Means of Growth

Brief Overview:

In this lesson, the class will explore regression models through the use of the TI-83/TI-84 graphing calculators. Students will use a variety of real-world data sets and activities to explore linear, quadratic and exponential regression models. Students will input data, create scatter plots, find and graph the line of best fit for each model using the graphing calculator.

NCTM Content Standard/National Science Education Standard:

Number and Operations

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems

Algebra

- Understand patterns, relations, and functions; use mathematical models to represent and understand quantitative relationships
- analyze change in various contexts

Measurement

- Apply appropriate techniques, tools, and formulas to determine measurements

Data Analysis and Probability

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

Problem Solving

- Apply and adapt a variety of appropriate strategies to solve problems;

Grade/Level:

9-12; Algebra I (lesson 1); Algebra II (lessons 1-3)

Duration/Length:

Approximately three 45-minute classes

Student Outcomes:

Students will:

- Enter data into lists using the graphing calculator.
- Create scatter plot using data.
- Generate a linear, quadratic, and exponential regression equation.
- Plot that equation against observed data.
- Make predictions about data using the graphing calculator and equation.
- Determine the correlation coefficient

Materials and Resources:

- TI-83 or TI-83 Plus or TI-84 calculator
- Overhead graphing calculator
- Measuring Tapes/Sticks
- Sentence strips
- Magnet tape

Development/Procedures:

Lesson 1

Preassessment– Give students time to complete a drill worksheet (Drill: Day 1) addressing basic graphing concepts. Discuss with the students the correct answers to the warm-up worksheet and answer questions. The purpose is to review material covered during the previous graphing unit.

Launch – Discuss whether there is a relationship between height and arm span. Predict whether it is a positive or negative correlation.

Teacher Facilitation – In pairs, the students will complete student activity (see Growth Patterns). Pass out gingerbread cut-out figure to each student. A large chart and scatter plot will be created at the front of the classroom using the data the students gather during the activity. After the scatter plot is completed, lead the whole class through the calculator activity (see Growth Pattern II) using the class data on the chart at the front of the classroom. The teacher or student volunteer will complete the steps on the overhead-graphing calculator. Write the calculator key strokes on the chalkboard/whiteboard.

Student Application – In pairs, the students will respond to the questions on the calculator activity (see Growth Pattern II) to analyze the graph and the line of best fit.

Embedded Assessment – During the preassessment, discuss with the students the correct answers to the drill worksheet. Walk around the classroom during both activities to observe the students' work, view calculator screens, answer questions, and assist students. Collect calculator activity and correct the responses to the questions that promote higher-level thinking.

Reteaching/Extension – Use the extra practice problems (see Growth Patterns III) to create a scatter plot on the calculator, find the line of best fit and analyze through questions. This worksheet can be used for students that need extra practice and/or for those that finish early. Students that are struggling can be paired with a student that has mastered the material for peer tutoring. Challenge students to bring in data from the Internet

containing sports players' height and weight. This data can be entered into their calculator to create another scatter plot and find the line of best fit.

Lesson 2

Preassessment – Pass out Drill worksheet. Give students time to work on problems and then review answers as a class making sure that students understand/recall the definitions of the terms maximum, minimum, and zeroes. Relate graph to previous day's lesson by having students note similarities and differences between a linear function and a quadratic function.

Launch – Introduce Garden problem (see Garden worksheet). Brainstorm with class what factors need to be considered to solve the problem.

Teacher Facilitation – Distribute Garden worksheet. Read aloud the problem as students follow along. Have students complete all four columns of the table and then answer the questions as a class. Review steps to enter data in the statistics function of the graphing calculator that were introduced yesterday. Prepare sentence strips with calculator key strokes in advance and have students provide correct order as review.

Student Application – Distribute Cannon worksheet. Have students work in pairs to enter data in calculator and to answer questions.

Embedded Assessment – Questions are included in worksheet to generate discussion and promote higher-level thinking. Walk around classroom to check student work, answer questions, and look for common misconceptions that can be clarified for the class in general.

Reteaching/Extension – Use Extra Practice section of Cannon worksheet for more practice using the CALC function keys and completing quadratic regression exercises. Students who work quickly and finish early can also complete these problems. Repeat the Garden activity with a different perimeter value. Make connections between the outcomes to both garden problems.

Lesson 3

Preassessment – The teacher will review slopes, scatter plots and linear regression on TI- 83 Plus graphing calculator with the students.

Launch – Discuss the type of growth that occurs in a 'family tree'. Visual models could be displayed on the board for the students to see the trend (i.e. Kennedy family, British Royal family, teacher's family etc.). Some models of equations do not follow a linear nor quadratic equation.

Teacher Facilitation – Introduce the standard form of the exponential equation. Differentiate between exponential growth and exponential decay. Provide additional examples and explanations if needed. The teacher will begin by demonstrating the opening Activity # 1 as students follow along with their own copies of activity sheets and calculators. The purpose is to determine if students can graph data and use their previous knowledge. The teacher will pair up the students for Activity #2 which is another example of Bacteria Reproduction taken over a 5-hour period at increments of half an hour. Teacher will circulate around room as students complete activity. In addition, the teacher will discuss the activity with the class. Activity #3 will now be distributed for individual practice.

Student Application – Students will complete Activity #2 by representing the data as a graph and as a mathematical equation. Students will interpret and make predictions about data. The student will be directed to enter the data for Activity #3 into the calculator.

Embedded Assessment – The teacher will check and monitor each student's progress in completing activities. The teacher will move around the class and answer questions posed by the students.

Reteaching/Extension- Students will review skills learned in this lesson. Weak students will be paired with stronger students and will complete and analyze data sets from the textbook.

As an extension, students will examine population decay models of endangered species of animals to predict populations in 10 years.

Summative Assessment:

The students will individually complete a three-question assessment using a graphing calculator. Using a given data set, the students will identify the type of regression model, generate the regression equation, and make predictions.

