

6.5 - Exponential Growth and Decay

Preparation (Watch at Home)

6.5a

Exponential growth and decay equation

$P(t) = P_0 e^{kt}$, where P_0 is the initial population and k is the constant relative growth rate

Exercise:

A bacteria culture grows with constant relative growth rate. The bacteria count was 400 after 2 hours and 25,600 after 6 hours.

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- a) What is the relative growth rate? Express your answer as a percentage.
 - b) What was the initial size of the culture?
 - c) Find an expression for the number of bacteria after t hours.
 - d) Find the rate of growth after 4.5 hours.

6.5b

Newton's Law of Cooling

$T(t) = D_0 e^{kt} + T_s$, where D_0 is the initial temperature difference and T_s is the surrounding temperature

In-Class Practice

1. A common inhabitant of the human intestines is the bacterium *Escherichia coli*, named after the German pediatrician Theodor Escherich, who identified it in 1885. A cell of this bacterium in a nutrient-rich broth medium divides into two cells every 20 minutes. The initial population of a culture is 50 cells.

- a) Find the relative growth rate.
 - b) Find an expression for the number of cells after t hours.
 - c) Find the number of cells after 6 hours.
 - d) Find the rate of growth after 6 hours.
 - e) When will the population reach a million cells?
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2. A roast turkey is removed from an oven when its temperature has reached $185^{\circ} F$ and is placed on a table in a room where the ambient temperature is $75^{\circ} F$.

a) If the temperature of the turkey is $150^{\circ} F$ after half an hour, what is the temperature after 45 minutes?

b) When will the turkey have cooled to $100^{\circ} F$?

[illegible]