The Skyline Design Challenge

An island named Willingdon has just been human-made. The president of the island is searching for young, creative, and brilliant architects who can build a city in Willingdon. Your challenge is to design an original model of a skyscraper building using three-dimensional shapes that will be placed in the new city on Willingdon. The president will need to see your plans, measurements, and a model in order to consider using your design. The skyscraper must stand up on its own and should include the use of at least 3 different three-dimensional shapes. You must complete the challenge within four class periods.

A Design Portfolio- The Skyline Design

Name _____

Date _____

In this design challenge, what is the problem you need to solve? _____

_____

_____

_____

_____

Specifications are the things that my solution must do. They are the project requirements. **Constraints** are things that limit my solution. For example, a **constraint** may be how much I'm allowed to spend, or how much time I have to complete the challenge.

Fill in the chart below with the **specifications** and **constraints** for this challenge.

Specifications	Constraints

KSB 1 Formulating Ideas

Use the internet, go to the library, or take pictures of skyscrapers. In the table below, write down the names of the geometric solids you found within the skyscrapers.

List Geometric Solids Below

What makes a three-dimensional shape a three-dimensional shape?

_____

_____

_____

_____

Draw two sketches of possible skyscrapers that you want to create. Write two reasons why each sketch fulfills the specifications.

Sketch 1

Reason 1:

Reason 2:

Sketch 2

Reason 1:

Reason 2:

Select the best skyscraper and create it using the Model Maker Software. Print the image you have on the screen. Attach the page behind this one.

The president of Willingdon has added some requirements for the model skyscraper that you're creating. Not only must the skyscraper must stand up on its own and use at least 3 three-dimensional figures, the president has requested that the skyscraper must also have a volume between 150cm^3 and 250cm^3. The president also asked that the surface area of your model skyscraper be between 170cm^2 and 350 cm^2. In addition, you may only use a glue stick to assemble your model skyscraper. You still have 4 class periods to complete the challenge.

Fill in the chart below with all of the **specifications** and **constraints** for this challenge.

Specifications	Constraints

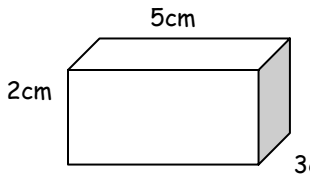
KSB 2- Surface Area

Draw each shape in the example box below. Label each shape with measurements (in centimeters) that you create. Find the area for each shape using the formulas given.

Shape And Formula for Surface Area	Example (Place your sketch and calculations here)	Properties of Each Shape (Ex: What makes a circle a circle?)
Parallelogram (square, rectangle) A= Base x Height	5 centimeters  3 centimeters A= Base x Height A= 5cm x 3cm A= $15cm^2$	
Triangle A= (Base x Height) ÷ 2		
Circle r= radius $r^2 = r \times r$ $\pi = 3.14$ $A = \pi r^2$		

KSB 3- Volume

a. The volume for the extruded figures in the chart below (rectangular prism, cylinder, triangular prism) can be determined by multiplying the area of the base by the height of the figure. Draw each three-dimensional figure in the example box. Use the measurements that you created in the surface area chart on the previous page as the measurements for the faces of the three-dimensional figures on this chart where it applies. Find the volume for each three-dimensional shape using the formulas given below.

3D Figure And Formula For Volume	Example	Properties of 3D Figure (Ex: What makes a cylinder a cylinder?)
Rectangular prism (including cube) V= Area of Base x Height	 V= Area of Base x Height V= $15cm^2$ x 2cm V= $30cm^3$	
Cylinder V= Area of Base x Height		
Triangular Prism V= Area of Base x Height		

3D Figure	Example	Properties of 3D Figure
Cone V= (Area of base x Height) ÷ 3		
Square Base Pyramid V= (Area of Base x Height) ÷ 3		
Triangle Base Pyramid V= (Area of Base x Height) ÷ 3		

Which three-dimensional figure included in the chart would roll from one side of a table to the other the best? Why? _____

_____

_____

STOP! You must get your work signed by the teacher in order to continue.

Teacher's Signature_____

KSB 4- Using ModelMaker

Open the ModelMaker software and create each of the three-dimensional figures you found the volume for on the previous pages. Use the same dimensions and units that you used in the chart above. After you create each figure, right click on it, and go to Properties. Scroll to the bottom to view the calculated volume and record it in the space provided below. Repeat for each figure you create. Print the images you have on the screen and attach it to the back of this page.

Three-dimensional Figure	Volume
Rectangular Prism	
Cone	
Cylinder	
Triangular Prism	
Square Base Pyramid	
Triangle Base Pyramid	

Does the volume for each figure match the volume you calculated in the chart? If not, make sure you used the same dimensions and units in your chart example and in ModelMaker. You may also want to go over the computations in your example.

Was there a mistake? _____

Which figures had a mistake? _____

Where did you find the mistake? (You may want to look back to your computations for surface area and volume. Did you use the formulas correctly? Did you complete the multiplication correctly? Did you copy a number incorrectly?)

