

§4.6 MODELING WITH EXPONENTIAL FUNCTIONS

ex. Suppose there are initially 400 bacteria in a petri dish & the population doubles every day.

Give a function $n(t)$ that gives the population of bacteria after t days.

What if there were initially 600 bacteria & they double every 5 days?

What if there were initially 900 bacteria & they triple every 7 days?

Can you make the function use the natural base $e \approx 2.718$?

EXPONENTIAL GROWTH (RELATIVE GROWTH RATE)

A population that experiences **exponential growth** increases according to the model

$$n(t) = n_0 e^{rt}$$

where $n(t)$ = population at time t

n_0 = initial size of the population

r = relative rate of growth (expressed as a proportion of the population)

t = time

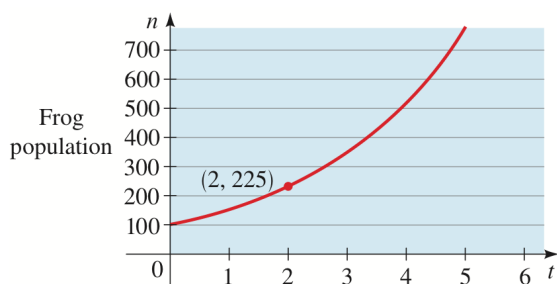
EXAMPLE 3 ■ Predicting the Size of a Population

The initial bacterium count in a culture is 500. A biologist later makes a sample count of bacteria in the culture and finds that the relative rate of growth is 40% per hour.

- (a) Find a function that models the number of bacteria after t hours.
- (b) What is the estimated count after 10 hours?
- (c) After how many hours will the bacteria count reach 80,000?
- (d) Sketch a graph of the function $n(t)$.

12. Frog Population Some bullfrogs were introduced into a small pond. The graph shows the bullfrog population for the next few years. Assume that the population grows exponentially.

- (a) What was the initial bullfrog population?
- (b) Find a function that models the bullfrog population t years since the bullfrogs were put into the pond.
- (c) What is the projected bullfrog population after 15 years?
- (d) Estimate how long it takes the population to reach 75,000.



8. Bacteria Culture It is observed that a certain bacteria culture has a relative growth rate of 12% per hour, but in the presence of an antibiotic the relative growth rate is reduced to 5% per hour. The initial number of bacteria in the culture is 22. Find the projected population after 24 hours for the following conditions.

- (a) No antibiotic is present, so the relative growth rate is 12%.
- (b) An antibiotic is present in the culture, so the relative growth rate is reduced to 5%.

14. Bacteria Culture The count in a culture of bacteria was 400 after 2 hours and 25,600 after 6 hours.

- (a) What is the relative rate of growth of the bacteria population? Express your answer as a percentage.
- (b) What was the initial size of the culture?
- (c) Find a function that models the number of bacteria $n(t)$ after t hours.
- (d) Find the number of bacteria after 4.5 hours.
- (e) After how many hours will the number of bacteria reach 50,000?