Optimization of a Square Based Prism

Investigation A: How can you compare the surface areas of square-based prisms with the same volume?

1. Use 16 interlocking cubes to build as many different square-based prisms as possible with a volume of 16 cubic units.
2. Calculate the surface area of each prism. Record your results in a table.

Length	Width	Height	Volume	Surface Area
			16 u^3	u^2
			16 u^3	u^2
			16 u^3	u^2

3. What are the dimensions of the square-based prism that has the minimum, or optimal, surface area?
_____ units x _____ units x _____ units

4. Describe the shape of this prism compared to the other prisms.
Closest to a _____.
5. Predict the dimensions of the square-based prism with minimum surface area if you use:

a) 27 cubes b) 64 cubes c) 125 cubes

6. **REFLECT:** Summarize your findings.

a) Do any relationships exist between the length, width, and height of a square-based prism with minimum surface area for a given volume?

b) What is the ideal shape for minimizing the surface area of a square-based prism when given a fixed volume? A _____.

c) How can you predict the dimensions of a square-based prism with minimum surface area if you know the volume? Take the _____ _____. V = _____ So, _____ = $\sqrt[3]{V}$

EX. 1. Cardboard Box Dimensions.

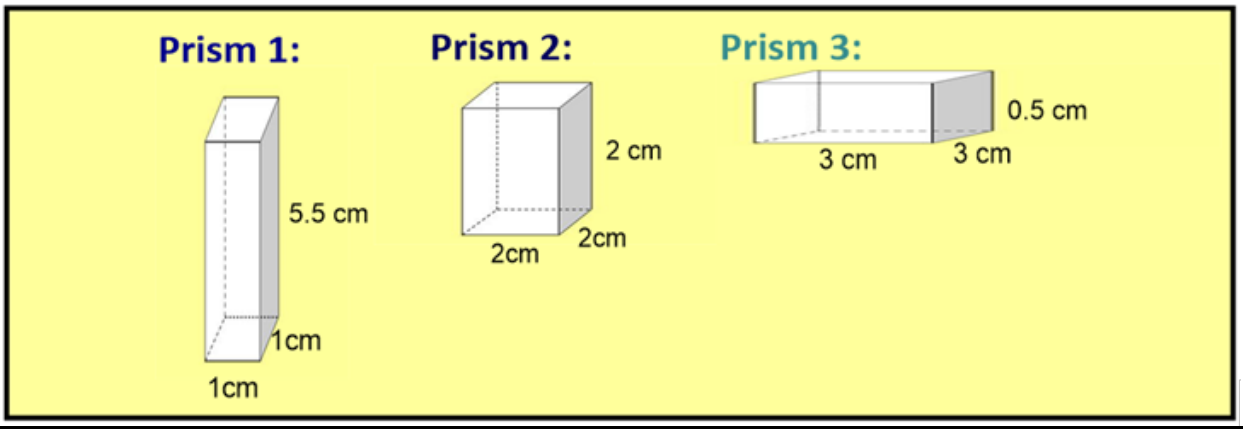
a) The Pop-a-Lot popcorn company ships kernels of popcorn to movie theatres in large cardboard boxes with a volume of 500,000 cm^3. Determine the dimensions of the square-based prism box, to the nearest tenth of a centimeter, the will require the least amount of cardboard.

b) Find the amount of cardboard required to make this box, to the nearest tenth of a square centimetre. Describe any assumptions you have made.

A_{total} =

<u>Investigation B:</u> How can you compare the volumes of square-based prisms with the same surface area?

1. Each of the square-based prisms below has a surface area of 24 cm^2. Calculate the area of the base and the volume of each prism. Record your data in the table.



Prism Number	Side length of base (cm)	Area of base (cm^2)	Surface area (cm^2)	Height (cm)	Volume (cm^3)
1			24		
2			24		
3			24		

2. What are the dimensions of the square-based prism that has the maximum, or optimal, volume?

3. Describe the shape of this prism compared to the other prisms.

4. Predict the dimensions of the square-based prism with maximum volume if the surface area is 54 cm^2.

5. **REFLECT:** Summarize your findings.

a) Do any relationships exist between the length, width, and height of a square-based prism with maximum volume for a given surface area?

b) What is the ideal shape for maximizing the volume of a square-based prism when given a fixed surface area?

c) How can you predict the dimensions of a square-based prism with maximum volume if you know the surface area?

EX. 2. Maximize the Volume of a Square-Based Prism

a) Determine the dimensions of the square-based prism with maximum volume that can be formed using 5400 cm^2 of cardboard.

b) What is the volume of the prism?