Algebra I
Lesson 7.1 Integer Exponents
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When we multiply a number by itself, we can use exponents as a shorthand method to indicate the repeated multiplication. Let's take the expression $(6)(6)(6)(6)(6)(6)(6) sheesh!$ Well, we can rewrite $(6)(6)(6)(6)(6)(6)(6)\ as\ 6^7$. The *exponent* tells us how many times a number is being multiplied. Here, "7" means we multiply 6, *the base,* by itself 7 times!

Vocabulary:
Raising to a power – Using an exponent
Base – the thing that's being multiplied, (6 in our example)
to the second power – is generally said as "squared"
to the third power – is generally said as "cubed"
When we deal with numbers, we usually just simplify; we'd rather deal with "27" than with "3^3". But with variables, we need the exponents, because we'd rather deal with $x^9\ than\ xxxxxxxxx$.

Rules for exponents

$x^n = x \cdot x \cdot x \cdot x \cdot x \ldots. \quad (n\ times)$ $x^0 = 1$ $x^{-n} = \frac{1}{x^n}$	$x^4 = x \cdot x \cdot x \cdot x$ $x^0 = 1$ $x^{-4} = \frac{1}{x^4}$

What about super tiny numbers? Can they be written as exponents too? Of course! (Why would I have asked this question?)  A classic example of the need for ***negative exponents*** is in manufacturing. Cars were a wonderful invention, but with them came a need for a precision not really used before. Car pistons for example had to have a diameter of $3\ \frac{7}{8}$ inch. This measurement could vary by most by $\frac{1}{1000}$ of an inch. Off by more than that tiny amount the pistons would not work properly. Oh, and that is where negative exponents come into the story because $\frac{1}{1000} = 10^{-3}$. Look at the table below. First let's complete it. Now, comparing our table to the exponent rules (above) we see that the last exponent rule listed states how to write tiny numbers as an exponent.

Complete the table below:

6^6	6^5	6^4	6^3	6^2	6^1	6^0	6^{-1}	6^{-2}	6^{-3}	6^{-4}	6^{-5}
46656	7776	1296	216	36	6	1	$\frac{1}{6}$	$\frac{1}{6^2}$			

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Dividing by 6 we see how the values are reduced.

Simplify

6^{-2} $\qquad$ 3^0 $\qquad$ -5^{-2} $\qquad$ -8^{-3}

4.2^0 $\qquad$ 1^{-8}

Simplify the following expressions:

A red blood cell is about $6^{-6}m$ diameter

The HIV virus cells are about $9^{-8}m$ diameter

The hydrogen atom is $2.5^{-10}m$
WAIT!!!! This is whole idea behind negative exponents. We don't want to write these incredibly small numbers out! But, you need to know write them out.
(From the Physics Fact Book)

What about when we are working with variables? Simplify the following *(means no negative exponents)*:

$4m^0$ $\quad$ $3k^{-4}$ $\quad$ $\frac{7}{r^{-7}}$ $\quad$ $\frac{c^4}{d^{-3}}$ $\quad$ p^7q^{-1} $\quad$ $\frac{x^{10}}{x^7}$

Evaluate each expression for the given value of the variable.

$x^{-1}\ for\ x = 3$ $\quad$ $p^{-3}\ \ for\ p = 4$ $\quad$ $8a^{-2}b^0\ \ for\ a = -2\ and\ b = 6$ $\quad$ $\left(\frac{2}{3}v\right)^{-3}$