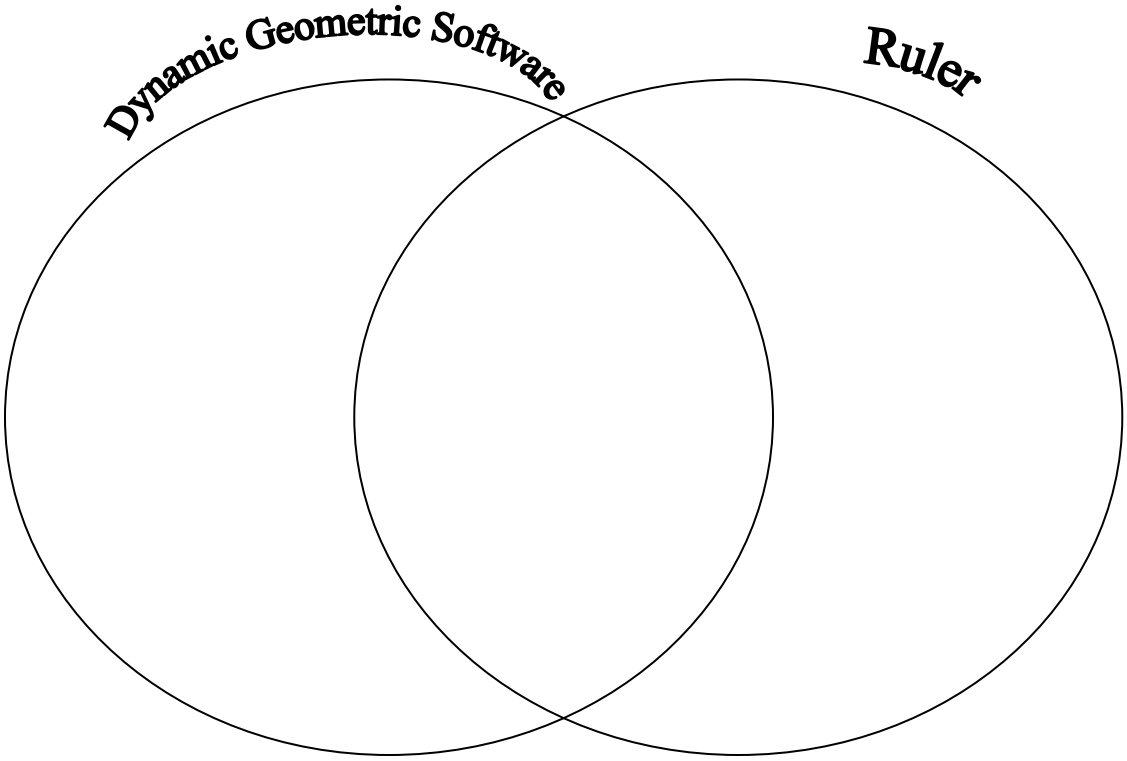
8. Upon exiting the Geometer's Sketchpad, the program will ask if you wish to save…select NO.

Techno Polly—Questions About Data

Data Source	Geometer's Sketchpad
How would you describe this set of data? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data extend what students already understand about our course content?	

Reflections on Data

Complete the following Venn diagram to compare and contrast the uses of the dynamic geometric software and a ruler as data sources.



What are the benefits of using data derived from the dynamic geometric software?

What are the benefits of using data derived from actual measurement?

How might these data sources function in a geometry classroom?

Debriefing the Exploration of Data

1. What questions can we ask as reflective practitioners to determine the effectiveness of a data source for promoting mathematical learning?

2. How does the technology-based data offer an opportunity to strengthen mathematical learning?

3. What paper-and-pencil methods do students need to know to make sense of the data we explored?

4. How do you define the use of technology in your classroom?

Polly Polly In Come Free Intentional Use of Data

TEKS			
Question(s) to Pose to Students	Math		
	Tech		
Cognitive Rigor		Knowledge	
		Understanding	
		Application	
		Analysis	
		Evaluation	
		Creation	
Data Source(s)		Real-Time	
		Archival	
		Categorical	
		Numerical	
Setting		Computer Lab	
		Mini-Lab	
		One Computer	
		Graphing Calculator	
		Measurement Based Data	
Bridge to the Classroom			

Polygarden Landscaping Company

Explore

Posing the Problem:

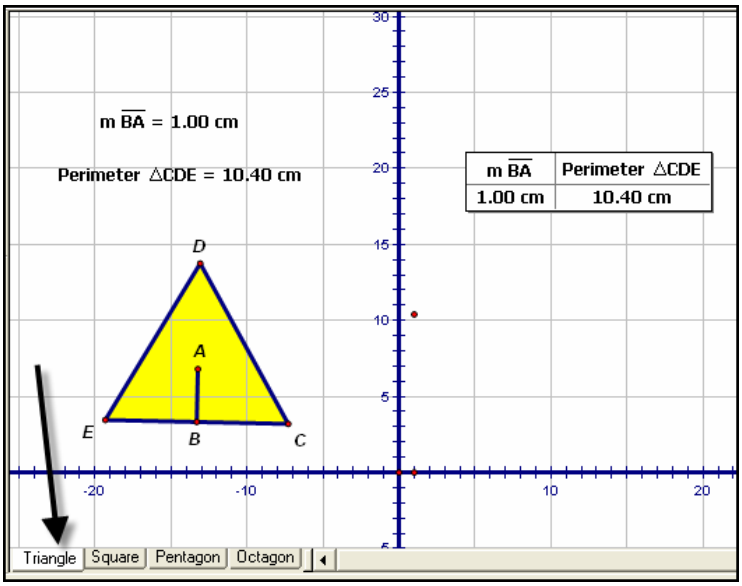
Polygarden Landscaping Company builds brick borders for flowerbeds that are always in the shape of regular polygons. To calculate the number of bricks necessary for a flowerbed, Brad, a bricklayer, needs to know the perimeter of the garden. On his last job Brad was not able to measure the perimeter of the flowerbed. He could only measure the distance from the center of the polygon to one side of the polygon. This distance is called the apothem. Is it possible for Brad to calculate the perimeter of the flowerbed if the only information he has is the length of the apothem and the number of sides of the garden?

