Warm-Up:

Evaluate -2^4 and $(-2)^4$

What kind of answers do you get for each?

Are they the same or different?
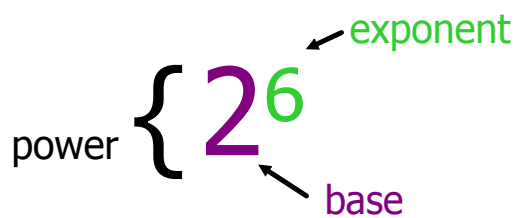
Why is this the case?

Objective:

SWBAT simplify monomials using the rules of exponentiation.

Exponentiation

Exponent Review:

exponent

power $\left\{ 2^6 \right.$

base

Use parentheses to **exponentiate** more than one symbol at a time:

$(xy)^3 =$

Monomials:		**Not Monomials:**	
5	xy	$8x - 1$	$2x^2 + 3x + 6$
$36x^2y$	$-9a,$		
$14b$	$2wxyzabcd$	$7y + 3z$	$x^4 - x^3 + x$

So, what's a monomial??

"A **monomial** is a number, a variable, or a product of a number and one or more variables."

More Vocabulary:
- **Constants** are monomials that contain no variables (just the number)
- **Coefficients** are the numbers in front of the variable (how many x's and y's you have)
- A **power** is an expression of the form x^n (the exponent)

$$x^n$$

base ⟶   ⟵ exponent

Rules of Exponentiation

Product of powers:

$$x^5 \cdot x^3 = \qquad xxxxx \cdot xxx =$$

Is there a short cut?
When **multiplying** two powers with the same base, **add** the exponents.

Quotient of powers:

$$\frac{x^5}{x^3} = \qquad \frac{xxxxx}{xxx} =$$

Is there a short cut?
When **dividing** two powers with the same base, **subtract** the exponents.

Power of a power:

$$(x^5)^3 = \quad (xxxxx)(xxxxx)(xxxxx)$$

Is there a short cut?
When **exponentiating** a power, **multiply** the exponents.

Powers of Products and Quotients:

$(2x^5y)^3 =$

$$\left(\frac{6x^5y}{9xz^4}\right)^2$$

When exponentiating a product or quotient, distribute the outside exponent to each factor inside the parentheses.
Be careful with coefficients!

Simplify: $\dfrac{x^3}{x^5}$

Negative Exponents: $x^{-n} = \dfrac{1}{x^n}$

Ex 1) 4^{-3} Ex 2) $\left(\dfrac{2}{3}\right)^{-2}$

Ex 3) $\dfrac{5}{y^{-6}}$

Zero Exponent: Anything raised to the zero power equals ...

Why? $$\dfrac{b^{35}}{b^{35}}$$

Multiplying Monomial Expressions **with Like Bases**

Expression	Work	Answer
$x^3 \cdot x^2$	$(x \cdot x \cdot x) \cdot (x \cdot x) = x \cdot x \cdot x \cdot x \cdot x$	x^5
$5^4 \cdot 5^2$	$(5 \cdot 5 \cdot 5 \cdot 5) \cdot (5 \cdot 5) = 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$	5^6
$(y)(y^2)$	$(y) \cdot (y \cdot y) = y \cdot y \cdot y$	y^3
$-2x^2 \cdot 3x$	$-2 \cdot x \cdot x \cdot 3 \cdot x = -2 \cdot 3 \cdot x \cdot x \cdot x$	$-6x^3$
$(7x^2yz^3)(-2xy^2z^3)$	$(7 \cdot x \cdot x \cdot y \cdot z \cdot z \cdot z)(-2 \cdot x \cdot y \cdot y \cdot z \cdot z \cdot z)$	$-14x^3y^3z^6$

Is there a shortcut...?

Expression	Process	Answer
$x^3 \cdot x^2$	x^{3+2}	x^5
$5^4 \cdot 5^2$	5^{4+2}	5^6
$(y)(y^2)$	y^{1+2}	y^3
$-2x^2 \cdot 3x$	$-2 \cdot 3 \cdot x^{2+1}$	$-6x^3$
$(7x^2yz^3)(-2xy^2z^3)$	$7 \cdot -2 \cdot x^{1+2} \cdot y^{1+2} \cdot z^{3+3}$	$-14x^3y^3z^6$

Dividing Expressions **with Like Bases**

$\dfrac{3^5}{3^2}$	$\dfrac{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 3} = 3 \cdot 3 \cdot 3 = 3^3$
$\dfrac{x^6}{x^4}$	$\dfrac{x \cdot x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x \cdot x} = x \cdot x = x^2$
$\dfrac{9x^6}{3x^2}$	$\dfrac{3 \cdot 3 \ x \cdot x \cdot x \cdot x \cdot x \cdot x}{3 \cdot x \cdot x} = 3x^4$

Is there a shortcut...?

Using the Division Property of Exponents

$$\frac{3^5}{3^2} = 3^{5-2} = 3^3$$

$$\frac{x^6}{x^4} = x^{6-4} = x^2$$

$$\frac{9x^6}{3x^2} = \frac{9}{3}x^{6-2} = 3x^4$$

Power Property of Exponents (power to a power)

Problem	Work	Answer
$(x^3)^2$	$(x \cdot x \cdot x)(x \cdot x \cdot x)$	x^6
$(5^2)^4$	$(5 \cdot 5)(5 \cdot 5)(5 \cdot 5)(5 \cdot 5)$	5^8
$\left(\dfrac{x^2}{y^4}\right)^3$	$\left(\dfrac{x^2}{y^4}\right)\left(\dfrac{x^2}{y^4}\right)\left(\dfrac{x^2}{y^4}\right)$ $=\left(\dfrac{x \cdot x \cdot x \cdot x \cdot x \cdot x}{y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y}\right)$	$\dfrac{x^6}{y^{12}}$
$(3x^2)^4$	$(3x^2)(3x^2)(3x^2)(3x^2) =$ $(3 \cdot 3 \cdot 3 \cdot 3)(x^2 \cdot x^2 \cdot x^2 \cdot x^2) =$ $3^4 \cdot (x^2)^4$	$81x^8$

Is there a shortcut...?

Examples using the shortcut...

$$\left(2f^4g^3h\right)^5$$

$$\left(\frac{2}{3r^2s^3z^5}\right)^2$$