Unit 6, Lesson 18

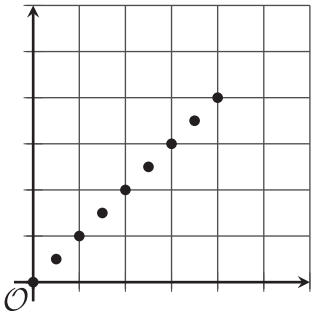
More Relationships

Let's use graphs and equations to show relationships involving area, volume, and exponents.

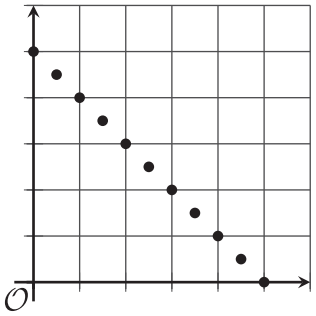
18.1 Which Three Go Together: Graphs

Which three go together? Why do they go together?

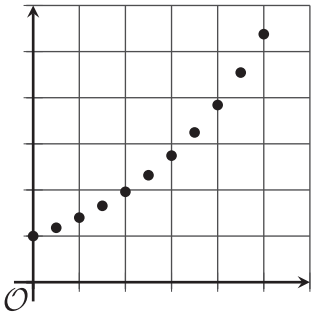
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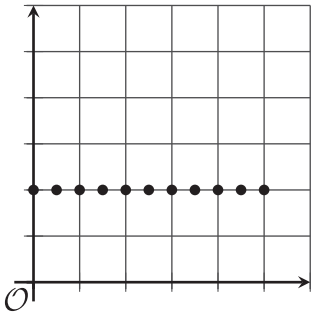
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D



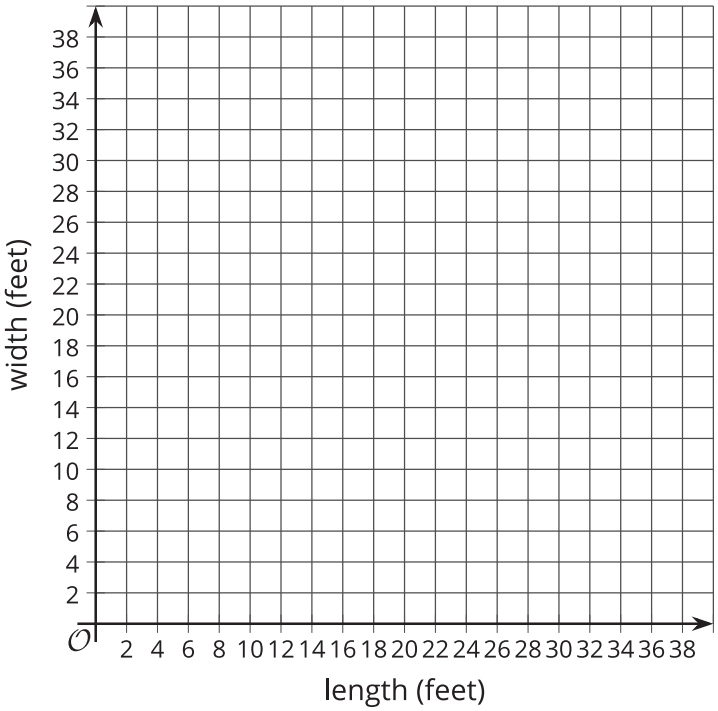
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18.2 Making a Banner

Mai is creating a rectangular banner to advertise the school play. The material for the banner is sold by the square foot. Mai has enough money to buy 36 square feet of material. She is trying to decide on the length and width of the banner.

1. What is the width of the banner if the length is:
   a. 6 feet?
   b. 4 feet?
   c. 9 feet?
2. To find different combinations of length and width that give an area of 36 square feet, Mai uses the equation $w = \frac{36}{\ell}$, where w is the width and ℓ is the length. Compare your strategy and Mai's method for finding the width. How were they the same or different?

3. We can use a graph to show the relationship between the side lengths of various rectangles that have an area of 36 square feet.
   - Use several combinations of length and width to create a graph.
   - Explain how the graph describes the relationship between length and width for different rectangles with an area of 36 square feet.



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4. Suppose Mai used the equation $\ell = \frac{36}{w}$ to find the length for different values of the width. Would the graph be different if she graphed length on the vertical axis and width on the horizontal axis? Explain how you know.

18.3 Cereal Boxes

A cereal manufacturer needs to design a cereal box that has a volume of 225 cubic inches and a height that is no more than 15 inches.

1. The designers know that the volume of a rectangular prism can be calculated by multiplying the area of its base and its height.