Obtaining and Analyzing the Data:

To solve this problem, we can use the problem-solving strategy of "solving a simpler problem." To do so, you will use geometric sketches to collect and analyze data.

Open the sketch **Growing Polly's.**

Select the **Triangle** tab.



1. Double click on the table to add another row then click and drag point *C* away from point *B*. What do you observe?

2. Double click on the table again, and then move point *C* farther away from point *B*. Repeat this process until you have 10 rows in your table.

3. What patterns do you observe in the table?

4. What observations can you make about your graph?

5. Develop an algebraic rule that describes the relationship of the length of the apothem, *x*, to the perimeter, *y*.

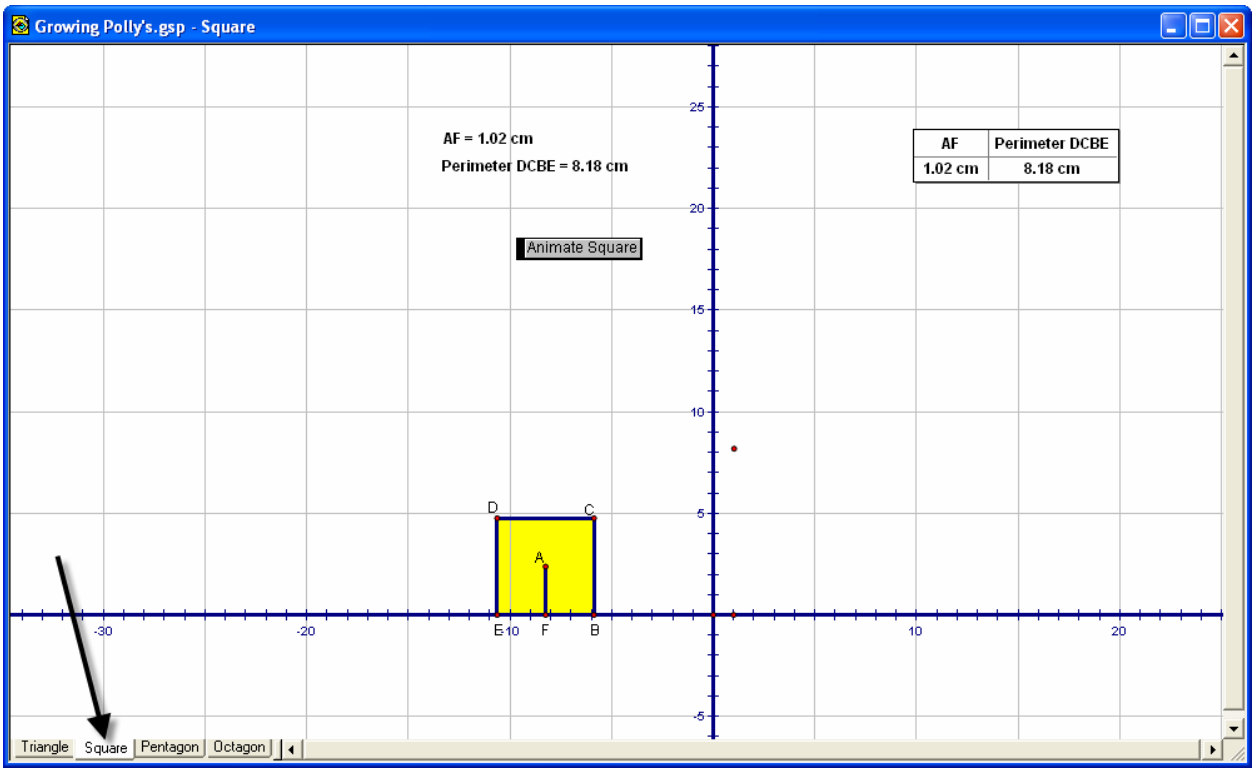
6. Verify that your function rule models your data. Explain your verification.

7. Write a verbal description of the relationship between the length of the apothem of an equilateral triangle and its perimeter.

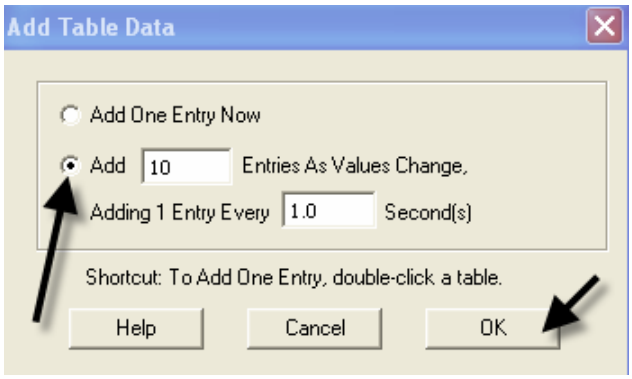
8. What is the approximate perimeter of a flowerbed that is in the shape of an equilateral triangle with an apothem of 7.23 centimeters?