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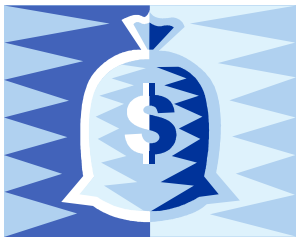


Drill: Day 1
Graphing Review

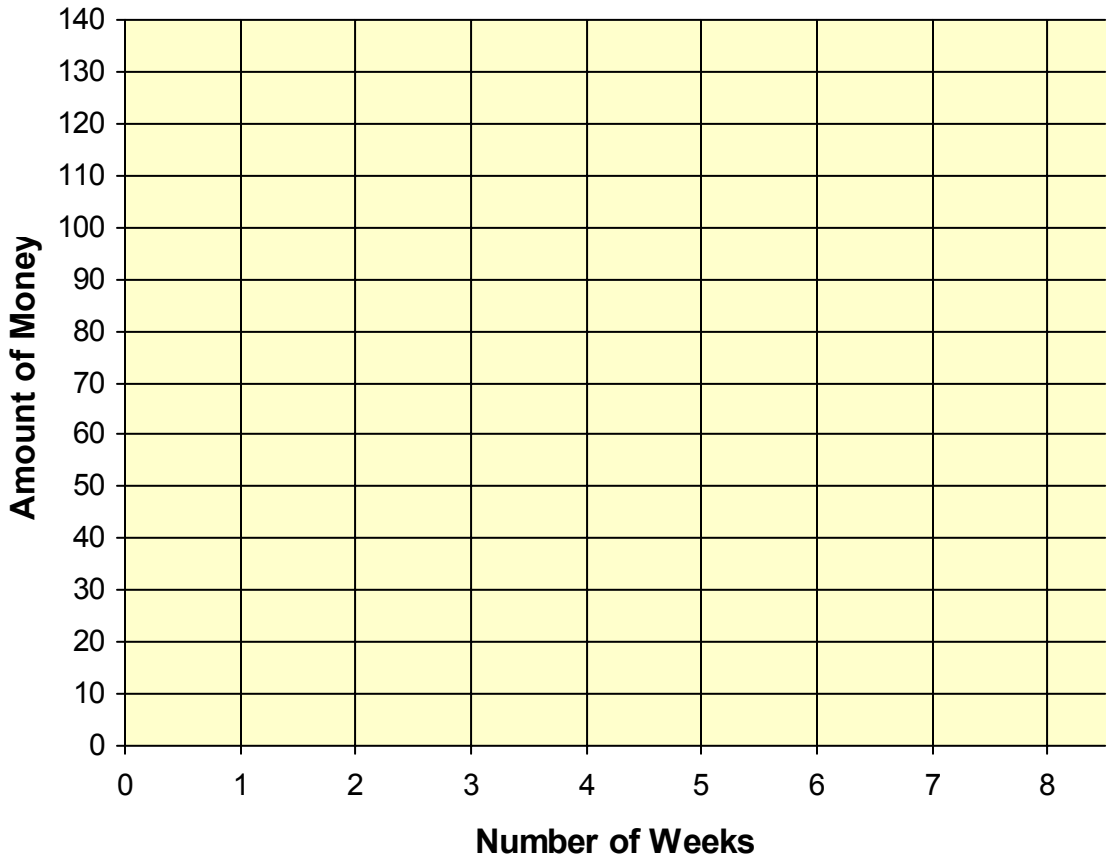
1. Use the information to complete the chart below. Tierah's allowance is $15 a week.

Number of Weeks	0	1	2	3	4	5	6	7	8
Amount of Money Saved	0	$15							

2. Select two points and determine the slope of the line. _____

3. Write the equation of the line in slope-intercept form. _____

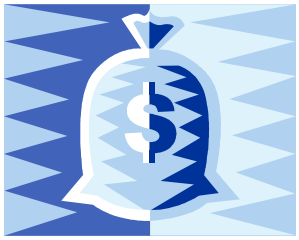
4. Use the information from the table above to complete the line graph below.



5. Using the equation, find how much money Tierah will have after 11 weeks. _____

6. Using the equation, find in how many weeks will Tierah have $220. _____

Answer Key



Drill: Day 1
Graphing Review

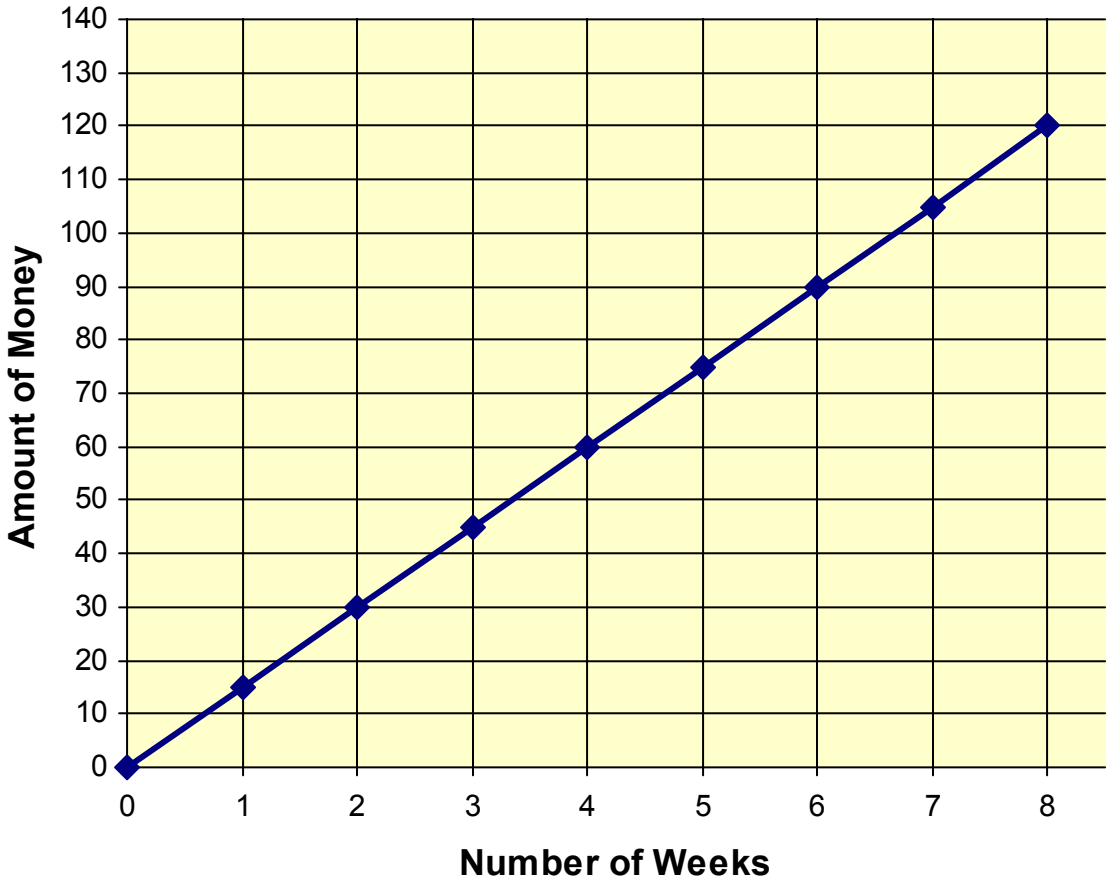
1. Use the information to complete the table below. Tierah's allowance is $15 a week.

