Name: _____ Date: _____

Exponential Unit, Lesson 2: Zero and Negative Exponents

In math, people often invent ways to **extend concepts** to areas that might not make sense at first. Pretty much everyone can understand what 2^3 means, because they understand that it represents multiplying by the number 2, 3 times. Yet, what does 2^0 or 2^{-4} mean? Does it make sense to talk about multiplying by a number a negative amount of times? Let's explore these ideas in the first exercise.

Do Now (a): We can think of powers of 2 as representing multiplication of the number 1 repeatedly.

(a) Fill in the pattern for powers that are not negative. What does this lead you to fill in for 2^0?

$2^4 = 1 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 16$

$2^3 = 1 \cdot 2 \cdot 2 \cdot 2 = 8$

$2^2 = 1 \cdot 2 \cdot 2 = 4$

$2^1 = 1 \cdot 2 = 2$

$2^0 = 1$

(b) If **positive exponents** indicated **multiplying** the number 1 by 2 repeatedly, then **negative exponents** should indicate division.

$2^{-1} = \frac{1}{2}$

$2^{-2} = \frac{1}{2 \cdot 2} = \frac{1}{2^2} = \frac{1}{4}$

$2^{-3} = \frac{1}{2^3} = \frac{1}{2 \cdot 2 \cdot 2} = \frac{1}{8}$

$2^{-4} = \frac{1}{2^4} = \frac{1}{2 \cdot 2 \cdot 2 \cdot 2} = \frac{1}{16}$

We want the pattern of positive, integer powers to extend to zero exponents and negative, integer exponents. We can now define zero and negative exponents as follows.

Zero and Negative Exponents

1. Zero Exponents: $b^0 = 1$

2. Negative Exponents: $b^{-n} = \frac{1}{b^n}$

***Exercise* #2:** Which of the following is **not** equivalent to 5^{-2}?

$= \frac{1}{5^2} = \frac{1}{25}$

(1) $\frac{1}{5^2}$

(2) $\frac{1}{10}$

(3) $\frac{1}{25}$

(4) 0.04

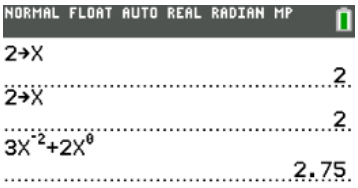
***Exercise* #3:** If $f(x) = 3x^{-2} + 2x^0$, then which of the following is the value of $f(2)$? Show the work that leads to your answer. Remember, exponents **always** come before multiplication.

(1) $2\frac{3}{4}$

(2) $1\frac{3}{4}$

(3) $1\frac{1}{12}$

(4) $2\frac{1}{2}$



$3x^{-2} + 2x^0$

$3(2)^{-2} + 2(2)^0$

$\frac{3}{1} \cdot \frac{1}{4} + 2 \cdot 1$

$\frac{3}{4} + 2$

$2\frac{3}{4}$

PEMDAS