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| You may have noticed the log button on the handheld. What does *log* mean? Right above the log button is an exponential key $10^{x}$. Why is the $10^{x}$ placed above the log button? You will investigate these questions in this activity.  |  |

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| **Go to the *y =* screen and follow the directions below.**1. In $Y\_{1}$, graph the function $Y\_{1}= 2^{x}.$ a. What are the domain and range of this function in $Y\_{1}?$b. Recall that $f\left(x\right)= 2^{x}$ is a one-to-one function, so it has an inverse reflected over the line *y* = *x*. Graph this line into $Y\_{2}$. What are the domain and range of *f–1*(*x*)? c. Press **graph**, then **trace**. The coordinates you see at the bottom of the screen is a point on the function $f\left(x\right)= 2^{x}$. Move the cursor left and right using the arrows, on the axis below, sketch what you think the reflection over the line $y=x$ would look like. Write a corresponding equation for what you think the function is.  d. The equation *x* = 2*y* cannot be written as a function of *y* in terms of *x* without new notation. The inverse of *f*(*x*)is actually $f^{-1}\left(x\right)= log\_{2}x$. In general, log*b* *x* = *y* is equivalent to *by = x* for *x* > 0, *b* > 0 and *b* ≠ 1. Why do you think *x* and *b* must be greater than 0? Why can *b* not be equal to 1?e. Enter the following function into $Y\_{3}$ and press graph: $Y\_{3}= log\_{2}x$. On the graph screen, while using **trace**, use the left/right arrows to trace a function, use the up/down arrows to toggle between functions. While on the exponential function, press the number 1 then **enter**. This point has coordinates of (1, 2). The point (1, 2) on *f*(*x*) = 2*x* indicates that 21 = 2. Move the cursor to the logarithmic function and press 2 then **enter**. This point has the coordinates. The point (2, 1) on  indicates that log2 2 = 1. Use this relationship between exponential expressions and logarithmic expressions to complete the following table. (Use the trace function as necessary.) |
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| ***P*** | ***P'*** | **Exponential Expression** | **Logarithmic Expression** |
| (1, 2) | (2, 1)  | 21 = 2 |  |
| (2, 4) |  |  |  |
|  | (8, 3)  |  |  |
|  |  | 20 = 1 |  |
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2. You have discussed the idea of reflecting the exponential function over the line $y=x$. The result of  this reflection is the logarithmic function. Now we will discuss any tabular relationships that are formed  between an exponential function and a logarithmic function. Using the first and second columns from the table above, fill in the following tables.

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| $$x$$ | $$f\left(x\right)= 2^{x}$$ |
| -3 |  |
| -2 |  |
| -1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

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| --- | --- |
| $$x$$ | $$f^{-1}\left(x\right)= log\_{2}x$$ |
| $$^{1}/\_{8}$$ |  |
| $$^{1}/\_{4}$$ |  |
| $$^{1}/\_{2}$$ |  |
| 1 |  |
| 2 |  |
| 4 |  |
| 8 |  |

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1. Briefly explain your process of filling in the tables on the previous page.
2. With a classmate, discuss and describe the patterns you see in each individual column.
3. Write down a rule for each table that you can use to classify the function as either exponential or logarithmic.
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| 3. Solve the logarithmic equation log232 = *y* using the patterns from questions 1 and 2. How does the exponential equation verify your result? |
|  |
| 4. Solve the equation using the patterns from questions 1 and 2. How does the exponential equation verify your result? |
| 5. Maya solved the logarithmic equation. She says the answer is 4 since 4 × 4 = 16. Is her answer correct? Why or why not?6. Alex says that when solving a logarithmic equation in the form log*b a* = *y*, he can rewrite it as *ba* = *y*. Is this a good strategy? Why or why not? |