



# What is Log?

## Student Activity

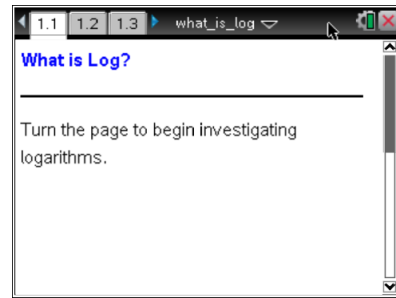
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Open the TI-Nspire document

*What\_is\_Log.tns*.

You may have noticed that above  $10^x$  is  $[\log]$ . What does *log* mean? Why is  $[\log]$  placed above the exponential key? You will investigate these questions in this activity.



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Press  $\boxed{\text{ctrl}}$   $\blacktriangleright$  and  $\boxed{\text{ctrl}}$   $\blacktriangleleft$  to navigate through the lesson.

1. The graph of the function  $f(x) = 2^x$  is shown.
  - a. What are the domain and range of  $f(x)$ ?
  
  
  
  
  
  
  
  
  
  
  - b. Recall that  $f(x) = 2^x$  is a one-to-one function, so it has an inverse reflected over the line  $y = x$ . What are the domain and range of  $f^{-1}(x)$ ?
  
  
  
  
  
  
  
  
  
  
  - c. Point  $P$  is a point on  $f(x)$ . Move the Show Reflection slider to Yes to and then move point  $P$ . As you do so, point  $P'$  invisibly traces the graph of  $f^{-1}(x)$ . Since  $f(x)$  can be written as  $y = 2^x$ , write a corresponding equation for the inverse.
  
  
  
  
  
  
  
  
  
  
  - d. The equation  $x = 2^y$  cannot be written as a function of  $y$  in terms of  $x$  without new notation. Move the Show Function slider to Yes. The inverse of  $f(x)$  is actually  $f^{-1}(x) = \log_2(x)$ . In general,  $\log_b x = y$  is equivalent to  $b^y = x$  for  $x > 0$ ,  $b > 0$  and  $b \neq 1$ . Why do you think  $x$  and  $b$  must be greater than 0? Why can  $b$  not be equal to 1?



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- e. Move point  $P$  so that its coordinates are  $(1, 2)$ . The point  $(1, 2)$  on  $f(x) = 2^x$  indicates that  $2^1 = 2$ .  $P'$  has the coordinates  $(2, 1)$ . The point  $(2, 1)$  on  $f^{-1}(x) = \log_2(x)$  indicates that  $\log_2 2 = 1$ . Use this relationship between exponential expressions and logarithmic expressions to complete the following table. (Move point  $P$  as necessary.)

$P$	$P'$	Exponential Expression	Logarithmic Expression
$(1, 2)$	$(2, 1)$	$2^1 = 2$	$\log_2 2 = 1$
$(2, 4)$			
	$(8, 3)$		
		$2^0 = 1$	
		$2^{-1} = \frac{1}{2}$	
$\left(-2, \frac{1}{4}\right)$			
			$\log_2 \frac{1}{8} = -3$

### Move to page 1.3.

2. Solve the logarithmic equation  $\log_2 32 = y$  using the patterns from question 1. Then, use the slider to change the  $n$ -value to solve the logarithmic equation. How does the exponential equation verify your result?

### Move to page 2.1.

3. Solve the equation  $\log_4 \frac{1}{256} = y$ . Then, use the slider to change the  $n$ -value to solve the logarithmic equation. How does the exponential equation verify your result?



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4. Maya solved the logarithmic equation  $\log_4 16 = y$ . She says the answer is 4 since  $4 \times 4 = 16$ . Is her answer correct? Why or why not?
5. Alex says that when solving a logarithmic equation in the form  $\log_b a = y$ , he can rewrite it as  $b^a = y$ . Is this a good strategy? Why or why not?