

COMMON CORE MATHEMATICS

Integration Activity

- **Pathway:** Agribusiness
- **Lesson:** ABR B4–1: The Time Value of Money
- **Common Core State Standards for Mathematics:** 9-12.F-LE.1, 3

Domain: Linear, Quadratic, and Exponential Models F-LE

Cluster: Construct and compare linear, quadratic, and exponential models and solve problems.

Standard: 1. Distinguish between situations that can be modeled with linear functions and with exponential functions.

Standard: 3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly.

- **Student Objective:** Students will distinguish between linear and exponential relationships and use this information to make financial decisions.

BACKGROUND KNOWLEDGE for Teachers and Students

- **Math Concepts:**

Linear Function: A function whose graph is a straight line. As the x-values increase, the y-values change by a constant amount each time.

Ex: $y = 500 + 25x$

x	y
0	500
1	525
2	550
3	575
4	600

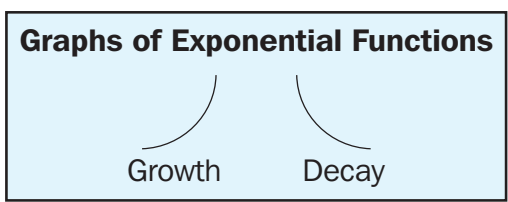
The y-values are increasing at a constant increment of 25.

Exponential Function: A function whose y-values change by the same factor as the x-values increase. The equation has the variable x as the exponent of a specified value.

Ex: $y = 100(1.5)^x$

x	y
0	100
1	150
2	225
3	337.50
4	506.25

The y-values are increasing by a constant factor of 1.5 (a 50% increase each time).



➤ **Agriculture Concepts:**

When making financial decisions for a family farm or agribusiness, it is important to understand that the value of a dollar increases over time. The economy experiences inflation, money that is invested can earn simple or compound interest, salaries increase, and land values increase.

Guided Practice Exercises: ANSWER KEY

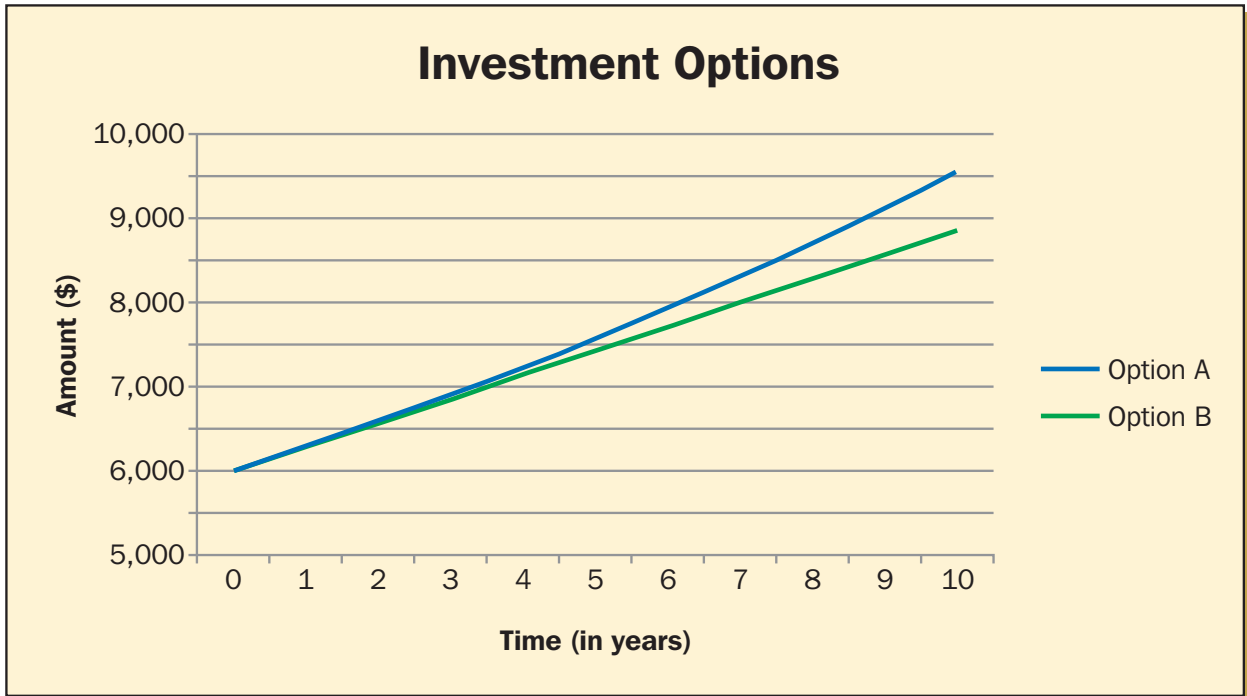
1. A)

Year	Total Value
now	\$6,000
1	\$6,285
2	\$6,570
3	\$6,855
4	\$7,140
5	\$7,425
6	\$7,710
7	\$7,995
8	\$8,280
9	\$8,565
10	\$8,850

B)

Year	Total Value
now	\$6,000.00
1	\$6,285.00
2	\$6,583.54
3	\$6,896.26
4	\$7,223.83
5	\$7,566.96
6	\$7,926.39
7	\$8,302.89
8	\$8,697.28
9	\$9,110.40
10	\$9,543.15

2. A) Adding \$285 each year
B) Multiplied by a factor of 1.0475 each year
- 3.



4. Option A—Linear
Option B—Exponential

5. Investment Option B grows faster because after the first year it is earning more interest than Option A. (Exponential growth will always exceed linear growth.)
6. Sample answers for which investment to choose:

I would choose Option B because over the course of the 10 years the investment would be worth more money.