Number of Weeks	0	1	2	3	4	5	6	7	8
Amount of Money Saved	0	$15	$30	$45	$60	$75	$90	$105	$120

2. Select two points and determine the slope of the line. _____15_____

3. Write the equation of the line in slope-intercept form. _____y = 15x + 0_____

4. Use the information from the table above to complete the line graph below.



5. Using the equation, find how much money Tierah will have after 11 weeks? ____$165____

6. Using the equation, find in how many weeks will Tierah have $220? __15 weeks _____

Growth Patterns: Student Activity
Scatter Plot and Line of Best Fit

1. Measure your arm span in inches. Be sure your arms are held straight and level. Assist your partner in measuring for accurate results.

   _____

2. Measure your height in inches. Assist your partner by measuring his/her height against the wall (student should first remove his/her shoes).

   _____

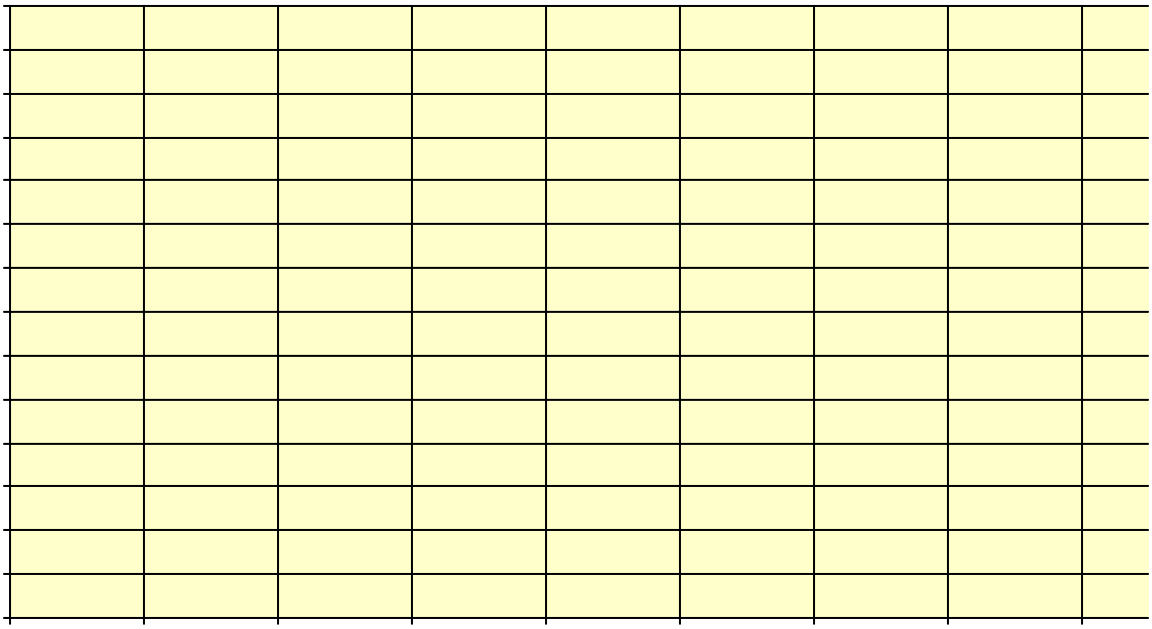
Arm Span	Height

Arm Span	Height

3. Write your arm span and height as an ordered pair where X = arm span (in inches) and Y = height (in inches). _____

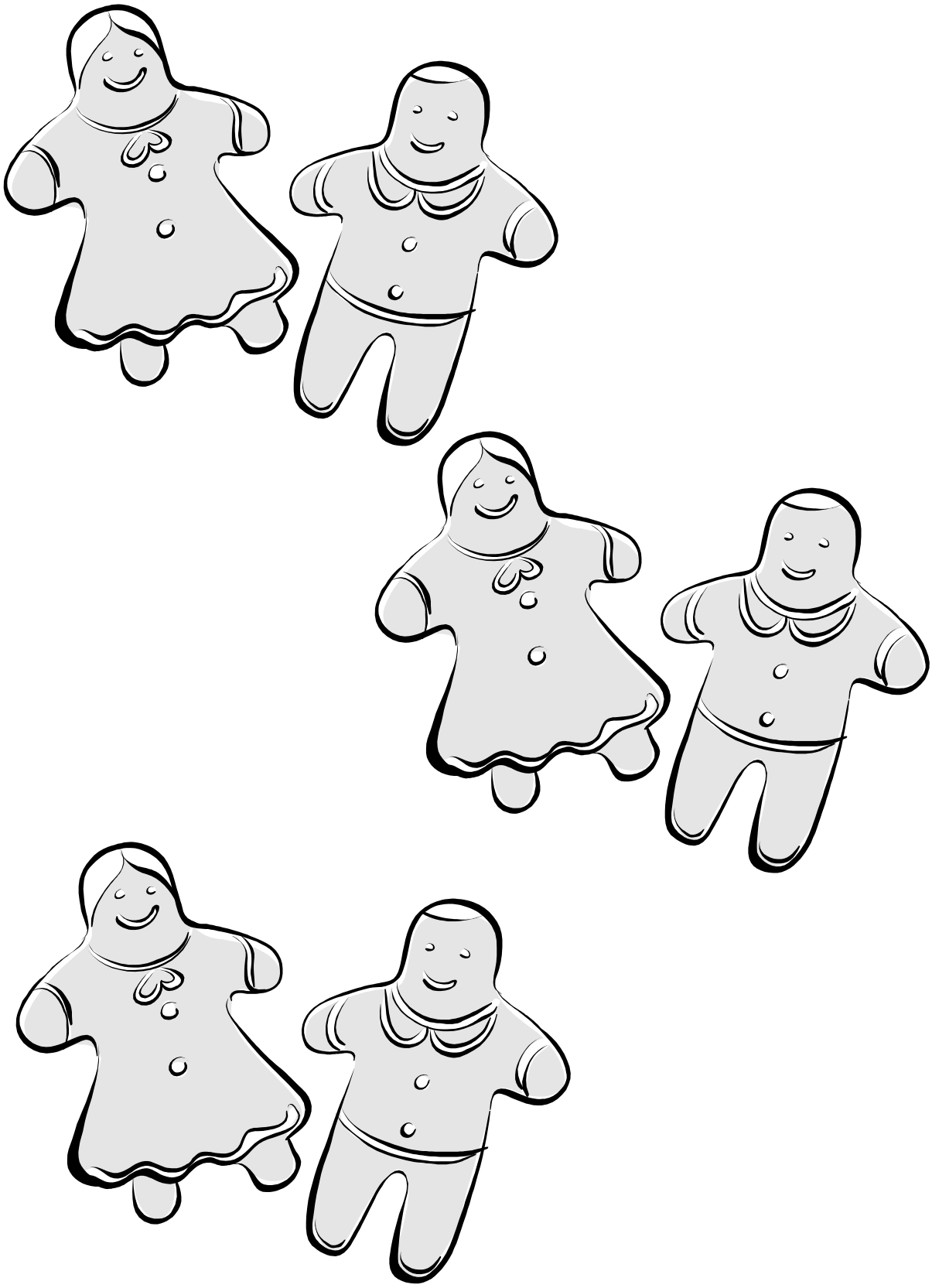
4. Write your ordered pair on the front of a gingerbread person. Enter your ordered pair into the chart on the board. Attach your cut-out to the coordinate grid in the front of the room.

5. Complete the chart and graph using with the class data recorded on the board.



Teacher Resource Page

Copy and cut enough for one gingerbread person per student.



Growth Patterns II: Calculator Activity

1. Turn on the scatter plot.
   - Using the STAT PLOT function turn on Plot 1. The Type is the scatter plot option. The Xlist is L_1 and the Ylist is L_2.

2. Enter the class data.
   - Enter arm span into L1 of the STAT EDIT function.
   - Enter height into L2 of the STAT EDIT function.

3. View the scatter plot.
   - To adjust the window, use the ZOOM function to choose ZoomStat (option 9).
   - Use the GRAPH function to view the scatter plot.

4. Answer the following questions using the data from above.
   - *Describe the changes in the height as the arm span changes.*

