Investigation – Optimization of Perimeter, Area, and Volume

Activity #1 – Minimum Perimeter

1. Choose a bag from the table and record the number from the card in the space below. Each member of your group should choose a different bag.

   Area = _______________

2. Count the number of squares in the bag to make sure that they match the number on your card. Each square tile in the bag represents 1 unit^2.

3. Using the **ALL** of the tiles in the bag, build a filled in rectangle that has the same area as the number on your card. Record the length, width, and perimeter of the rectangle in the first row of the table on the right.

   Good Rectangle (Filled In) Bad Rectangle (Not Filled In)

4. Build <u>another</u> rectangle with the same area using **ALL** of the tiles, but with different dimensions than the one you just built. Record the length, width, and perimeter in the table.

5. Build <u>as many different rectangles as you can</u> using **ALL** of the tiles in your bag. Record the lengths, widths, and perimeters in the table. *There may be more rows in your table than you need*.

6. Circle the rectangle in your table that had the smallest possible perimeter.

7. What is special about the rectangle with the smallest possible perimeter?

8. Compare your results with the other members of your group. What type of shape results in the minimum perimeter?

The rectangle with the smallest possible perimeter is a

____

Length	Width	Perimeter 2L + 2W

AREA 16 units^2	AREA 16 units^2
AREA 36 units^2	AREA 36 units^2
AREA 25 units^2	AREA 25 units^2
AREA 64 units^2	AREA 64 units^2

Investigation – Optimization of Perimeter, Area, and Volume
Activity #2 – Maximum Area

1. Choose a bag from the table and record the number from the card in the space below. Each member of your group should choose a different bag.

   Perimeter = ______________

2. Count the number of sticks in the bag to make sure that they match the number on your card. Each stick in the bag represents 1 unit.

3. Using the **ALL** of the sticks in the bag, build a rectangle that has the same perimeter as the number on your card. Record the length, width, and area of the rectangle in the first row of the table on the right.

4. Build another rectangle with the same perimeter using **as many tiles as you need**, but with different dimensions than the one you just built. Record the length, width, and area in the table.

5. Build as many different rectangles as you can with the same perimeter using **as many tiles as you need**. Record the lengths, widths, and perimeters in the table. *There may be more rows in your table than you need.*

6. Circle the rectangle in your table that had the largest possible area.

7. What is special about the rectangle with the largest possible area?

8. Compare your results with the other members of your group. What type of shape results in the largest area?

The rectangle with the largest possible area is a

____

Length	Width	Area L×W

A hobby farmer is creating a fenced exercise yard for her horses. She has 900 m of flexible fencing and wishes to maximize the area. She is going to fence a rectangular or a circular area. Determine which figure encloses the greater area.

Solution

Rectangular

1. What type of rectangle maximizes the area?
2. What's the formula for the perimeter of this object?
3. Find the length of the sides using the formula (substitute 900 into P).
4. Use the Area formula to find the area.

Circular

1. What's the formula for perimeter of a circle?
2. Find Radius (Use formula and substitute 900 into C)
3. Use area formula to find the area.

PERIMETER 12 units	PERIMETER 12 units
PERIMETER 20 units	PERIMETER 20 units
PERIMETER 16 units	PERIMETER 16 units
PERIMETER 24 units	PERIMETER 24 units

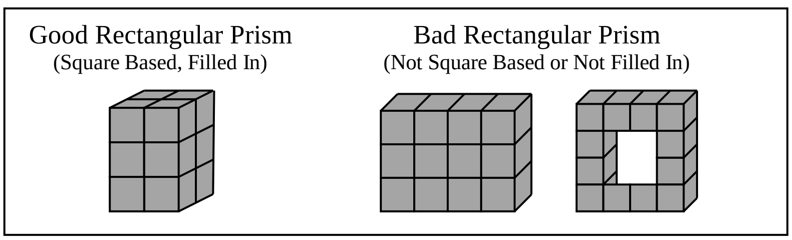
Investigation – Optimization of Perimeter, Area, and Volume
Activity #3 – Minimum Surface Area

1. Choose a bag from the table and record the number from the card in the space below.

   Volume = ______________

2. Count the number of cubes in the bag to make sure that they match the number on your card. Each square tile in the bag represents 1 unit^3.

3. Using the **ALL** of the cubes in the bag, build a solid filled in rectangular prism. Record the length, width, height, and surface area of the rectangle in the first row of the table on the right.



4. Build <u>another</u> rectangular prism with the same volume using **ALL** of the cubes, but with different dimensions than the one you just built. Record the length, width, height, and surface area in the table.

5. Build <u>as many different rectangular prisms as you can</u> using **ALL** of the cubes in your bag. Record the lengths, widths, heights, and surface areas in the table. *There may be more rows in your table than you need*.

6. Circle the rectangular prism in your table that had the smallest possible surface area.

7. What is special about the rectangular prism with the smallest possible surface area?

8. Compare your results with the other members of your group. What type of shape results in the minimum perimeter?

The rectangular prism with the smallest possible surface area is a ______________________

Length	Width	Height	Surface Area 2LW+2WH+2LH

VOLUME 8 units^3	VOLUME 8 units^3
VOLUME 27 units^3	VOLUME 27 units^3
VOLUME 64 units^3	VOLUME 64 units^3

Prisms versus Cylinder

1. Your task is to design a can that uses no more than 375 cm^2 of aluminum.

1. Write down surface area formula
2. Fill in the surface area as that is the same for all of our cans.
3. Rearrange the formula to solve for h.
4. Now you have a general formula for h.

Let's complete the first one in the table together.

1. Find h, using the formula from above.
2. Now use Volume formula to find the volume.

Cylinder	Radius	Height	Volume	Surface Area
1	1			375 cm^2
2	2			375 cm^2
3	3			375 cm^2
4	4			375 cm^2
5	5			375 cm^2

What will be the relation between radius and height that will maximize the volume of a cylinder?

2. Your task is to design a can that has the least surface area but with a volume of 500 cm^3

1. Use the volume formula and substitute the known volume.
2. Solve for h.
3. Now you have a general formula for h.

Cylinder	Radius	Height	Surface Area	Volume
1	1			500 cm^3
2	2			500 cm^3
3	3			500 cm^3
4	4			500 cm^3
5	5			500 cm^3

What is the relation between radius and height that will minimize surface area?

What other shape will do an even better job of maximizing volume and minimizing the surface area?
Why is that shape not used by pop-can manufacturers?