9. What is the approximate length of the apothem of an equilateral triangle whose perimeter is 68.5 centimeters?

Select the **Square** tab.



1. ***Right*** click in the table and select the **Add Table Data** option. Select the **Add 10 Entries As Values Change, Adding 1 Entry Every 1.0 Second(s)** and click **OK**.



2. Start the data collection process by clicking on the **Animate Square** button. After your table fills with data, stop the animation by clicking on the **Animate Square** button again. What happened?

3. What patterns do you observe in the table?

4. What observations can you make about your graph?

5. Develop an algebraic rule that describes the relationship of the length of the apothem, *x*, to the perimeter, *y*.

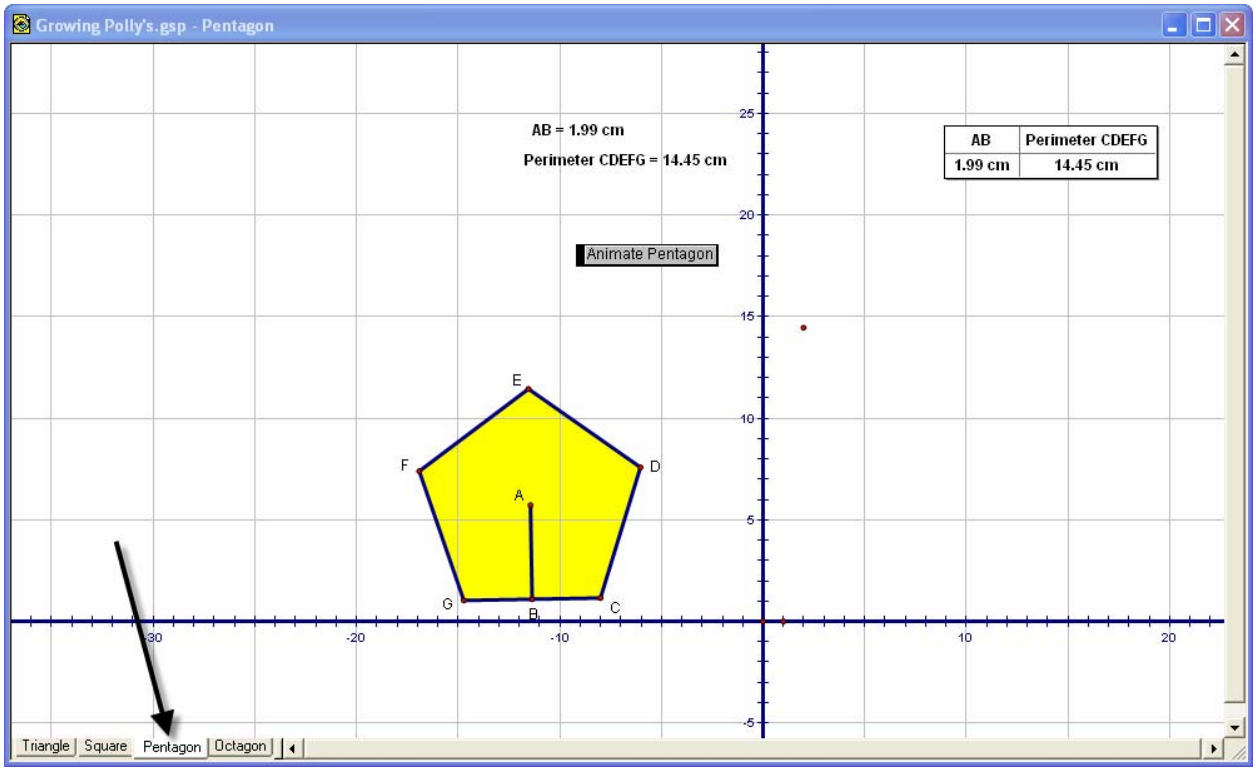
6. Verify that your function rule models your data. Explain your verification.

7. Write a verbal description of the relationship between the length of the apothem of square and its perimeter.

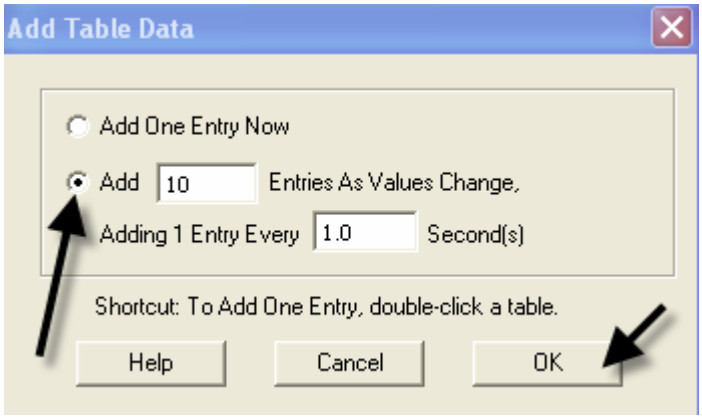
8. What is the approximate perimeter of a flowerbed that is in the shape of a square with an apothem of 7.23 centimeters?

9. What is the approximate length of the apothem of a square whose perimeter is 68.5 centimeters?

Select the **Pentagon** tab.



1. ***Right*** click in the table and select the **Add Table Data** option. Select the **Add 10 Entries As Values Change, Adding 1 Entry Every 1.0 Second(s)** and click **OK**.