_____

_____

_____

   - *Using the graph on Growth Patterns I, predict the height of a person with an arm span of 74 inches.* _____
   - *Using the graph on Growth Patterns I, predict the arm span of a person with a height of 53 inches.* _____

5. Find the equation for the line of best fit.
   - Use the STAT CALC function, to choose LinReg(ax+b) (option 4). Press ENTER.
   - This calculates the equation for the line of best fit.

6. Answer the following questions using the information above.
   - *Write the equation for the line of best fit.* _____
   - *Identify the slope. Describe the slope in the context of the problem.*

_____

_____

- *Using the equation, find the height of a person with an arm span of 74 inches. Show your work.*

- *Using the equation, find the arm span of a person with a height of 53 inches. Show your work.*

7. View the scatter plot with the line of best fit.
   - Use the STAT CALC function, to choose LinReg(ax+b) (option 4). Next, choose the VARS function, followed by Y-VARS. Choose FUNCTION (option 1) then choose Y_1 (option 1). Press ENTER.
   - Use the GRAPH function to view the scatter plot with the line of best fit.

8. Answer the following questions using the information above.

   - *Is the line drawn on the graph a good fit for the data? Justify your answer.*

   - *Compare the predictions based on the graph to the predictions using the equation.*

     What factors could cause the differences in the data?

Answer Key

Growth Patterns II: Calculator Activity

1. Turn on the scatter plot.
   - Using the STAT PLOT function turn on Plot 1. The Type is the scatter plot option. The Xlist is L_1 and the Ylist is L_2.

2. Enter the class data.
   - Enter arm span into L1 of the STAT EDIT function.
   - Enter height into L2 of the STAT EDIT function.

3. View the scatter plot.
   - To adjust the window, use the ZOOM function to choose ZoomStat (option 9).
   - Use the GRAPH function to view the scatter plot.

4. Answer the following questions using the data from above.
   - *Describe the changes in the height as the arm span changes.*

   As the arm span increases, the height increases. This is an example of a positive correlation.