_____

_____

_____

Revised Optimum Skyscraper Design

Using Model Maker, create a revised design of the skyscraper that meets the new requests of the president of Willingdon. Print the image that you have on the screen and attach it to the back of this page. This is the design that you will be constructing.

STOP! Your teacher must approve your skyscraper design.

Teacher's Signature _____

Once your teacher signs your portfolio you may print the nets of each figure and construct your design.

Which three-dimensional figures did you use in your design?

_____

_____

Why did you choose these figures?

_____

_____

_____

_____

In the chart below, list each three-dimensional figure that you used to create your skyscraper. Using ModelMaker, find the volume of each figure and record it in the space provided.

Three-dimensional Figure	Volume

Total volume of skyscraper _____cm^3

Using ModelMaker and the model of your skyscraper, determine the surface area of your design. (Hint: Don't count the surface area of the faces and parts of faces that cannot be seen when the building is standing upright.)

Use the space below for your calculations.

Calculations for figure 1

Calculations for figure 2

Calculations for figure 3

Calculations for figure 4

Surface area of figure 1: _____ cm^2

Surface area of figure 2: _____ cm^2

Surface area of figure 3: _____ cm^2

Surface area of figure 4: _____ cm^2

What changes, if any, did you make from your plan of the skyscraper? Why? Did the skyscraper meet all of the specifications? Explain

_____

_____

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_____

Print out the screen image of your final design and paste it in the space below. Label the important features that indicate the skyscraper met the specifications.

Reflection

What did you learn about three-dimensional figures, surface area, and volume by completing this design challenge? _____

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What are some trade-offs or modifications that you had to make in order to be sure that your design fit all of the specifications? _____

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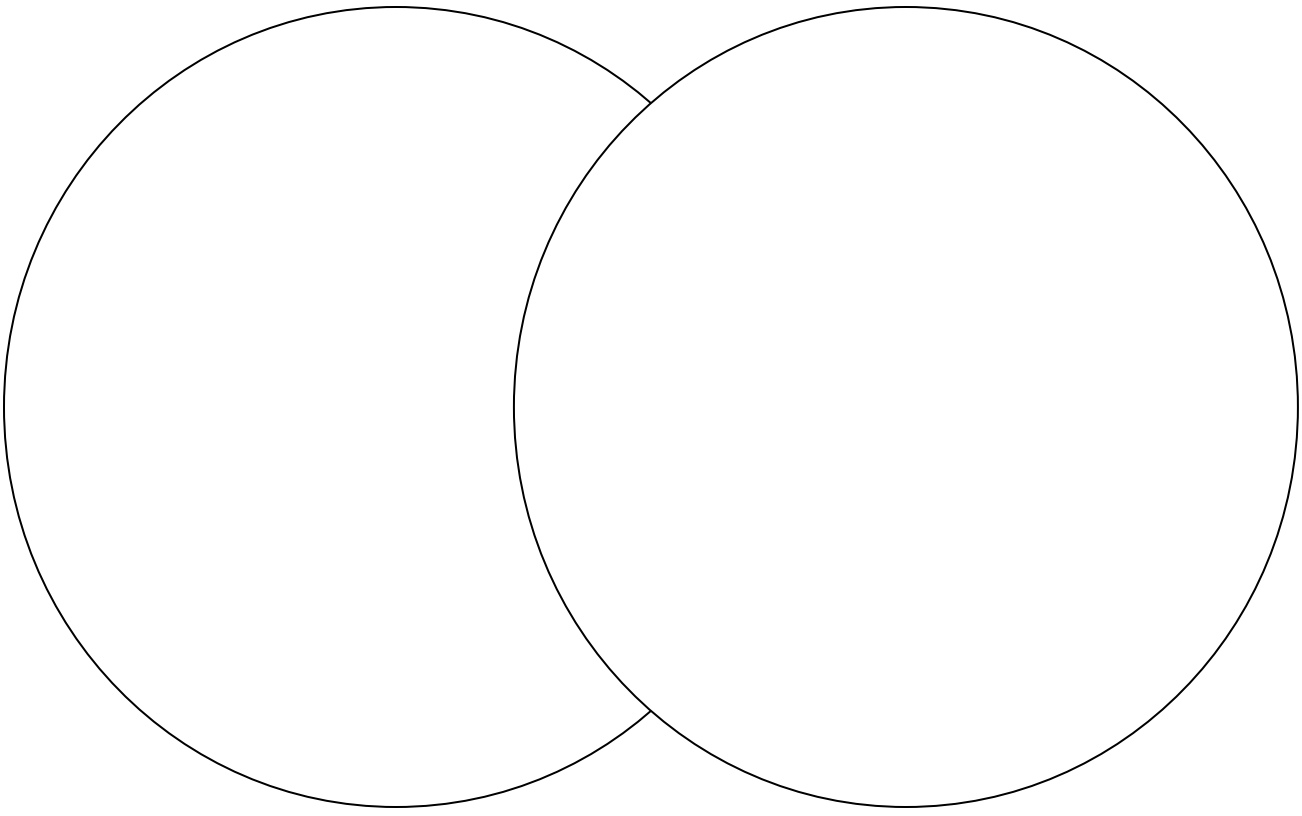
Exchange your design portfolio and model skyscraper with a neighbor. Use your peer review rubric to evaluate your partner's work. When you are finished, return the model skyscraper, design portfolio, and rubric to your neighbor. Attach the rubric that your neighbor filled out for your skyscraper to the back of your design portfolio.