2. Start the data collection process by clicking on the **Animate Pentagon** button. After your table fills with data, stop the animation by clicking on the **Animate Pentagon** button again. What happened?

3. What patterns do you observe in the table?

4. What observations can you make about your graph?

5. Develop an algebraic rule that describes the relationship of the length of the apothem, *x*, to the perimeter, *y*.

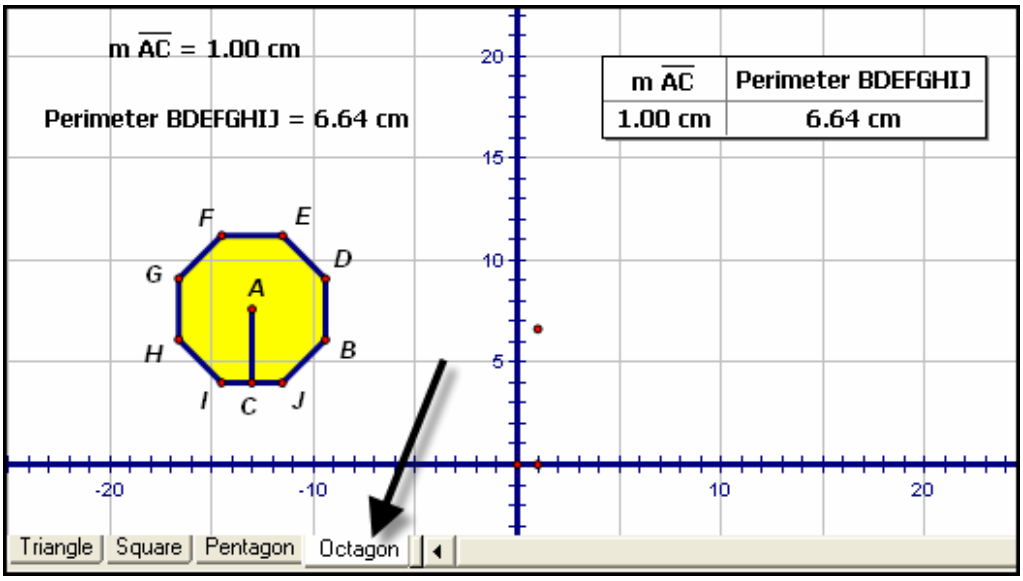
6. Verify that your function rule models your data. Explain your verification.

7. Write a verbal description of the relationship between the length of the apothem of a regular pentagon and its perimeter.

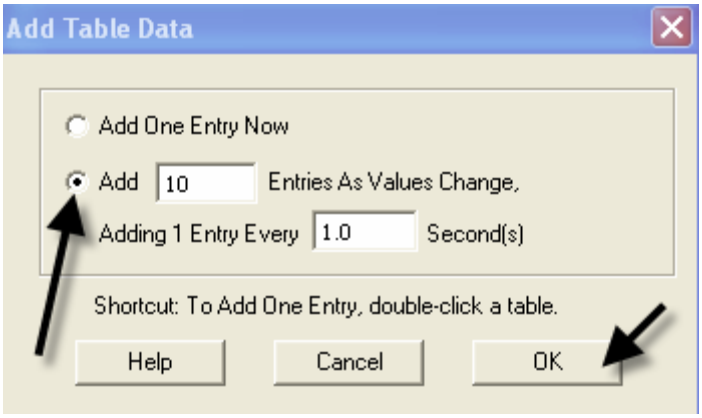
8. What is the approximate perimeter of a flowerbed that is in the shape of a regular pentagon with an apothem of 7.23 centimeters?

9. What is the approximate length of the apothem of a regular pentagon whose perimeter is 68.5 centimeters?

Select the **Octagon** tab.



1. ***Right*** click in the table and select the **Add Table Data** option. Select the **Add 10 Entries As Values Change, Adding 1 Entry Every 1.0 Second(s)** and click **OK**.



2. Start the data collection process by clicking on the **Animate Octagon** button. After your table fills with data, stop the animation by clicking on the **Animate Octagon** button again. What happened?

3. What patterns do you observe in the table?

4. What observations can you make about your graph?

5. Develop an algebraic rule that describes the relationship of the length of the apothem, x, to the perimeter, y.

6. Verify that your function rule models your data. Explain your verification.

7. Write a verbal description of the relationship between the length of the apothem of regular octagon and its perimeter.

8. What is the approximate perimeter of a flowerbed that is in the shape of a regular octagon with an apothem of 7.23 centimeters?

