(A) Lesson Context

BIG PICTURE of this UNIT:	• How do algebraically & graphically work with growth and decay applications? • What are logarithms and how do we invert or undo an exponential function? • How do we work with simple algebraic and graphic situations involving the use of logarithms (or inversing exponentials?)		
CONTEXT of this LESSON:	Where we've been We have seen algebra skills related to the parent exponential function $f(x) = AB^x$ in Lesson 1 zand we've worked with Inverses in SEM 1	Where we are What are & How do work with the inverse of exponential functions?	Where we are heading How do work with the mathematically model $f(x) = AB^{k(x+c)} + d$?

(B) Lesson Objectives:

a. How can we summarize number patterns associated with logarithmic & exponential relationships?
b. Convert between exponential & logarithmic forms of numerical expressions
c. Solve simple logarithmic equations using fundamental knowledge of exponents

(C) EXPLORATION #1: Looking for PATTERNS

Consider the following logarithmic equations below ➔ explain what is happening/going on in all these equations

$\log_5 25 = 2$ $\quad \log_7 1 = 0$ $\quad \log_2 8 = 3$ $\quad \log_6 36 = 2$ $\quad \log_5 25 = 2$ $\quad \log_3 81 = 4$

$\log_4 64 = 3$ $\quad \log_2 32 = 5$ $\quad \log_5 25 = 2$ $\quad \log_{12} 144 = 2$ $\quad \log_4 2 = \frac{1}{2}$ $\quad \log_{\frac{2}{3}}\left(\frac{4}{9}\right) = 2$

$\log_{125} 5 = \frac{1}{3}$ $\quad \log_9 3 = \frac{1}{2}$ $\quad \log_8 2 = \frac{1}{3}$ $\quad \log_2 \frac{1}{16} = -4$ $\quad \log_{243} 27 = \frac{3}{5}$ $\quad \log_8 4 = \frac{2}{3}$

$\log_2 \frac{1}{8} = -3$ $\quad \log_9 \frac{1}{81} = -2$ $\quad \log_3 \frac{1}{27} = -3$ $\quad \log_{\frac{3}{5}}\left(\frac{25}{9}\right) = -2$ $\quad \log_{27} \frac{1}{3} = -\frac{1}{3}$ $\quad \log_{128} \frac{1}{2} = -\frac{1}{7}$

(D) Application: Solving Logarithmic Equations

Given the pattern you found in Part C, evaluate & solve the following logarithmic expressions/equations

Evaluate the following logarithmic expressions

$\log_5 125 =$

$\log_2 \frac{1}{16} =$

$\log_2 \frac{1}{128} =$

$4\log_9 3 =$

$\log_4 256 =$

$\log_3 \frac{1}{243} =$

$4\log_2 4 =$

$\log_2 64 =$

$\log_{\frac{1}{6}} 36 =$

$2\log_4 2 =$

More examples at:

http://www.mathworksheets4kids.com/logarithms/evaluating-expressions-level1-easy2.pdf (EASY)

http://www.mathworksheets4kids.com/logarithms/evaluating-expressions-level2-medium1.pdf (MEDIUM)

http://www.mathworksheets4kids.com/logarithms/evaluating-expressions-level2-hard2.pdf (HARD)

Solve the following logarithmic equations

$\log_x 32 = 5$

$\log_3 x = 3$

$\log_3 81 = x$

$\log_5 x = -2$

$\log_6 x = 2$

$\log_9 x = \frac{1}{2}$

$\log_5 0.04 = x$

$\log_2 \frac{1}{x} = 4$

$\log_x 2 = \frac{1}{3}$

$\log_x 256 = -4$

More examples at:

http://www.mathworksheets4kids.com/logarithms/solve-level1-easy2.pdf (EASY)

http://www.mathworksheets4kids.com/logarithms/solve-level1-medium2.pdf (MEDIUM)

http://www.mathworksheets4kids.com/logarithms/solve-level2-medium2.pdf (HARD)

