Math 9

3.1 Using Exponents to Describe Numbers

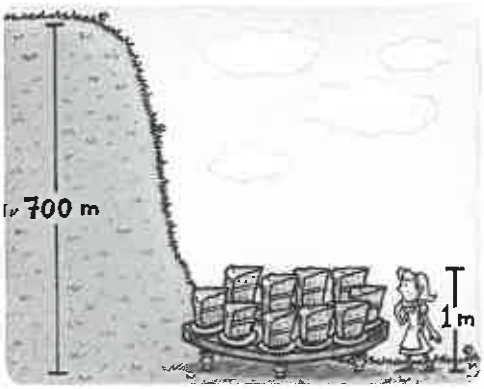
Name: _____

Date: Mar. 11

Learning Goals: *I will learn to*

- represent repeated multiplication with exponents

Explore and Analyze



In the story Alice in Wonderland, Alice could change her size dramatically by eating cake. If she needed to triple her height, she would eat a piece of cake. ×3

Imagine that she is currently 1 m tall. She needs to increase her height to 700 m in order to see over a hill.

How many pieces of cake will she need to eat?

1m $\xrightarrow{\times 3}$ 3m $\xrightarrow{\times 3}$ 9m $\xrightarrow{\times 3}$ 27m $\xrightarrow{\times 3}$ 81m $\xrightarrow{\times 3}$ 243 $\xrightarrow{\times 3}$ 729m tall enough!

She needs to eat 6 pieces of cake.

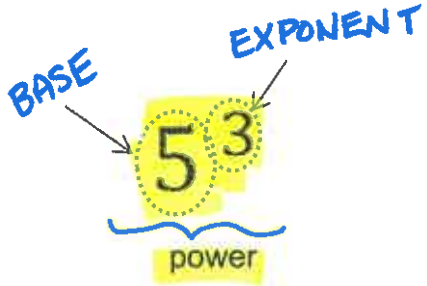
$1 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 1 \times 3^6$

expanded form — exponential form

EXPONENTIAL FORM is a shorter way of writing repeated multiplication, using a base and an exponent.

→ For example: $5 \times 5 \times 5$ in exponential form is 5^3

A **POWER** is an expression made up of a base and an exponent.



The **BASE** is the number that you multiply by itself.

The **EXPONENT** tells you the number of times the base is multiplied by itself.

Example 1: Write and Evaluate Powers

a) Write $2 \times 2 \times 2 \times 2 \times 2$ in **exponential form**. Label the base and the exponent.

2^5 ← 5 ← exponent; 2 ← base

b) Evaluate the **power**.

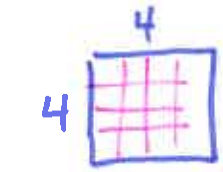
$2^5 = \boxed{32}$

$x^{\blacksquare}$ x^y y^x $\wedge$

Example 2: Powers with Positive Bases

a) Use a model to evaluate the power 4^2.

read as: "four to the power of two" OR "four squared"



(16 squares) AREA

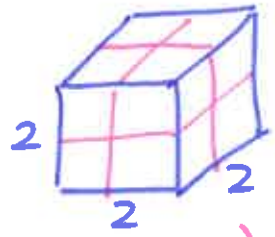
side length

$4^2 = 4 \times 4 = 16$

↑ area of square

b) Use a model to evaluate the power 2^3.

read as: "two to the power of three" OR "two cubed"



(8 cubes) VOLUME

side length

$2^3 = 2 \times 2 \times 2 = 8$

↑ volume of cube

c) Evaluate the power $\left(\frac{2}{5}\right)^4$.

$= \frac{2}{5} \times \frac{2}{5} \times \frac{2}{5} \times \frac{2}{5}$

$= \frac{2 \times 2 \times 2 \times 2}{5 \times 5 \times 5 \times 5}$

$= \frac{2^4}{5^4} \longrightarrow \boxed{\frac{16}{625}}$

Example 3: Powers with Negative Bases

Evaluate each power.

a) $(-2)^4$ base = −2

$= (-2)\times(-2)\times(-2)\times(-2)$

$= 16$

b) -2^4 base = 2

like having a −1 out front

$= -1 \times 2^4$

$= -1 \times 2 \times 2 \times 2 \times 2$

$= -1 \times 16$

$= -16$

Show You Know

1. Write $6 \times 6 \times 6 \times 6$ as a power. Then, evaluate the power.

$6^4 = 1296$

2. Evaluate the following powers.

a) $3^4 = 81$

b) $\left(\frac{3}{8}\right)^3 = \frac{3^3}{8^3} = \frac{27}{512}$

c) $(-0.9)^2 = 0.81$

d) $7^0 = 1$

e) $(-6)^2 = 36$

f) $(-6)^5 = -7776$

$(-6)\times(-6)\times(-6)\times(-6)\times(-6)$

3. Explain how $(-5)^2$ and -5^2 are different and how they are the same.

$= (-5) \times (-5)$
$= 25$

$= -1 \times 5^2$
$= -1 \times 5 \times 5$
$= -1 \times 25$
$= -25$

DIFFERENT

- the first power has a negative base
  → the final value is positive because
  ≠ neg. x neg. = pos.
- the second power has a positive base
  → the final value is negative because the neg. sign in front is like multiplying by negative 1

SAME

- both powers have an exponent of 2
- the values are the same distance from 0 on a numberline.