



Mathematical Representation of Crop Growth Lesson

Grade Level: 8th Grade Math

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Common Core Content Standards:

8.EE.5

8.EE.7

8.SP.1

8.SP.2

8.SP.3

8.F.2

8.F.3

Objectives:

Students will mathematically represent the growth of a classroom set of seedlings using various representations (table of values, unit rate, scatter plot, linear graph, non-linear graph, linear equation.)

Students will explain how a linear representation of the data may be misleading.

Students will adjust the domain of the data set to write and graph linear equations that better represent the data.

Procedure:

Plant seeds in mid-March. This will allow time for seeds to germinate, followed by about a month of growth measurements. This time of year is also beneficial because it coincides with the end of the algebra part of the course and the beginning of the statistics.

Measure and record the height of each plant to the nearest centimeter twice a week. You don't need a plant for every student, but you should plant enough to get a good sample size, but not so many that the amount of data is overwhelming. Ten plants measured twice a week for four weeks will result in a graph with 80 data points. In my opinion this is a large enough sample to get good results while still allowing students to analyze the data using a simple calculator. However, I would plant 20 and eliminate seeds that did not germinate, plants that die, and the largest and smallest outliers in order to have a sample of ten plants for the data analysis.



I would recommend a large, fast growing plant that grows straight and tall without the need for support. Sunflowers are a good choice.

Once you have a data set representing the growth of ten plants over the period of about a month, students will create a scatter plot utilizing all the data points. **(8.SP.1)** This scatter plot will be the basis for a large part of the mathematical analysis. It is important that they are accurate. The domain should start with Day 0 as the day seeds were planted. Allow the domain (x-axis) to extend over two sheets of graph paper, in order to make it easier for students to analyze rate of growth for smaller intervals of time. Allow for enough space below the x-axis so that students may alter the day values for the smaller intervals of time (i.e. The first day of each time interval will always correspond to Day 0.) Make several copies of each student's scatter plot.

Students construct the line of best fit for the entire data set. **(8.SP.2)**

Calculate the slope and the y-intercept of the line of best fit.

Students write a linear equation in the form of $y = mx + b$, representing plant growth. In a short paragraph, students will identify what the slope and y-intercept in this equation represent and why this equation does **not** accurately represent the growth of the plants. (The slope is the rate of growth per day. The y-intercept is the starting height of the plants. Although the line of best fit will be linear, the rate of growth will probably not be linear. Additionally, due to the time needed for germination, the y-intercept will probably be negative, which would indicate that the plants had a negative height at the start, when they actually had a height of zero)

(8.F.4)

Adjust the domain of the scatter plot so that only several weeks are represented at a time. (i.e. days 14 - 21, or 21 - 28). The first day of the new plot will now correspond to day 0. Have students do this on the copies you made of their original scatter plots. Using the adjusted domains (time intervals), have students construct a line of best fit for each interval, calculate the slope and y-intercept and write a linear equation in the form $y = mx + b$. Students should identify in a short paragraph why these new equations better represent the growth of the plants. (Within the shorter intervals, the relationship between time and height will be closer to linear. The y-intercept will nearly represent the average height of the plants at the start of the interval.

Students calculate the average starting height, finishing height and unit rate (rate of growth in cm/day) for the entire time interval and both shorter intervals. In a short paragraph, students explain how average starting height and rate of growth for each interval correspond to the slope and y-intercept for the equations they wrote. **(8.SP.3)**



Using the original scatter plot, sketch the graph as a non-linear function for all or part of the data. **(8.F.3)**

Students will use their equations and graphs to predict the future height of the plants. **(8.EE.7)**

PLANT #	DAY										
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

10 plants will be selected for analysis once all data is collected.

Create a scatter plot and construct a line of best fit on separate graph paper as instructed by your teacher.

Using your line of best fit, calculate the following:

Slope = _____

y-intercept = _____



What does the slope of this equation represent?

What does the y-intercept of this equation represent?

Write an equation to represent the line of best fit. _____

Explain why the slope and y-intercept of this equation do **not** accurately represent the growth of the plants.

Adjust the domain of your scatter plot so that only a short time interval is represented. (Your teacher will select the starting and ending days.) Re-number the days on your graph so that the first day of this new interval is Day 0.

Construct a line of best fit through the data points of this shorter interval.

Using your line of best fit, calculate the following:

Slope = _____

y-intercept = _____

What does the slope of this equation represent?

What does the y-intercept of this equation represent?

Write an equation to represent the line of best fit. _____

Explain why the slope and y-intercept of this new equation better represent the growth of the plants.



Adjust the domain of your scatter plot so that a different short time interval is represented. (Your teacher will select the starting and ending days.) Re-number the days on your graph so that the first day of this new interval is Day 0.

Construct a line of best fit through the data points of this shorter interval.

Using your line of best fit, calculate the following:

Slope = _____

y-intercept = _____

What does the slope of this equation represent?

What does the y-intercept of this equation represent?

Write an equation to represent the line of best fit. _____

Explain why the slope and y-intercept of this new equation better represent the growth of the plants.

In reality, your data may best be represented using a non-linear function. Sketch a non-linear graph through the data points.

Use one of your equations to predict the height of a plant 30 after being planted. **SHOW YOUR WORK.**



You have a plant that is 8 cm tall _____ days after planting. Use one of your equations to predict how tall it would be _____ days after planting. **SHOW YOUR WORK.** (Values in this problem will be determined by your teacher, and will depend on the intervals used to write your equations and the rates of growth for the seeds planted. Students may be required to solve several problems like this with different values.)