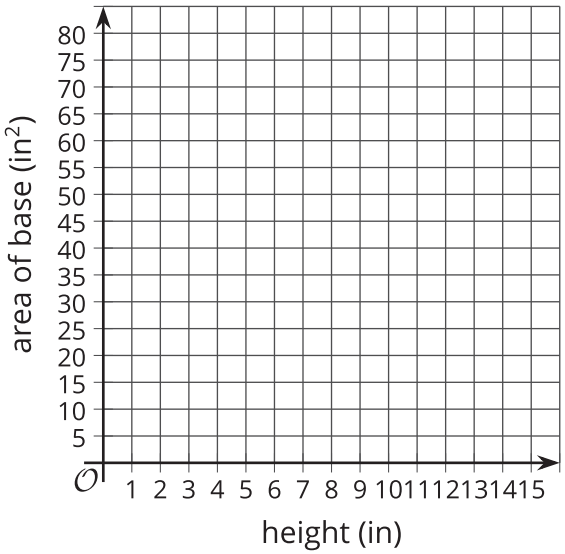
   Complete the table with pairs of values that will make the volume 225 in^3.

height (in)		5	9	12		$7\frac{1}{2}$
area of base (in^2)	75				15	

2. Describe how you found the missing values for the table.

3. Write an equation that shows how the area of the base in square inches, A, is affected by changes in the height in inches, h, for different rectangular prisms with a volume 225 in^3.

4. Plot the ordered pairs from the table on the coordinate grid to show the relationship between the area of the base and the height for different boxes with volume 225 in^3.



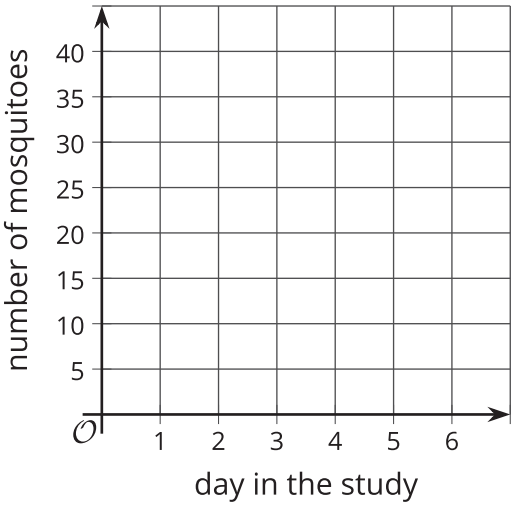
18.4 Multiplying Mosquitoes

A researcher who is studying mosquito populations collects the following data:

day in the study (d)	number of mosquitoes (n)
1	2
2	4
3	8
4	16
5	32

1. The researcher said that, for these five days, the number of mosquitoes, n, can be found with the equation $n = 2^d$ where d is the day in the study. Explain why this equation matches the data.

2. Use the ordered pairs in the table to graph the relationship between number of mosquitoes and day in the study for these five days.



3. Describe the graph. Compare how the data, equation, and graph illustrate the relationship between the day in the study and the number of mosquitoes.

4. If the pattern continues, how many mosquitoes will there be on day 6?

Are you ready for more?

A scientist is growing a colony of bacteria in a petri dish. She knows that the number of bacteria doubles every hour.

When she leaves the lab at 5 p.m., there are 100 bacteria in the dish. When she comes back the next morning at 9 a.m., the dish is completely full of bacteria. At what time was the dish half full?

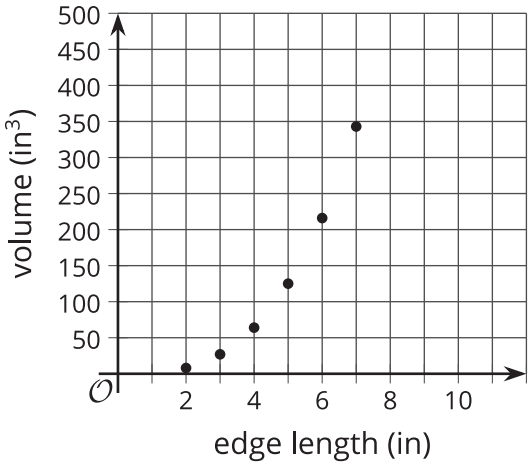
Lesson 18 Summary

Equations can represent relationships between geometric quantities. Examples:

- If s is the side length of a square, then the area A is related to s by $A = s^2$.
- Sometimes the relationships are more specific. For example, the perimeter P of a rectangle with length ℓ and width w is $P = 2\ell + 2w$. If we consider only rectangles with a length of 10, then the relationship between the perimeter and the width is $P = 20 + 2w$.
- If x is the edge length of a cube, then the volume V is related to x by $V = x^3$.

Equations and graphs can give us insight into different kinds of relationships between quantities and help us answer questions and solve problems.

For example, this graph shows the relationship between the edge length of a cube, x, and its volume, V, which is also represented by the equation $V = x^3$. The point at $(5, 125)$ shows that when the edge length of a cube is 5 inches, its volume is 125 cubic inches.



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