I would choose Option A because although I would earn \$693.15 less in the long run, I would be paid the interest each year throughout the life of the investment. I would like to receive the \$285 interest payment each year to help with my yearly expenses, rather than having to wait 10 years to receive the money.

Independent Practice Exercises: ANSWER KEY

1. Company A:

Year	Salary
0	\$32,000
1	\$32,700
2	\$33,400
3	\$34,100
4	\$34,800
5	\$35,500
6	\$36,200
7	\$36,900
8	\$37,600
9	\$38,300

- Company B:

Year	Salary
0	\$28,000.00
1	\$29,120.00
2	\$30,284.80
3	\$31,496.19
4	\$32,756.04
5	\$34,066.28
6	\$35,428.93
7	\$36,846.09
8	\$38,319.93
9	\$39,852.73

2. Company A—Linear (because the salaries increase by a constant \$700 each year)
Company B—Exponential (because the salaries increase by a factor of 1.04 each year)
3. The salaries that grow exponentially increase faster than the salaries that grow linearly.
4. Company A is offering a higher salary for the first seven years of employment. After seven years, the two companies have almost the same salary (Company A is still slightly higher). After eight years, Company B has higher salaries.
5. Student answers will vary. Sample answer: After working for 10 years, I would be earning more money per year at Company B. However, for most of that 10 years, I would have made more per year at Company A.

6. Company A 10-year total = \$351,500

Company B 10-year total = \$336,171

Student answers will vary. Sample answer: Over the course of a 10-year career, I would make more money at Company A. If I was going to work for only 10 years, during which time Company A has higher salaries, I would choose Company A.


7. The salaries at Company A will continue to increase steadily by \$700 each year. However, once I am past the eight-year mark, the salaries at Company B will continue to be higher than those at Company A, as they are growing faster. Eventually, the total money earned will be higher for Company B than Company A.


Decision: Student answers will vary. In their decision, students may consider how long they would expect to work at a particular job or whether they would like to have more money initially or more money in the long run.

- ⓘ This would also be a good opportunity for a class discussion on what other factors (besides salary) should be considered when accepting a job. Factors to consider may include distance from home to work; job conditions (physical labor vs. office job, work day hours, travel expected); or benefits, such as health insurance or use of a company vehicle.

Guided Practice Exercises:

You have \$6,000 and want to invest it for a period of 10 years. You have two options for how to invest it.

 **Option A** is to invest in a bond that offers 4.75% simple interest. With a bond, the interest is paid to you at the end of each year, and the principal continues to earn interest for the remaining years.

 **Option B** is to invest in a certificate of deposit (CD) that offers 4.75% interest compounded annually. With a CD, the money remains in the account for the full 10-year term and can be withdrawn, including any interest earned, at the end of the term.

- Complete each table to represent the total value of each investment over the 10-year period. Round values to the nearest cent if necessary.

A)

Year	Total Value
now	\$6,000
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

B)

Year	Total Value
now	\$6,000
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

- Look at the values in the Total Value column of each chart (there should be a pattern to the values). What is the pattern for the total value of each option?

3. Graph the values in each table. Put the year (x) on the horizontal axis and the total value (y) on the vertical axis. Graph both sets of data on the same axes so that you can compare the results.


4. Which situation represents a linear relationship? Which situation represents an exponential relationship?


5. Which investment grows faster?

6. Which investment option would you choose, and why?

Independent Practice Exercises:

You are looking for a job working for a seed company. You have interviewed with several companies and end up with two full-time job offers.

 **Company A** is offering you a starting salary of \$32,000 per year, with a \$700 raise guaranteed each year.

 **Company B** is offering you a starting salary of \$28,000 per year, with a 4% raise guaranteed each year.

Use the questions below to analyze the situation and choose which offer to accept.

- Complete the tables below to determine your salary for each company over the first 10 years of employment. Round values to the nearest cent if necessary.

Company A:

Year	Salary
0	\$32,000
1	
2	
3	
4	
5	
6	
7	
8	
9	

Company B:

Year	Salary
0	\$28,000
1	
2	
3	
4	
5	
6	
7	
8	
9	

- Looking at the Salary columns, determine which job offer represents a linear relationship and which represents an exponential relationship.
- Which salaries increase faster, the ones following a linear pattern or those following an exponential pattern?