   - *Using the graph on Growth Patterns I, predict the height of a person with an arm span of 74 inches.* The answer depends upon the data found by the individual class.

   - *Using the graph on Growth Patterns I, predict the arm span of a person with a height of 53 inches*. The answer depends upon the data found by the individual class.

5. Find the equation for the line of best fit.
   - Use the STAT CALC function, to choose LinReg(ax+b) (option 4). Press ENTER.
   - This calculates the equation for the line of best fit.

6. Answer the following questions using the information above.
   - *Write the equation for the line of best fit.* The answer depends upon the data found by the individual class.

   - *Identify the slope. Describe the slope in the context of the problem.*

   The answer depends upon the data found by the individual class.

Answer Key

- *Using the equation, find the height of a person with an arm span of 74 inches. Show your work.*

The answer depends upon the data found by the individual class.

- *Using the equation, find the arm span of a person with a height of 53 inches. Show your work.*

The answer depends upon the data found by the individual class.

7. View the scatter plot with the line of best fit.
   - Use the STAT CALC function, to choose LinReg(ax+b) (option 4). Next, choose the VARS function, followed by Y-VARS. Choose FUNCTION (option 1) then choose Y_1 (option 1). Press ENTER.
   - Use the GRAPH function to view the scatter plot with the line of best fit.

8. Answer the following questions using the information above.

   - *Is the line drawn on the graph a good fit for the data? Justify your answer.*

Answers will vary.

_____

- *Compare the predictions based on the graph to the predictions using the equation.*

  What factors could cause the differences in the data?

Answers could include: accurate measurement, bent arms, wearing shoes, etc.

_____

Growth Patterns III: Extra Practice

1. The table below shows the population (in millions) of Springfield.

Year	1985	1990	1995	2000	2005
Population	0.7	1.4	2.3	2.9	3.8

a. Use your graphing calculator to find the line of best fit. Let ***x*** represent the years since 1985 (i.e.1985 will be 0, 1990 will be 5, etc.) Let ***y*** represent the population.

b. Write the equation for the line of best fit. _____

c. What is the slope of the line? What does slope mean in the context of this problem?

d. Predict the population of Springfield in 2020. Show your work.

2. The table below shows the cost of computers at the store Perfect Purchase.

Year	1999	2000	2001	2002	2003
Cost	$2,555	$2,218	$2,085	$1,835	$1,449

a. Use your graphing calculator to find the line of best fit. Let *x* represent the years since 1999 (i.e.1999 will be 0, 2000 will be 1, etc.) Let *y* represent the cost.

b. Write the equation for the line of best fit. _____

c. What is the slope of the line? What does slope mean in the context of this problem?

d. Predict the cost of computers at the store Perfect Purchase in 2008. Show your work.

Answer Key

Growth Patterns III: Extra Practice

1. The table below shows the population (in millions) of Springfield.

Year	1985	1990	1995	2000	2005
Population	0.7	1.4	2.3	2.9	3.8

a. Use your graphing calculator to find the line of best fit. Let *x* represent the years since 1985 (i.e.1985 will be 0, 1990 will be 5, etc.) Let y represent the population.
b. Write the equation for the line of best fit. ___ $y = .154x + .68$ _____
c. What is the slope of the line? What does slope mean in the context of this problem?
Slope = .154
The population increases by .154 billion (or 154,000) people per year.

d. Predict the population of Springfield in 2020. Show your work.
$2020 - 1985 = 35$
$y = .154 \bullet 35 + .68$
$y = 5.39 + .68$
$y = 6.07$
The population of Springfield in 2020 will be 6.06 billion.

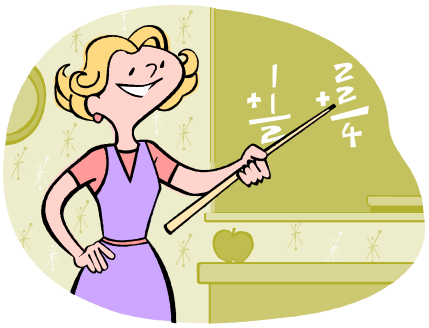
2. The table below shows the cost of computers at the store Perfect Purchase.

Year	1999	2000	2001	2002	2003
Cost	$2,555	$2,218	$2,085	$1,835	$1,449

a. Use your graphing calculator to find the line of best fit. Let *x* represent the years since 1999 (i.e.1999 will be 0, 2000 will be 1, etc.) Let y represent the cost.
b. Write the equation for the line of best fit. ____ $y = -259.5x + 2{,}547.4$ ____
c. What is the slope of the line? What does slope mean in the context of this problem?
Slope = 259.5
The cost of computers at Perfect Purchase decreases by $259.50 per year.
d. Predict the cost of computers at the store Perfect Purchase in 2008. Show your work.

$2008 - 1999 = 9$
$y = -259.5 \bullet 9 + 2547.4$
$y = -2335.5 + 2547.4$
$y = 211.9$
The cost of a computer at the store Perfect Purchase in 2008 will be $211.90.

Drill

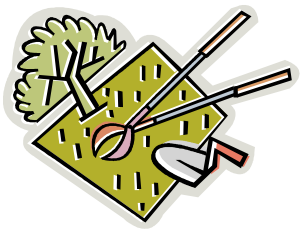


1) Given the equation $y = 2x - 6$, identify:

   a) the slope of the line
   b) the y-intercept

2) Given the equation $y = -x^2 - 2x + 3$, graph on your calculator and identify:

   a) the maximum or minimum value
   b) the zero(s)



How Does (the Size of) Your Garden Grow?

Robin wants to fence in a portion of her yard to grow a vegetable garden. Based on the amount of fencing that Robin purchased, the perimeter of the rectangle-shaped garden will be 120 feet. What is the maximum area of the garden?

Give 8 possible values for length and width that would result in a rectangle with a perimeter of 120 feet.

Length	Width	Perimeter	Area

How did you determine your pairs?

What is the relationship between length and width?

