A. Lesson Context

BIG PICTURE of this UNIT:	• How can we analyze growth or decay patterns in data sets & contextual problems? • How can we algebraically & graphically summarize growth or decay patterns? • How can we compare & contrast linear and exponential models for growth and decay problems. • How can we extend basic function concepts using exponential functions?

B. Lesson Objectives

i. Study applications of exponential functions

PART 1 – Concept Investigations

C. Working with Rational Exponents

What about more complex functions?

5. $8^{\frac{2}{3}}$
6. $25^{\frac{3}{2}}$
7. $16^{-\frac{5}{4}}$
8. $64^{\frac{7}{6}}$
9. $81^{-\frac{3}{4}}$

What about combinations?

10. $3^{\frac{4}{3}} \cdot 3^{\frac{5}{3}}$
11. $(7^3)^{\frac{2}{3}}$
12. $8^{-\frac{5}{3}} \cdot 8^{\frac{6}{3}}$
13. $\dfrac{32^{\frac{7}{5}}}{32^{\frac{9}{5}}}$
14. $\left(64^{\frac{3}{2}}\right)^{-\frac{1}{3}}$

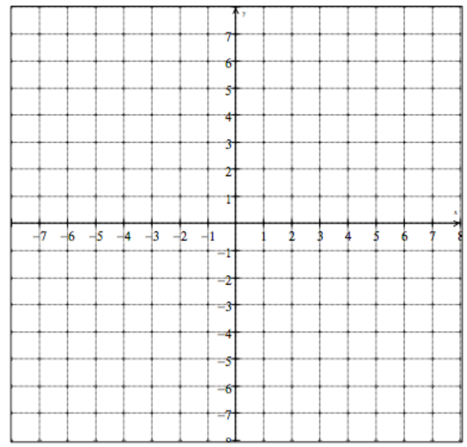
D. Graphs of Exponential Functions

Example 3: Use $f(x) = 2^x$ to obtain the graph $g(x) = -2^{x+3} - 1$.

Domain of g: ____________

Range of g: _____________

Equation of any asymptote(s) of g: ______________



PART 2 – Skills PRACTICE

E. Word Problems

1) Which of the exponential functions below show **growth** and which show **decay**?

a) $y = 5(2)^x$ b) $y = 100(.5)^x$ c) $y = 80(1.3)^x$ d) $y = 20(0.8)^x$

e) $y = 20(1+0.025)^x$ f) $y = 40(1-0.4)^x$

2) Since January 1980, the population of the city of Brownville has grown according to the mathematical model $y = 720{,}500(1.022)^x$, where x is the number of years since January 1980.

   a. Explain what the numbers 720,500 and 1.022 represent in this model.
   b. What is the annual growth rate for this population?
   c. What would the population be in 2000 if the growth continues at the same rate.
   d. Use this model to predict about when the population of Brownville will first reach 1,000,000.

3) A population of 800 beetles is growing each month at a rate of 5%.

   a. Write an equation that expresses the number of beetles at time x.
   b. About how many beetles will there be in 8 months?

4) The half-life of a medication is the amount of time for half of the drug to be eliminated from the body. The half-life of *Advil* or ibuprofen is represented by the equation $R = M\left(\frac{1}{2}\right)^{\frac{t}{2}}$, where R is the amount of Advil remaining in the body, M is the initial dosage, and t is time in hours.

   a. A 200 milligram dosage of Advil is taken at 1:00 pm. How many milligrams of the medication will remain in the body at 6:00 pm?
   b. If a 200 milligram dosage of Advil is taken how many milligrams of the medication will remain in the body 12 hours later?

5) Your new computer cost $1500 but it depreciates in value by about 18% each year.

   a. Write an equation that would indicate the value of the computer at t years.
   b. How much will your computer be worth in 6 years?
   c. About how long will it take before your computer is worth close to zero dollars, according to your equation?

6) From 1990 to 1997, the number of cell phone subscribers S (in thousands) in the US can be modeled by the equation $S = 5535.33(1.413)^t$ where t is number of years since 1990.

   a. Identify the growth factor and annual percent increase.
   b. Sketch a graph of the model.
   c. In what year was the number of cell phone subscribers about 31 million?
   d. According to the model, in what year will the number of cell phone subscribers exceed 90 million?
   e. Estimate the number of subscribers in 2010.
   f. Do you think this model can be used to predict future number of cell phone subscribers? Explain.

7) From 1991 to 1995, the number of computers C per 100 people worldwide can be modeled by the function $C(t) = 25.2(1.15)^t$ where t is the number of years since 1991.

   a. Identify the initial amount, the growth factor and the annual percent increase.
   b. Sketch a graph of the model.
   c. Estimate the number of computers in 2000.
   d. In what year does the number of computers exceed 60 computers per 100 people ?

8) Ten grams of Carbon 14 is stored in a container. The amount C (in grams) of Carbon 14 present after t years can be modeled by $C(t) = 10(0.99987)^t$. How much is present after 1000 years?

9) A diamond ring was purchased twenty years ago for $500. The value of the ring increased by 8% each year. What is the value of the ring today?

10) In 1990 the tuition at a private college was $15000. During the next 9 years, tuition increased by about 7.2% per year.

a. Write a model giving the cost C of tuition at the college t years after 1990.
b. Estimate the year the tuition is $20,000.
c. Estimate the tuition in 2010.
d. How long does it take for the cost of tuition to double?

11) A tool & die business purchased a piece of equipment of $250,000. The value of the equipment depreciates at a rate of 12% each year.

a. Write an exponential decay model for the value of equipment.
b. What is the value of equipment after 5 years?
c. Estimate when the equipment will have a value of $70,000?
d. What is the monthy rate of depreciation?