Algebra II
Lesson 8-5: Exponential and Logarithmic Equations
Mrs. Snow, Instructor

We have been looking at exponential equations and techniques to evaluate them, that is solve for x. We found that in a situation where for example: $3^x = 243$ we were able to get the right side into an exponential form and we found that $3^x = 3^5$. We also know a rule that says if the bases are equal the exponents must be equal; therefore $x = 5$.

Solve: $2^x = 30$

Plan A: In order to solve this equation, we will need x to be down on the ground floor. This can be done with logarithms, so we get: $log_2 30 = x$. Here we have the problem that we don't have the where with all to solve a base 2 log!!
Plan B: **Golden rule of algebra**: What you do to the left do to the right. This combined with our **power property** of logarithms will allow us to solve for x. So let's look back at our equation:

$2^x = 30$	1. Take the log of both sides 2. With the power property, take the exponent down in front of the log as a coefficient 3. Divide each side by the $log 2$ Use a calculator to simplify
$6^{2x} = 21$	$3^{x+4} = 101$

$e^{2x+1} = 37$	$10^x = 19$

When **x** is part of the argument of a log function, a similar process may be used:

Solve: $log(3x + 1) = 5$	1. Already in log form so make into an exponential function (base 10). **Recognize that by rewriting into exponential form, we can unlock the x and get it out of the log!!** 2. solve for **x** by isolating the **x** term and by clearing coefficient
$2logx = -1$	$2\ logx - log3 = 2$

$log_2(6x) - 3 = -2$	$ln(3x) = 6$

CHANGE OF BASE

Now let's take a look at logs with bases other than 10. Evaluate $\boldsymbol{log_3 29},$ there is no neat solution for this equation, unless we come up with another method. A method that works for these types of equations is called the **Change of Base Formula**.

Argument $$log_b M = \frac{log_c M}{log_c b}$$

– the argument is kept in the numerator above the base in the denominator!
Or, the base stays in the basement! Whew!

Letting **c** be our base 10, we may take a ratio of the log of the argument to the log of the original base. So our
equation above becomes: $log_3 29 = \frac{log 29}{log 3} = 3.065$

$log_2 7$	$log_3 54$