9. What is the approximate length of the apothem of a regular octagon whose perimeter is 68.5 centimeters?

Putting It All Together

1. Complete the table.

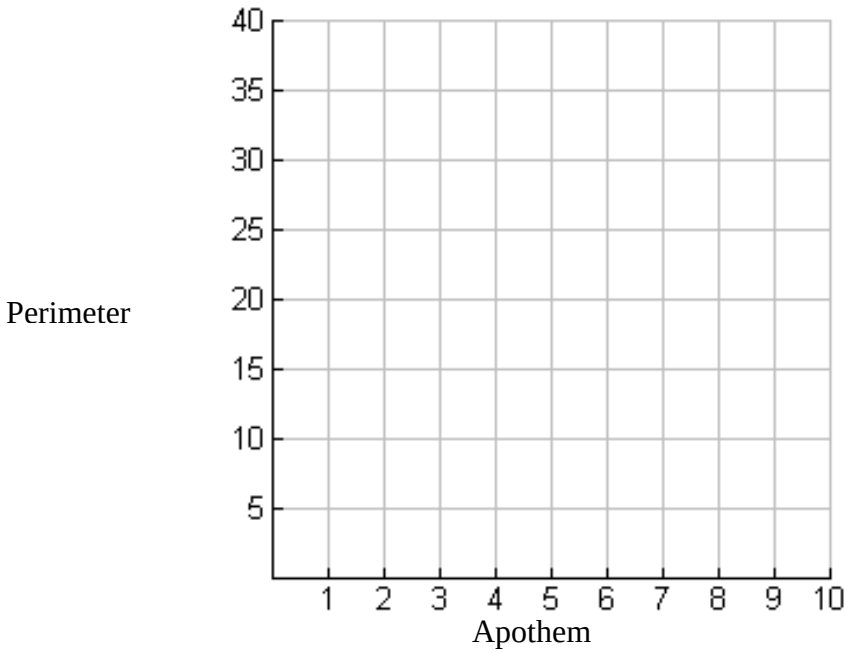
Perimeter *versus* Apothem

Regular Polygon	Function Rule
Triangle	
Square	
Pentagon	
Octagon	

2. In what ways are the function rules the same?

3. In what ways are the function rules different?

4. Graph all four-function rules on the same set of axes. Sketch your graph. Label each line with the name of the polygon.



5. What observations can you make about your graph? Connect your observations to geometric properties observed in this exploration.

6. Look back at Brad's problem. Is it possible for Brad to calculate the perimeter of the flowerbed if the only information he has is the length of the apothem and the number of sides of the garden? Why or why not?

7. Is there a general rule or trend you can develop using the information gathered? If so what is it?

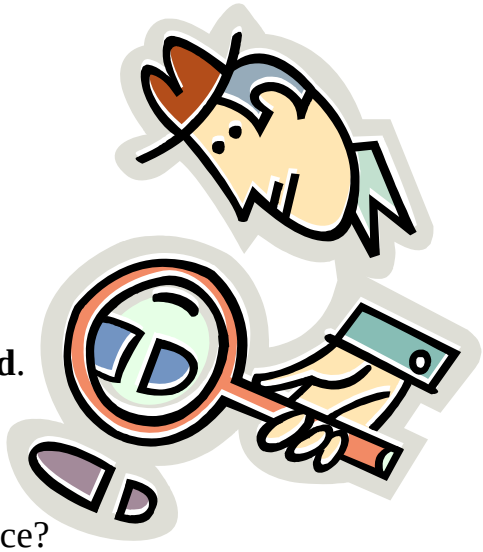
8. If the length of the apothem remains constant, what is the effect on perimeter as the number of sides of the polygon increases?

9. If you continue to increase the number of sides of the polygon while keeping the length of the apothem constant, what value will the perimeter approach?

Polygarden Landscaping Company
Intentional Use of Data

TEKS		
Question(s) to Pose to Students	Math	
	Tech	
Cognitive Rigor	Knowledge	
	Understanding	
	Application	
	Analysis	
	Evaluation	
	Creation	
Data Source(s)	Real-Time	
	Archival	
	Categorical	
	Numerical	
Setting	Computer Lab	
	Mini-Lab	
	One Computer	
	Graphing Calculator	
	Measurement Based Data	
Bridge to the Classroom		

Sketchpad Skills Investigation



For detailed instructions see Technology Tutorial T²

1. Open a blank sketch in **Geometer's Sketchpad**.

2. Create some random points. What do you notice?

3. Select some points. Deselect them. How did you do this?

4. Label some points. What happens when you use the **Label Tool**? Why do you think this happens?

5. Make some circles. How can you deselect the last circle?

1. Construct some segments, lines and rays. How do they differ from each other? Why?

2. Label some of the segments, lines and rays you have created.

3. Use the box feature of the **Selection** tool to quickly select some of your items. What happened?

4. Use the **Selection Tool** to clear all objects from this page.

5. Click on the **File** menu and read the options. Slide the cursor across the menu bar and read the other options. What do you notice about some of the option choices?

6. Draw a segment and use the **Measurement** menu to measure it. Did you encounter any problems? If so, what were they?

   a. Did you measure a distance or a length? How could you have measured the other?

   b. What is the difference between distance and length and how Geometer's Sketchpad interprets this?

   c. Create a line and measure it. Create a ray and measure it. What did you discover?

7. Draw an angle and use the **Measurement** menu to measure it. Did you encounter any problems? If so, what were they?

   a. What was required in order for you to be able to measure your angle?

8. Click on one side of your angle and adjust the size of your angle. What happens?

9. Construct a circle and use the **Measurement** menu to explore the various measurement options. What measurements can be made?

10. Adjust the size of your circle by clicking on the control point on the circumference and dragging. What happens?

11. Draw a triangle and use the **Measurement** menu to explore the various measurement options. What measurements can be made?

    a. Can you measure the perimeter? Is there another way?

    b. How can you measure the area? Is there another way?

12. Construct the interior of your triangle. What measurement options are now available?

13. Change the size of your triangle. What happens to the measurements?

14. Draw a right triangle. Try to move it. Does it stay a right triangle? Why or why not?

15. Construct a 30-60-90 triangle.

16. Explore moving your triangle by clicking on various segments and angles. Which objects allow the triangle to stay the same size? Why?

    a. Which parts of the triangle allow it to adjust size? Why?

    b. Will this triangle always stay a 30-60-90 degree triangle no matter how big or small it gets? How do you know?