- Enter Length into L1 of the STAT EDIT function.
- Enter Width into L2 of the STAT EDIT function.
- Turn STAT PLOT 1 ON.
- Use ZOOM 9 to view scatter plot.
- *What type of relationship exists between your x and y values?*

  _____

  _____

Find the equation of the line of best fit using the linear regression function.

- Clear L2 in your calculator. Enter Area in L2. Use ZOOM 9 to view scatter plot.
- *What do you notice about the shape of the curve formed by the scatter plot?*
- *Is a linear equation the best fit for this data set?*

Use the calculator to find a quadratic equation to fit this data.

- Go to the CALC menu of the STAT function and select 5:QuadReg (the abbreviation for quadratic regression). The calculator will give us an equation in standard quadratic form $y = Ax^2 + Bx + C$.

- Write the equation and observe the curve on the calculator.

- *Why does it make sense to only look at the portion of the graph that falls within quadrant I in the coordinate plane?*

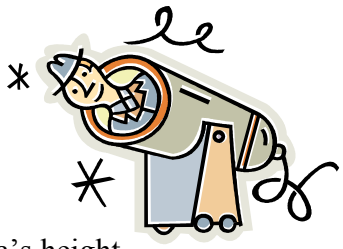
In order to solve Robin's problem, locate the maximum value of the quadratic equation.

- Using the CALC menu (select 2ND TRACE), select 4:Maximum
- Choose points on the left side and the right side of the approximate maximum point on the calculator as directed by instructions on your screen.
- Hit ENTER until the maximum x and y values appear at the bottom of the screen.

What is the maximum area of a garden with a perimeter of 120 feet? Give answer with appropriate units!

Does this match with the any of the data points you selected that are located on the chart on the front of this worksheet?

** What is the shape of the garden with the maximum area? Be specific!**



Cannon Worksheet

Bubba, the human cannon ball, is shot from a cannon at the state fair. Bubba's height above the ground, *h*, in feet, is recorded at intervals of time, *t*, in seconds after Bubba leaves the cannon. The data is recorded in the table below.

Time (*t*)	0	1	2	3	4	5
Height (*h*)	10	84	126	136	114	60

Using the quadratic regression function, find the quadratic equation that best fits the data.

What is the maximum height that Bubba reaches?

After how many seconds will Bubba hit the ground?

What is the *y*-intercept? What does it mean within the context of this problem?

Extra Practice

Determine the regression equation for each quadratic function represented below. For each equation/graph, identify the maximum/minimum and the zero(s).

1.

x	0	1	2	3	4	5	6
y	0	-1	-1	0	2	5	9

2.

x	-2	-1	0	1	2	3
y	-4.5	-.9	.5	-.3	-3.3	-8.5

3.

x	-3	-2	-1	0	1	2	3
y	8.5	6	4.5	4	4.5	6	8.5

How Does (the Size of) Your Garden Grow? Answer Key

Possible values are given below.

Length	Width	Perimeter	Area
15	45	120	675
30	30	120	900
20	40	120	800
10	50	120	500
25	35	120	875
12	48	120	576
38	22	120	836
36	24	120	864

Students should have determined pairs by dividing the perimeter of 120 in half resulting in a quotient of 60. The length and the width should then add to 60.

A negative relationship exists between x and y in the scatter plot. As x increases, y decreases, etc.

The shape of the scatter plot is a quadratic function, a parabola, etc.

The equation of the line representing the curve of best fit is $y = -x^2 + 60x$.

As the curve represents the relationship between length of the rectangle and area, all values must be positive as distance and area are always positive.

The maximum value is the ordered pair (30, 900), so the maximum area of Robin's garden is 900 square feet. If the length of the rectangle is 30, then the width is 30 and the shape of the garden is a square.

Cannon Worksheet Answer Key

The equation representing Bubba's flight is $y = -16x^2 + 90x + 10$.

The maximum height Bubba will reach is 136.5625 feet.

Bubba will hit the ground when height is 0. He will hit the ground after 5.734 seconds. Students could choose to approximate the answer by looking at the graph or table or by using the Zero function from the CALC menu.

The y-intercept is 10. Bubba is 10 feet above the ground when he is shot from the cannon. Students could also explain this value as the initial height or starting height.

Extra Practice Answer Key

1. $y = 0.5\,x^2 - 1.5\,x$

   The minimum point is (1.5 , -1.125)
   The zeros are at 0 and 3.

2. $y = -1.1\,x^2 - 0.3\,x + 0.5$

   The maximum point is (0.136, 0.52).
   The zeros are at -0.5515 and 0.824.

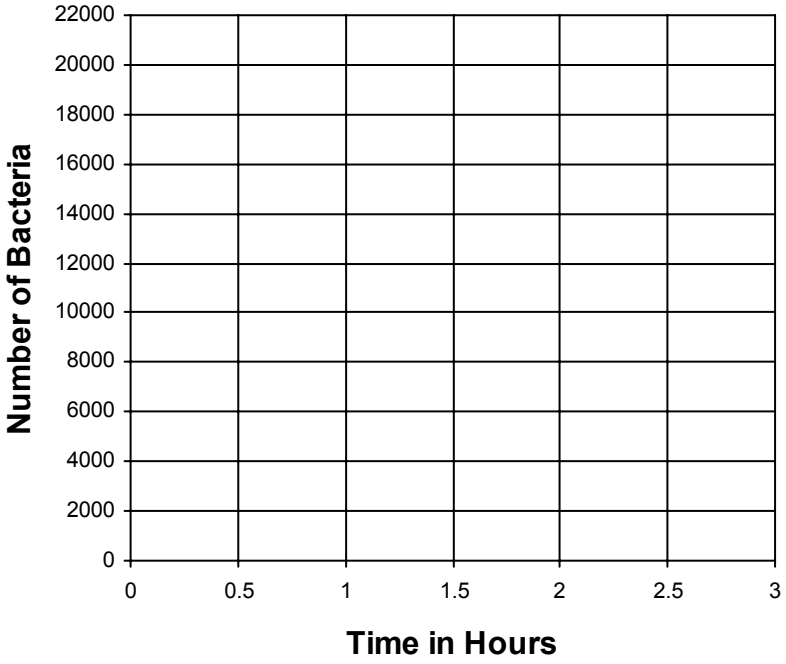
3. $y = 0.5x^2 + 4$

   The minimum point is (0, 4).
   There are no real zeros.

