Objectives for Exponential and Logarithmic Functions Activity

- Build models using exponential functions and logarithmic functions
- Analyze models using characteristics of exponential and logarithmic functions

1. You place $1000 into an account paying a nominal rate of 5.5% compounded quarterly (4 times per year).

a. Find an equation for the balance *B*, after *t* years.

b. What is the **annual growth rate** (to four decimal places).

c. How much money will be in the account after 10 years?

d. How long will it take for the amount of money to double (round your answer to two decimal places)?

2. Find a formula for an exponential function, *f*, with *f*(1) = 10 and *f*(3) = 14.4. Do this problem algebraically and check your answer using regression. Write your exponential function in both forms (i.e. $y = ab^t$ and $y = ae^{kt}$)

3. The half-life of carbon-14 is approximately 5728 years. If a fossil is found with 20% of its initial amount of carbon-14 remaining, how old is it?

4. A population of bacteria decays at a continuous rate of 10% per hour.

a. What is the half-life of these bacteria?

b. If the population starts out with 100,000 bacteria, create a function to represent the number of bacteria, N, after t hours.

c. Use your function found in part b. to find out how many bacteria would remain after 1 day (24 hours).

d. What is the decay rate of the bacteria (i.e. by what percentage does the bacteria decrease each hour)?

5. A population of bacteria is measured to be at 1,000 after 10 minutes since it appeared. 25 minutes after it appeared, it is measured to be 10,000.
   a. What is the initial size of the population?

   b. What is the doubling time of the population?

   c. When will the population reach 1,000,000?

6. The population of a town is given by the following table:

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Population in thousands	100	108	117	127	138	149	162	175	190	205

a. Use your calculator to find an exponential model to fit the data.

b. What is the annual growth rate of the city? What is the continuous growth rate?

c. What is the doubling time of the city?

d. According to the model, when will the population of the city be 1,000,000?

7.

Historical U.S. Population Growth

by year 1966-1998

Date	National Population
July 1, 1998	270,298,524
July 1, 1997	267,743,595
July 1, 1996	265,189,794
July 1, 1995	262,764,948
July 1, 1994	260,289,237
July 1, 1993	257,746,103
July 1, 1992	254,994,517
July 1, 1991	252,127,402
July 1, 1990	249,438,712
July 1, 1989	246,819,230
July 1, 1988	244,498,982
July 1, 1987	242,288,918
July 1, 1986	240,132,887
July 1, 1985	237,923,795
July 1, 1984	235,824,902
July 1, 1983	233,791,994
July 1, 1982	231,664,458
July 1, 1981	229,465,714
July 1, 1980	227,224,681
July 1, 1979	225,055,487
July 1, 1978	222,584,545
July 1, 1977	220,239,425
July 1, 1976	218,035,164
July 1, 1975	215,973,199
July 1, 1974	213,853,928
July 1, 1973	211,908,788
July 1, 1972	209,896,021
July 1, 1971	207,660,677
July 1, 1970	205,052,174
July 1, 1969	202,676,946
July 1, 1968	200,706,052
July 1, 1967	198,712,056
July 1, 1966	196,560,338

Table from http://www.npg.org/facts/us_historical_pops.htm

The table to the left gives the US population between 1966 and 1998.

a. Find an exponential model to fit this data.

b. According to your model, what should the US population have been on July 1, 2011?

c. In July of 2011, the US census buereau estimated the population at 313,232,044 (from http://www.indexmundi.com/united_states/population.html) . According to the model from part a, when should the US population have reached 313,232,044? To what do you attribute the difference in your answers?

8. Using the population clock (http://www.census.gov/main/www/popclock.html) record the population for the US and the World at 4-5 intervals (say every half hour). Use this data to build exponential functions to model the US and World Population. Then use the models to predict what the population will be at the start of class next week.