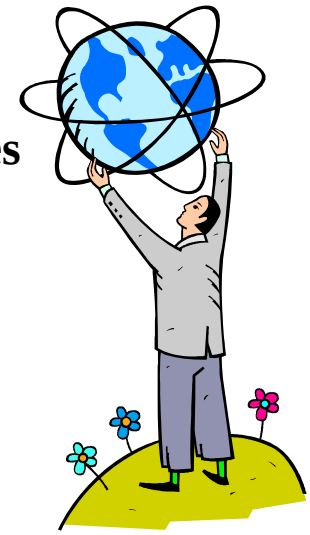
17. Create a Hide/Show button to hide your extra construction pieces.

18. Reflect your triangle. What happens?

19. How can you continue with this to make a tessellation? Try it.

    a. Did you encounter any challenges? If so, what were they and how did you overcome them?

20. What other shapes appear in your tessellation?



Explore the World with Geometric Properties

- Open a new sketch in Geometer's Sketchpad.

- Search the Internet for pictures or take digital photos that would demonstrate the following geometric properties: parallel lines, tangent to a circle, similar figures, congruent figures, central angle of a circle. *Challenge:* Find other geometric concepts represented in the world.

- Import your pictures into Geometer's Sketchpad, one picture per page.

- Use the Geometer's Sketchpad tools to construct and prove the geometric properties represented in your picture. Use a Text Box to show the URL where your picture was found along with any additional information that would be helpful for other participants viewing your construction.

- Report your findings to the rest of the participants via the method suggested by the facilitator.

Geometric Properties and Sketchpad Skills
Intentional Use of Data

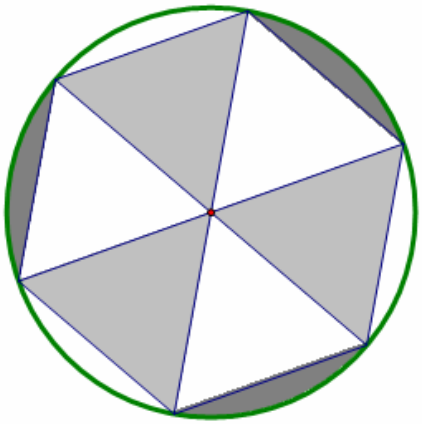
TEKS			
Question(s) to Pose to Students	Math		
	Tech		
Cognitive Rigor		Knowledge	
		Understanding	
		Application	
		Analysis	
		Evaluation	
		Creation	
Data Source(s)		Real-Time	
		Archival	
		Categorical	
		Numerical	
Setting		Computer Lab	
		Mini-Lab	
		One Computer	
		Graphing Calculator	
		Measurement Based Data	
Bridge to the Classroom			

Dome Floor Dilemma

Explore

Posing the Problem:

The diagram below represents the tile pattern on the circular floor of a domed building. Each shade, light, medium, and dark, represents a different color of floor tile. Each central angle is congruent to all others.



If you know the length of the radius of the circular floor, is it possible to calculate the area of each shaded region?

Obtaining and Analyzing the Data:

To solve this problem, we can use the problem-solving strategy of "solving a simpler problem." To do so, you will construct a geometric figure then collect and analyze data. You will determine three functional relationships: area of a sector of a circle versus the radius, area of a segment of a circle versus the radius, and the area of the triangle bound by the segment and the radii drawn to the endpoints of the arc of the segment.

The Sector Construction

For detailed instructions on Geometer's Sketchpad see the **Technology Tutorial T^2--Dome Floor Dilemma.**

1. Construct a circle with a radius.

2. Rotate the radius and the endpoint that lies on the circle 60^o.

3. Construct the intercepted arc of the sector.

4. Construct the interior of the sector.

5. Measure the length of the radius and the area of the sector.

6. Create a table to compare the two measurements. Which one is the independent variable and which one is the dependent variable?

7. Plot the two measurements on a graph and turn on the trace feature.

Collect the Data

8. Click and drag the endpoint of the radius that is on the circle toward the center of the circle until the radius of the circle is approximately 0.5 centimeters. Double click on the table to add another row, then click and drag the endpoint of the radius that is on the circle about 0.5 centimeters more away from the center. What do you observe?

9. Double click on the table again, and then move the endpoint of the radius that is on the circle farther away from the center. Repeat this process until you have 8 rows in your table.

10. What patterns do you observe in the table?

11. What observations can you make about your graph?

The Arc Segment Construction

1. Construct the arc segment.
2. Change the color of the segment.
3. Measure the area of the segment.
4. Create a table to compare the measure of the area of the arc segment and the length of the radius. Which one is the independent variable and which one is the dependent variable?
5. Plot the two measurements on the graph and turn on the trace feature.

Collect the Data

Click and drag the endpoint of the radius that is on the circle toward the center of the circle until the radius of the circle is approximately 0.5 centimeters. Double click on the table to add another row then click and drag the endpoint of the radius that is on the circle about 0.5 centimeters more away from the center. What do you observe?

6. Double click on the table again, and then move the endpoint of the radius that is on the circle farther away from the center. Repeat this process until you have 8 rows in your table.
7. What patterns do you observe in the table?
8. What observations can you make about your graph?

The Triangle Construction

1. Construct the triangle interior.

2. Measure the area of the triangle.

3. Create a table to compare the area of the triangle to the length of the radius. Which one is the independent variable? Which one is the independent variable?

4. Plot the two measurements on the graph and turn on the trace feature.

Collect the Data

5. Click and drag the endpoint of the radius that is on the circle toward the center of the circle until the radius of the circle is approximately 0.5 centimeters. Double click on the table to add another row then click and drag the endpoint of the radius that is on the circle about 0.5 centimeters more away from the center. What do you observe?