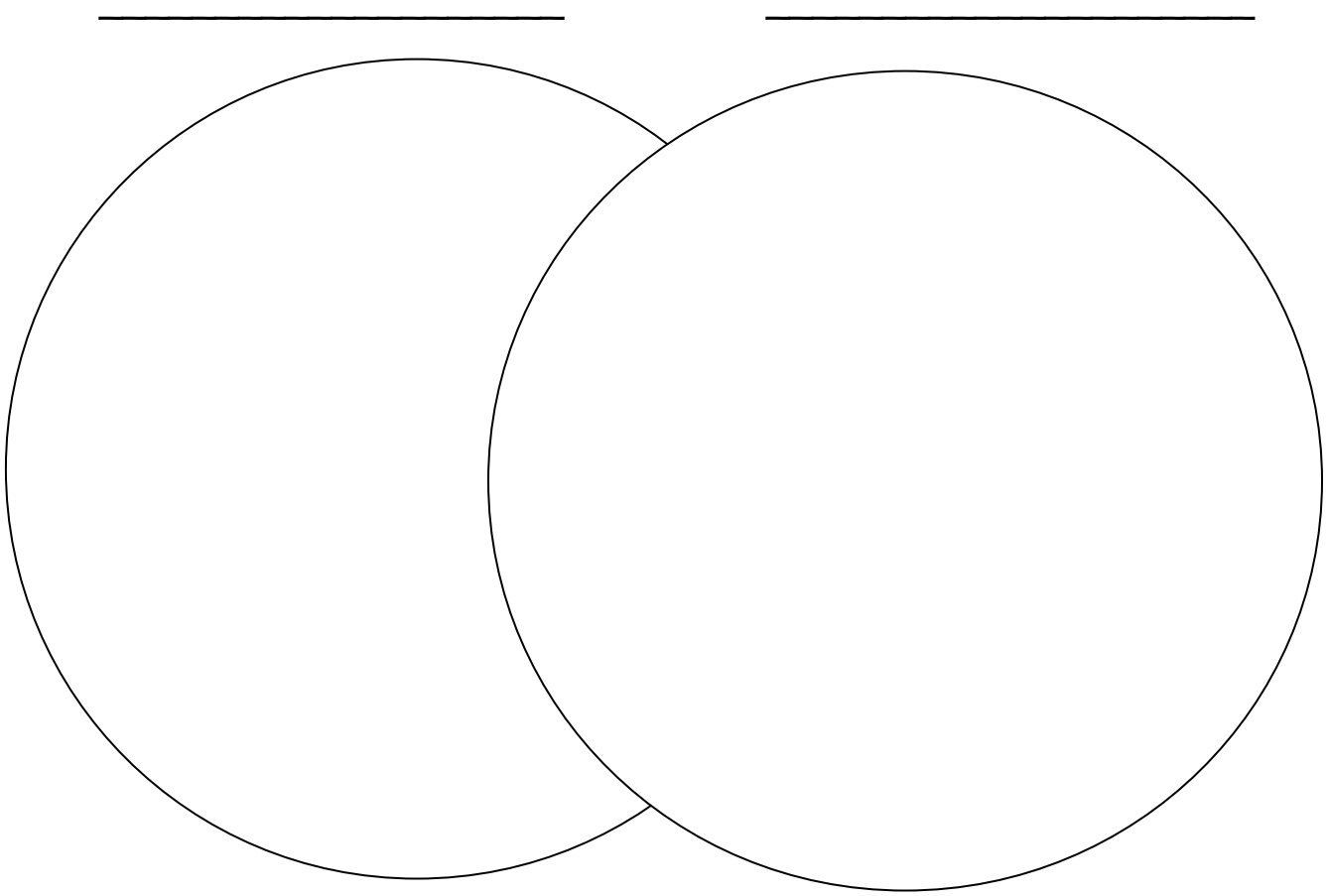
Extension Questions

1. How does the base area of an extruded figure relate to the volume of the extruded figure? _____
   _____
   _____
   _____
   _____

2. Use the venn diagram below to note the similarities and differences of a cone and a pyramid.



3. Use the venn diagram below to compare and contrast 2 three-dimensional shapes of your choice.



4. If the president of Willingdon required your unique design to include at least one three-dimensional figure placed inside another, how would you approach this? What are some things that you might think about? _____

Sketch one possible design for this requirement.

Daily Learning Log

Day_____
This is what I did today:_____
_____
_____
This is what I learned:_____
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Day_____
This is what I did today:_____
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This is what I learned:_____
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Day_____
This is what I did today:_____
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This is what I learned:_____
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Day_____
This is what I did today:_____
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This is what I learned:_____
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