Moldy Mesz Worksheet #1

Time (Hours)	Number of Bacteria
0.0	30
0.5	90
1.0	270
1.5	
2.0	
2.5	
3.0	

- Fill in the missing data in the table.
- Plot all points in the data set on the graph below.



- Look at the scatter plot. What model best fits this data set?

Use the calculator to perform an exponential regression.

- Using the EDIT function from the STAT menu, enter Time in L1 and the Number of Bacteria in L2.

- Under the CALC function of the STAT menu, what function will give us an equation in the standard exponential equation form of $y = ab^x$?

- Write the equation that models the data.

  _____

- *Use the equation to predict how many bacteria will be in the sample after 4 hours. Show your work.*

Use the table function to determine how long it will take for the number of bacteria to reach 150,000.

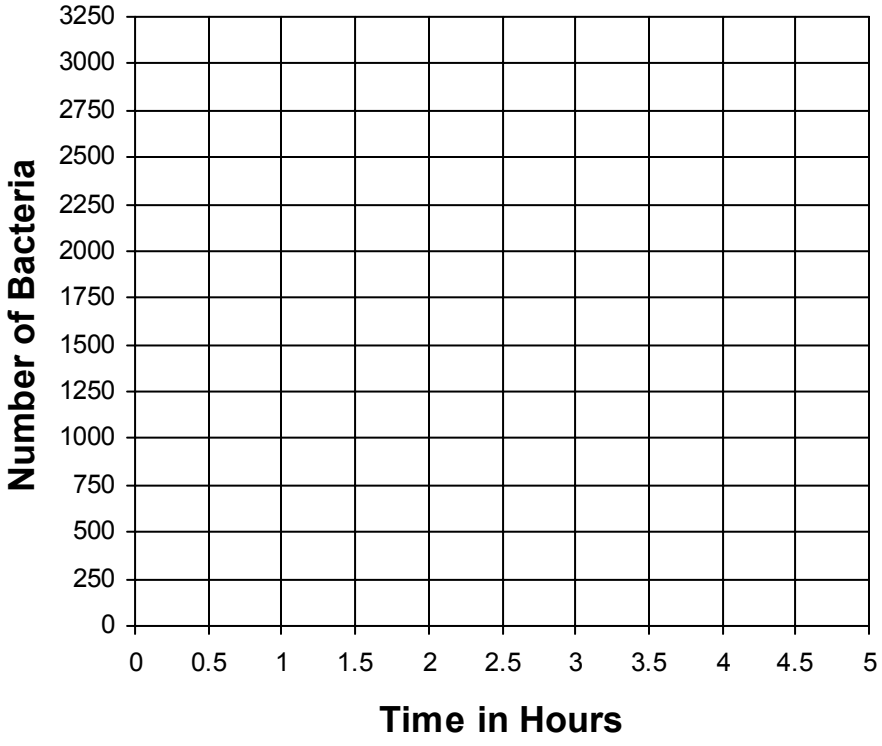
- Hit 2^{nd} GRAPH to display the table on the calculator screen.
- Use the blue up and down arrows to scroll down the table until the *y*-value is 150,000.

Bacteria Production Worksheet #2

The number of bacteria in a colony is growing exponentially.

Time in hours	Number of Bacteria
0.0	1
0.5	3
1.0	8
1.5	23
2.0	64
2.5	153
3.0	332
3.5	683
4.0	1017
4.5	1693
5.0	3031

- Plot the data points on the graph below.



- Use your calculator to find the equation that best models the data.

_____

- Graph the equation on the front of this worksheet.

- Using the table function in your calculator, predict how long it will take for the number of bacteria to reach 5,000.

_____

- Using the table, predict how many bacteria will be in the sample after 6.5 hours.

_____

Artist Delite Worksheet
Activity # 3

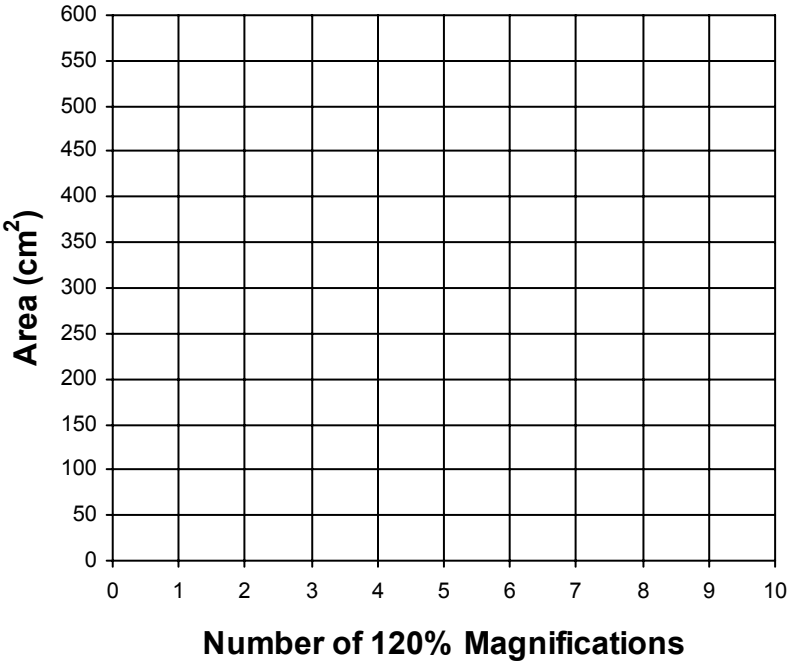
Juan decides to make several flyers showing his artwork in various sizes. He decided to use the copy machine with settings of 150%, 120%, 75%, and 50%.