6. Double click on the table again, and then move the endpoint of the radius that is on the circle farther away from the center. Repeat this process until you have 8 rows in your table.

7. What patterns do you observe in the table?

8. What observations can you make about your graph?

Analyze the Data

1. Develop an algebraic rule that describes the relationship of the length of the radius, *x*, to the area of the sector, *y*.

2. Verify that your function rule models your data. Explain your verification.

3. Develop an algebraic rule that describes the relationship of the length of the radius, *x*, to the area of the triangle, *y*.

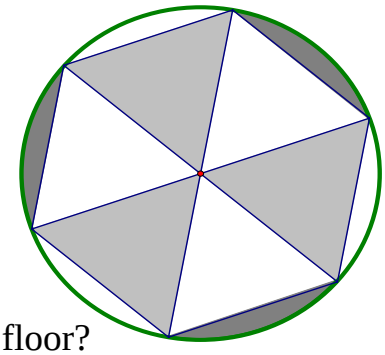
4. Verify that your function rule models your data. Explain your verification.

5. Develop an algebraic rule that describes the relationship of the length of the radius, *x*, to the area of the segment, *y*.

6. Verify that your function rule models your data. Explain your verification.

7. Recall the floor design discussed earlier. The radius of the circle is 45 feet in length and the cost of tiling the different areas is listed below.

Un-shaded areas - $10.50 per square foot,
Medium shaded areas - $12.00 per square foot and the
Darkest shaded areas - $17.45 per square foot.



Approximately what will be the total cost of tiling the floor?

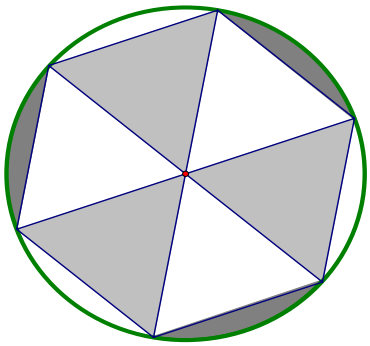
Explain

1. What knowledge of geometric properties was necessary to complete the constructions?

2. What process did you use to develop your algebraic rules?

3. How did you verify your function rules?

4. How did you solve the dome floor dilemma?



5. How can you explain your graph of all three functions in a geometric context?

6. What are the relative advantages and disadvantages of using a graphing calculator to solve this problem?

7. What are the relative advantages and disadvantages of using a spreadsheet to solve this problem?

8. What are the relative advantages and disadvantages of using TI-Interactive to solve this problem?

9. How will the use of these technologies promote a better understanding of the targeted mathematical concepts?

Dome Floor Dilemma
Intentional Use of Data

TEKS		
Question(s) to Pose to Students	Math	
	Tech	
Cognitive Rigor	Knowledge	
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Bridge to the Classroom		

Ring Around the Rose Window

A common architectural feature used in construction during the renaissance was the rose window. It can be found on palaces, cathedrals, and other buildings of that time. Originally made of stone and glass the windows consisted of a large circle with decorative features arranged like spokes of a wheel in the interior of the circle.

Attributes of the window:

- **The window (figure 1) is made up of a central circle with twelve spokes.**
- **The distance from A to C is three times the distance for A to B.**
- **The smaller circles are tangent to each other.**
- **The arcs at the outer edge of the circle are tangent to each other and tangent to the smaller circle on its spoke.**

Your task is to use geometric tools to reproduce this window. The reproduction should be scalable with no visual defects.