(E) Converting Forms ➔ between Exponential & Logarithmic

Given the following examples ➔ convert all log equations to equivalent exponential equations & vice versa (convert exponential equations into equivalent logarithmic equations

1) $\log_{16} 256 = 2$	2) $\log_9 81 = 2$	21) $4^{\frac{1}{2}} = 2$	22) $3^5 = 243$
3) $\log_2 \frac{1}{8} = -3$	4) $\log_5 25 = 2$	23) $14^{-2} = \frac{1}{196}$	24) $18^2 = 324$
5) $\log_{20} 400 = 2$	6) $\log_{17} 289 = 2$	25) $3^3 = 27$	26) $\left(\frac{1}{6}\right)^3 = \frac{1}{216}$
7) $\log_{13} 169 = 2$	8) $\log_5 125 = 3$	27) $14^2 = 196$	28) $36^{-\frac{1}{2}} = \frac{1}{6}$
9) $\log_9 \frac{1}{81} = -2$	10) $\log_{169} 13 = \frac{1}{2}$	29) $6^3 = 216$	30) $17^2 = 289$
11) $\log_y x = \frac{2}{3}$	12) $\log_y 76 = x$		

Further Examples

http://www.mathworksheets4kids.com/logarithms/log-exp-form-num1.pdf
http://www.mathworksheets4kids.com/logarithms/log-exp-form-var1.pdf

(F) Working with our TI-84 ➔ Evaluating Log & Exponent Expressions & Equations

Using the logbase key on the TI-84, for each of the following log expressions, (i) evaluate the expression and then write the exponential equation that would have created the given log expression.

Use a calculator to approximate each to the nearest thousandth.

635) $\log_5 33$

636) $\log_4 90$

637) $\log_4 57$

638) $\log_3 23$

639) $\log 17$

640) $\log_2 47$

641) $\log_9 14$

642) $\log_8 4.9$

643) $\log_8 1.4$

644) $\log_7 86$

645) $\log_6 53$

646) $\log_6 7.33$

647) $\log_5 2.4$

648) $\log_3 9$

649) $\log_4 43$

650) $\log_3 66$

651) $\log_2 25$

652) $\log_9 82$

653) $\log_9 48$

654) $\log_8 5.9$

655) $\log_7 1.3$

656) $\log_7 39$

657) $\log_6 5$

658) $\log_5 2.6$

659) $\log_5 7.2$

660) $\log_3 44$

661) $\log_4 78$

662) $\log_2 -8.3$

663) $\log_3 -4.8$

664) $\log -8.3$

(G)Summary

(i) Equivalence of Exponential & Logarithmic equations ➔

(ii) Key Terminology ➔

Natural Logarithms

1. Verify ln(1) = 0
2. Verify ln(2.718281828) = 1 approximately. You calculator may round to 1.
3. **Experiment**: Calculate the natural logarithm of 2.7, 2.71, 2.71, 2.718, 2.7182, and so on. See how the values approach or get closer and closer to 1.
4. Evaluate ln(2) =
5. Evaluate ln(3) =
6. Evaluateln(6) =
7. Evaluate ln(2) + ln(3) - ln(6) =
8. Evaluate ln(0.5)
9. Evaluate ln(1/2)
10. Evaluate ln(1/3)
11. Evaluate ln (4)
12. Evaluate ln (1/4) =
13. Evaluate ln (1.25) + ln(0.8)
14. Evaluate ln(10)
15. Evaluate ln (5)/ln(10) = ln(5) divided by ln(10).
16. Use the log button on your calculator to compute log(5). That should give the same result as ln(5)/ln(10).
17. Evaluate $\ln(2^5) - 5\ln(2)$

http://www.mathworksheets4kids.com/logarithms/solving-expressions-calc-natural3.pdf

http://www.mathworksheets4kids.com/logarithms/solving-expressions-calc-natural2.pdf

http://www.mathworksheets4kids.com/logarithms/solving-expressions-calc-common3.pdf