If Juan selects a magnification factor of 120%, the dimensions of the artwork are given below:

Number of 120% Magnifications Performed	**Width (in cm)**	**Length (in cm)**	**Area (in cm^2)**
0	3	5	15
1	3.6	6	21.6
2	4.3	7.2	31
3	5.2	8.6	44.7
4	6.2	10.3	63.9
5	7.4	12.4	91.8
6	8.9	14.9	132.6
7	10.7	17.9	191.5
8	12.8	21.5	275.2
9	15.4	25.8	397.3
10	18.5	31	573.5

In this activity, we will be examining the relationship between the number of times the magnification is performed and the area of the resulting artwork.

- Plot the data set on the graph below.
- Use your calculator to find the equation that best models the data and graph.



- *The area of the original piece of artwork is 15 cm^2. After how many magnifications, will the area increase by a multiple of four?*

- *What will be the area of the artwork after 18 magnifications are performed? Show your work.*

- *After how many magnifications will the area of the artwork exceed 1,000 cm^2? Justify your response.*

Assessment

Directions: Given the following data sets, select the appropriate regression model, write the equation, and answer the questions that follow. Round answers to two decimal places.

1.

x	.5	5.5	3.5	2	4	4.5
y	42	39	85	105	72	32

a. Name the regression model. _____

b. Write the equation that best models the data. _____

2.

x	-2	0	-4	3	6	5
y	3	5	3	7	13	11

a. Name the regression model. _____

b. Write the equation that best models the data. _____

3. The table below shows the population of Jennyville in millions. Let 1976 = 0.

Year	1976	1981	1986	1991	1996	2001
Population	566	677	764	755	768	813

a. Write the equation of the line of best fit. _____

b. What is the slope of the line of best fit? What does slope mean in the context of this problem?

c. Predict the population of Jennyville in 2013. Show your work.

Assessment

Directions: Given the following data sets, select the appropriate regression model, write the equation, and answer the questions that follow. Round answers to two decimal places.

1.

x	.5	5.5	3.5	2	4	4.5
y	42	39	85	105	72	32

a. Name the regression model. Quadratic Regression

b. Write the equation that best models the data. $y=-15.89x^2 + 78.32x + 8.31$

2.

x	-2	0	-4	3	6	5
y	3	5	3	7	13	11

a. Name the regression model. Exponential Regression

b. Write the equation that best models the data. $y=4.85\ (1.17)^x$

3. The table below shows the population of Jennyville in millions. Let 1976 = 0.

Year	1976	1981	1986	1991	1996	2001
Population	566	677	764	755	768	813

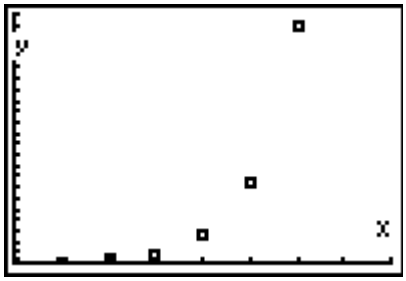
a. Write the equation of the line of best fit. $y=8.57x + 616.76$

b. What is the slope of the line of best fit? What does slope mean in the context of this problem?
Slope = 8.57
The population of Jennyville increases by 8.57 million people per year.

c. Predict the population of Jennyville in 2013. Show your work.
$2013 - 1976 = 37$
$y = 8.57 \bullet 37 + 616.76$
$y = 317.09 + 616.76$
$y = 933.85$
The population of Jennyville in 2013 will be 933.85 million.

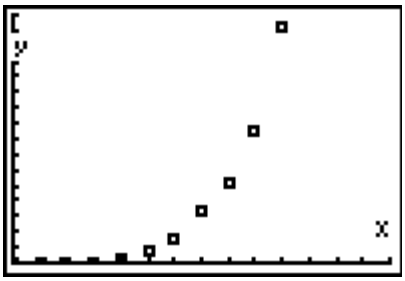
Moldy Mesz Answer key

Time	Number of Bacteria
0.0	30
0.5	90
1.0	270
1.5	810
2.0	2430
2.5	7290
3.0	21870



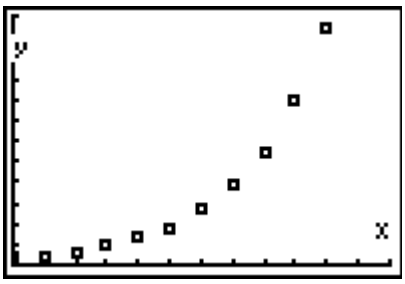
- The equation that models this data is $y = 30(9)^x$
- $x = 4$
  $y = 30(9)^4$
  $y = 196{,}830$ bacteria
- If the table is set to increase in increments of 0.005, the student should obtain an answer of approximately 3.875 hours.

Bacteria Reproduction Answer Key



- The equation that models this data is $y = 1.73\ (5)^x$
- If the table is set to increase in increments of 0.02, the student should obtain an answer of approximately 4.96 hours. The student could also use an estimation of 5 hours.
- $x = 6.5$
  $y = 1.73\ (5)^{6.5}$
  $y = 60{,}443.71$ bacteria

Artist Delite Answer Key



- The equation that models the data is $y = 14.96\ (1.44)^x$.

- Multiplying the area by four will result in an area of 60 cm^2. By using the table function or by approximating from the original data set, the student should obtain an answer of between 3.8 and 4 magnifications.

- $x = 18$
  $y = 14.96\ (1.44)^{18}$
  $y = 10{,}603.68\ cm^2$

- By setting the table to increments of 0.01, students should obtain an answer of 11.54 magnifications.

  $y = 14.96\ (1.44)^{11.54}$
$y = 1{,}005.62\ cm^2$