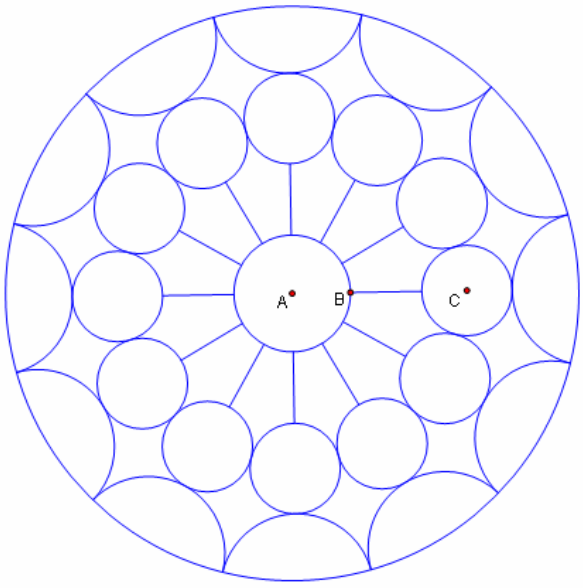
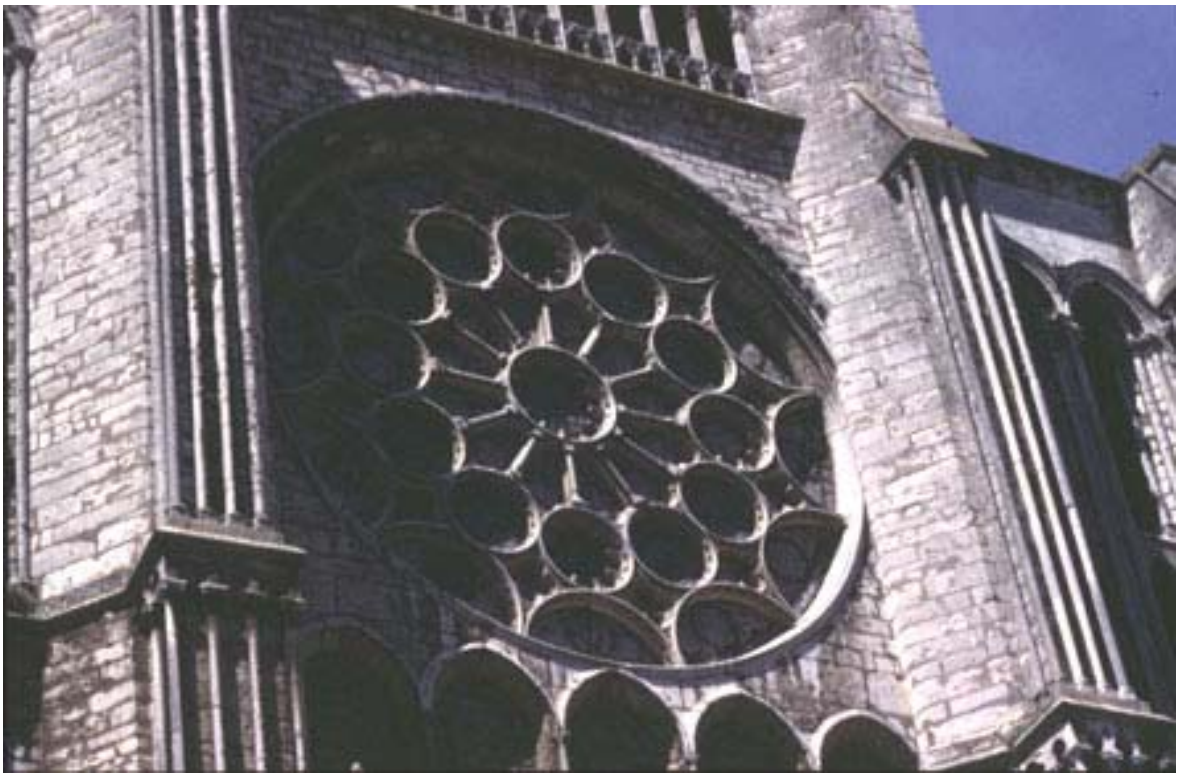
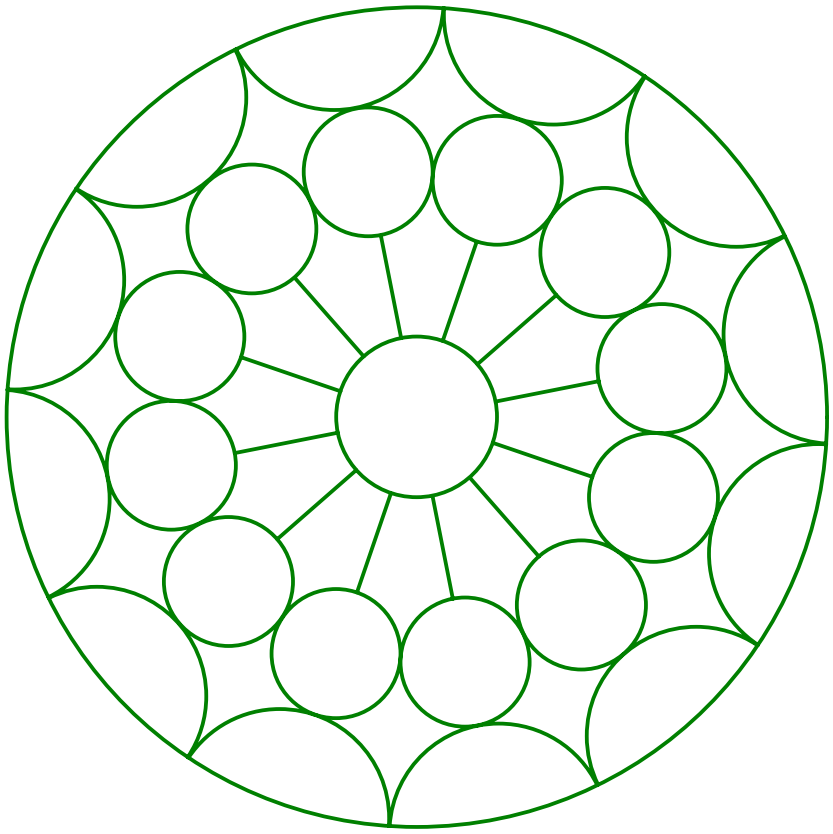


Figure 1.





Understanding the Problem and Planning the Solution

1. Which geometric concepts and skills can be identified in the picture?

2. List as many problem-solving strategies as you can recall. Which strategies will you use to perform your construction?

3. Determine a plan for your construction utilizing pencil and paper techniques. What will you do first, second, etc…? Write your plan below including any diagrams or rough sketches and justifications.

4. What geometric concepts will you utilize to carry out your plan?

5. How can you determine if your pencil and paper construction is scalable with no visual defects?

6. What are some of the challenges to constructing the figure with pencil and paper?

Constructing the Rose

1. Construct the rose window using Geometer's Sketchpad.

2. Did you have to alter your plan for constructing the figure? If so, how and why.

Gallery Walk Observations

Polygarden Landscaping Company	How did the activity promote careful decision-making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about “geometric sense”?

Sketchpad Skills Investigation and Exploring the World	How did the activity promote careful decision-making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about “geometric sense”?

Dome Floor Dilemma	How did the activity promote careful decision-making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about “geometric sense”?

Ring Around the Rose Window	How did the activity promote careful decision-making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about “geometric sense”?