Unit 7, Activity 5, "Turning" a Plane Figure Into a Solid Figure

Group Members: _____ Date: _____

1. On a piece of graph paper, graph the coordinates: $A(0,0), B(2,0), C(2,5),$ and $D(0,5)$.
   a. Connect the points to create line segments $\overline{AB}, \overline{BC}, \overline{CD},$ and $\overline{AD}$.
   b. Shade the area created by the segments.
   c. What polygon is created? _____
   d. Identify the dimensions of the polygon:

      Base: _____

      Height: _____

      Find the area of the polygon: _____

2. Imagine this polygon rotating 360° about the *x*-axis.
   a. What object does the rotation create? _____
   b. Draw a model of the object below. Be sure to label the known dimensions of the object.

3. How are the base and height of the polygon in question 1 related to the dimensions of the object created in question 2?

4. Using the original polygon from question 1 above, imagine the polygon rotating 360° about the *y*-axis.
   a. What object does it create? _____
   b. Draw a model of the object. Be sure to label the dimensions of the object.

   c. Explain why the base and height of the polygon represent different dimensions for this object than the object created in question 2.

5. **Make a conjecture:** Look at the objects created by the rotations:
    a. Which of the objects do you think has the largest surface area? Explain your reasoning.

    b. Which object do you predict will have the greatest volume? Explain your reasoning.

    c. Will the object with the largest surface area also be the same one that has the largest volume? Explain your reasoning.

6. Calculate the following (show your work below the chart):

Object created in Question 2	Object created in Question 4
Surface Area:	Surface Area:
Volume:	Volume:

7. Compare the objects and verify your conjecture:
    a. Which object **actually** has the greatest surface area?

    b. Which object **actually** has the greatest volume?

    c. Were your conjectures correct? Explain.

    d. Explain which measurement determined the greatest volume.

    e. Do you think this would always be true? Explain your reasoning.

Unit 7, Activity 5, "Turning a Plane Figure Into a Solid Figure with Answers

Group Members: _____ Date: _____

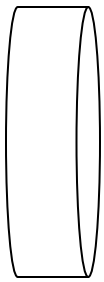
1. On a piece of graph paper, graph the coordinates: $A(0,0), B(2,0), C(2,5),$ and $D(5,0)$.
   a. Connect the points to create line segments $\overline{AB}, \overline{BC}, \overline{CD},$ and $\overline{AD}$.
   b. Shade the area created by the segments.
   c. What polygon is created? *Rectangle*
   d. Identify the dimensions of the polygon:

      Base: *2 units*

      Height: *5 units*

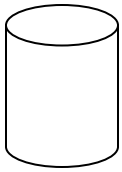
      Find the area of the polygon: *10 square units*

2. Imagine this polygon rotating 360° about the *x*-axis.
   a. What object does the rotation create? *Cylinder*
   b. Draw a model of the object below. Be sure to label the known dimensions of the object.



Radius: 5 units
Height: 2 units

3. How are the base and height of the polygon in question 1 related to the dimensions of the object created in question 2?
   The height of the rectangle becomes the radius of the cylinder, and the base of the rectangle becomes the height of the cylinder.
4. Using the original polygon from question 1 above, imagine the polygon rotating 360° about the *y*-axis.
   a. What object does it create? *Cylinder*
   b. Draw a model of the object. Be sure to label the dimensions of the object.



Radius: 2 units
Height: 5 units

   c. Explain why the base and height of the polygon represent different dimensions for this object than the object created in question 2.
   Since the rectangle was rotated about a different axis, the dimensions of the cylinder will change. The height of the rectangle will be the height of the cylinder, and the base of the rectangle will be the radius of the cylinder.

5. **Make a conjecture:** Look at the objects created by the rotations:
   a. Which of the objects do you think has the largest surface area? Explain your reasoning.
   Student responses may vary; look for logical reasoning and explanations. Students may refer to activity 1 with the experiments they have already conducted.

   b. Which object do you predict will have the greatest volume? Explain your reasoning.
   Student responses may vary; look for logical reasoning and explanations. Students may refer to activity 1 with the experiments they have already conducted.

   c. Will the object with the largest surface area also be the same one that has the largest volume? Explain your reasoning.
   Student responses may vary; look for logical reasoning and explanations. Students may refer to activity 1 with the experiments they have already conducted.

6. Calculate the following (show your work below the chart):

Object created in Question 2	Object created in Question 4
Surface Area: *70π square units*	Surface Area: *28π square units*
Volume: *50π square units*	Volume: *20π square units*

7. Compare the objects and verify your conjecture:
   a. Which object **actually** has the greatest surface area?
   The cylinder created in question 2; radius of 5 units and height of 2 units.
   b. Which object **actually** has the greatest volume?
   The cylinder created in question 2; radius of 5 units and height of 2 units.
   c. Were your conjectures correct? Explain.
   Answers will vary; see students' explanations.

   d. Explain which measurement determined the greatest volume.
   The radius determines the greater volume. The height of the cylinder in question 4 is greater than the height of the cylinder in question 2; however, the volume is less. Therefore, the greater the radius the greater the volume.

   e. Do you think this would always be true? Explain your reasoning.
   Answers will vary; see students' reasoning. Overall, students should see that this will always be true because the radius is being squared which increases the volume exponentially.

