

**(A) Lesson Context**

BIG PICTURE of this UNIT:	<ul style="list-style-type: none"> <li>• How can I analyze growth or decay patterns in data sets &amp; contextual problems?</li> <li>• How can I algebraically &amp; graphically summarize growth or decay patterns?</li> <li>• How can I compare &amp; contrast linear and exponential models for growth and decay problems.</li> </ul>		
CONTEXT of this LESSON:	Where we've been  In Lessons 1,2,3, you generated & analyzed data from a variety of activities	Where we are  How do we work with equations that model growth & decay patterns	Where we are heading  How can I use equations that will help me make predictions about scenarios which feature exponential growth & decay?

**(A) Lesson Objectives:**

- Write exponential equations to model real world applications
- Make predictions/extrapolations through numeric or algebraic analysis
- Use multiple representations to solve the exponential equations that arise from real world applications

**(B) Review** → An Exponential equation has the form  $Y = C(a)^x$  or  $Y = C(1 + r)^x$ , where  $C$  = initial value,  $a$  is the growth factor/common ratio. (It turns out that  $a = 1 + r$ , where  $r$  is the decimal value of % increase given).

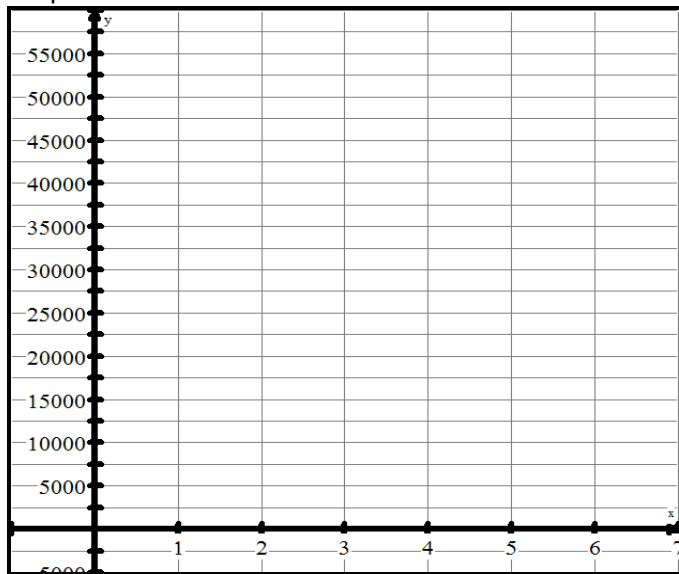
For the following equations, (i) decide if they can be used to model growth or decay and (ii) determine the rate at which the change happens.

$Y = 200(1.15)^x$		
$Y = 400(0.85)^x$		
$Y = 100(2)^x$		
$Y = 100(\frac{1}{2})^x$		
$Y = 200(1.05)^x$		
$Y = 400(1.75)^x$		
$Y = 100(0.75)^x$		
$Y = 100(0.995)^x$		
$Y = 1,000(0.30)^x$		
$Y = 2500(1.5)^x$		

# IM 2 Assign 4.5: Modeling with Exp. Equations | Unit 4 – Exponential Relations

**(C) Opening Exploration** → Mr Santowski has been given a new job contract. He will earn \$40,000 per year and get a 6% raise per year for the next 5 years

Graph:



DEFINE YOUR VARIABLES, then complete the tables

Data Table:

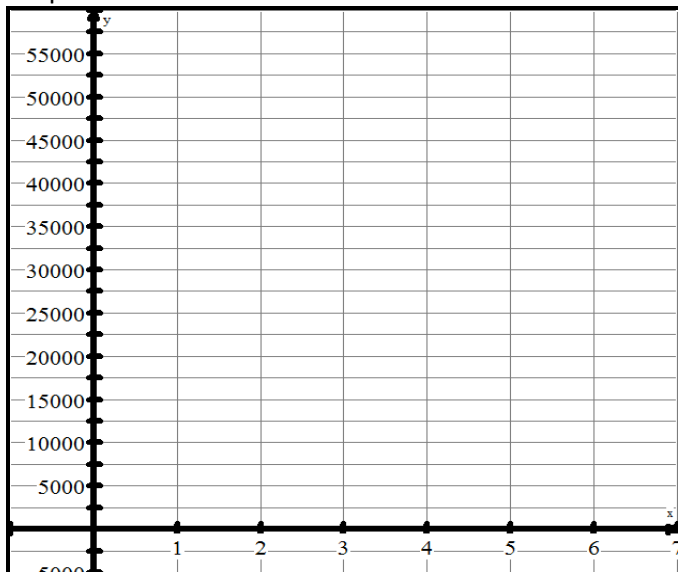
x						
y						

- (a) Write an equation for Mr. S's salary.
- (b) What does the y-intercept represent?
- (c) I would like Mr. S's salary to be modelled with a linear relation. HOW would you change the original info so that a linear model can be used?
- (d) What would my salary be in 8 years?
- (e) After how many years would my salary be \$70,000?
- (f) What assumption are you making as you answer Qd,e?

# IM 2 Assign 4.5: Modeling with Exp. Equations | Unit 4 – Exponential Relations

**(D) Opening Exploration** → Mr Santowski has purchased a new car. It cost \$50,000 but its value depreciates at a rate of 12% raise per year for the next 6 years

Graph:



DEFINE YOUR VARIABLES, then complete the tables

Data Table:

x						
y						

- (a) Write an equation for the value of Mr. S's car.
- (b) What does the y-intercept represent?
- (c) I would like the value of Mr. S's car to be modelled with a linear relation. HOW would you change the original info so that a linear model can be used?
- (d) What would be the value of my car be in 8 years?
- (e) After how many years would the value of my car be \$7,000?
- (f) What assumption are you making as you answer Qd,e?

## IM 2 Assign 4.5: Modeling with Exp. Equations | Unit 4 – Exponential Relations

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**(E) Examples:** For each question, show your equation and a sketch of your graph.

- a. A colony of 1,000 ants can increase by 15% in a month.
  - i. How many ants will be in the colony after 10 months?
  - ii. How long will it take to get 7,500 ants in the colony?
- b. A population of 10 hamsters will triple every year.
  - i. What will be the population after 4 years?
  - ii. How long will it take to get 1,500 hamsters?
  - iii. Determine the WEEKLY growth rate for the hamsters.
- c. A baby weighing 7 pounds at birth may increase in weight by 11% per month.
  - i. How much will the baby weigh after 1 year?
  - ii. When will the baby weigh 18 pounds?
  - iii. Determine the approximate DAILY rate of growth for this infant.
- d. A deposit of \$1500 in an account pays interest 7.25% on the balance annually.
  - i. What is the account balance after 8 years?
  - ii. When will the value of the account be double its original value?

**(F) Examples :** For each question, show your equation and a sketch of your graph

- a. A colony of 100,000 ants is infected by a virus and decreases by 12% in a month.
  - i. How many ants will be in the colony after 10 months?
  - ii. How long will it take to get 25,000 ants in the colony?
  - iii. Determine the DAILY death rate for the ant colony.
  
- b. A sample of 100 g radioactive plutonium-238 has a half-life of 87.7 years, so it will exponentially decay every year.
  - i. Determine the YEARLY decay rate for plutonium.
  - ii. What amount will remain after 400 years?
  - iii. How long will it take to eliminate 95% of the plutonium?
  
- c. An investment of \$150,000 in an account loses value at a rate of 3.25% annually.
  - i. What is the account balance after 5 years?
  - ii. When will the value of the account be half its original value?

**(G) Homework Links:**

- a. From [the Nelson 12 text, Chap 2.3](#), p110-112, Q2,4,5,6,13,14,15