Unit 7, Activity 9, Population Density

Group Members: _____ Date: _____

1. **Record** the classroom dimensions and population below. Then **calculate** the area and amount of classroom space per person. Be sure to state the units you are using.

   Length: _____ Width: _____

   Area: _____

   Population: _____ people in the classroom

   How much space does each person have? _____

2. **Prediction:** How much space would each person have if the number of people in the class doubled?

3. Calculate the population density.

   Population density: _____

4. Calculate the population density for the following countries in people per square mile.

Country name	Population	Land Area (sq. miles)	Density (people per sq. mile)
Australia	22,421,417	2,967,908	
Bangladesh	164,425,000	55,599	
Canada	34,207,000	3,851,808	
China	1,339,190,000	3,705,405	
India	1,184,639,000	1,269,345	
Japan	127,380,000	145,883	
Liechtenstein	35,904	62	
Monaco	33,000	0.77	
Mongolia	2,768,800	604,250	
USA	309,975,000	3,717,811	

Source: http://www.worldatlas.com/aatlas/populations/ctypopls.htm

5. In question 4, you calculated the population density of the USA to be approximately 83.4 people per square mile. Now calculate the population density of the following cities and answer the question that follows the chart.

City Name	Population	Land Area (sq. mile)	Density (people per sq.mile)
Chicago, IL	2,784,000	227	
Dallas, TX	1,007,000	342	
Jacksonville, FL	635,000	759	
Los Angeles, CA	3,485,000	469	
New York, NY	7,323,000	309	
Philadelphia, PA	1,586,000	135	
Phoenix, AZ	983,000	420	

Source: http://www.census.gov/population/www/documentation/twps0027/twps0027.html

a. How can someone be justified saying that the USA has a population density of 83.4 people per square mile when the city of New York has a population density of 23,699 people per square mile?

Unit 7, Activity 9, Population Density with Answers

Group Members: _____ Date: _____

1. **Record** the classroom dimensions and population below. Then **calculate** the area and amount of classroom space per person. Be sure to state the units you are using.

   All answers for this question will vary depending on the classroom and the number of students in the classroom. Students should use appropriate units (meters or feet/yards) for the length and width, square units for the area, and square units per person for the space per person.

   Length: _____ Width: _____

   Area: _____

   Population: _____ people in the classroom

   How much space does each person have? _____

2. **Prediction:** How much space would each person have if the number of people in the class doubled?

   Answers will vary, but students should realize the amount of space per person in question one will be cut in half.

3. Calculate the population density.

   Population density: *Answers will vary based on classrooms and population; units should be people per square meter.*

4. Calculate the population density for the following countries in people per square mile.

Country name	Population	Land Area (sq. miles)	Density (people per sq. mile)
Australia	22,421,417	2,967,908	*7.6 people per sq. mile*
Bangladesh	164,425,000	55,599	*2957.3 people per sq. mile*
Canada	34,207,000	3,851,808	*8.9 people per sq. mile*
China	1,339,190,000	3,705,405	*361.4 people per sq. mile*
India	1,184,639,000	1,269,345	*933.3 people per sq. mile*
Japan	127,380,000	145,883	*873.2 people per sq. mile*
Liechtenstein	35,904	62	*579.1 people per sq. mile*
Monaco	33,000	0.77	*42,857.1 people per sq. mile*
Mongolia	2,768,800	604,250	*4.6 people per sq. mile*
USA	309,975,000	3,717,811	*83.4 people per sq. mile*

Source: http://www.worldatlas.com/aatlas/populations/ctypopls.htm

5. In question 4, you calculated the population density of the USA to be approximately 83.4 people per square mile. Now calculate the population density of the following cities and answer the question that follows the chart.

City Name	Population	Land Area (sq. mile)	Density (people per sq.mile)
Chicago, IL	2,784,000	227	*12,264 people per sq. mile*
Dallas, TX	1,007,000	342	*2,944 people per sq.mile*
Jacksonville, FL	635,000	759	*837 people per sq. mile*
Los Angeles, CA	3,485,000	469	*7,431 people per sq. mile*
New York, NY	7,323,000	309	*23,699 people per sq. mile*
Philadelphia, PA	1,586,000	135	*11,748 people per sq. mile*
Phoenix, AZ	983,000	420	*2,340 people per sq. mile*

Source: http://www.census.gov/population/www/documentation/twps0027/twps0027.html

b. How can someone be justified saying that the USA has a population density of 83.4 people per square mile when the city of New York has a population density of 23,699 people per square mile?

Answers will vary, but students should understand that the population density of the USA is based on the land area of all of the USA and the city population density is based on a much smaller land area. Also, students should be able to understand that larger cities are more densely populated than rural areas.