



# Measuring the Average Growth Rate of Wheat (Calculating Slope)

## Overview:

This is not a typical lesson, but rather a series of activities intended to last for the duration of a semester. Over the course of the semester, students will: 1) plant an in-ground garden bed with wheat seeds, 2) track and record the growth of wheat stalks until they are ready to harvest, and 3) calculate the average growth rate of the wheat berries on their plants once they have collected enough data.

## Objectives:

At the end of the lesson students will be able to:

-  **Define** measures of central tendency (average, mean, mode, median).
-  **Calculate** the slope between two points using change in y over change in x.
-  **Recognize** proportional relationships.
-  **Create** an equation for each new data point and the origin using the point-slope formula:  $(y - y_1) = m(x - x_1)$ .
-  **Plant** and cultivate a wheat plant to use to solve real world math problems.

## Materials:

-  For Step 1:
  - An empty garden bed
  - Wheat seeds
  - Trowels, gloves, water
-  For Step 2, each student will need:
  - A manila folder
  - Graph paper
  - Rulers
  - Pencils
  - Colored pencils

## On the Board:

-  Student Reflection Questions

## Suggested Snack:

-  Anything made from whole wheat!

## Vocabulary:

- |   |   |   |
|---|---|---|
|  Slope                       |  Mean                      |  Data point                  |
|  Coordinate Grid             |  Median                    |  Outliers                    |
|  Ordered pair                |  Mode                      |  Associations (Correlations) |
|  Constant of Proportionality |  Proportional Relationship |   |

## Learning Activities:

- I. Step 1: Planting Wheat (1 lesson)

- A. Prepare a garden bed for planting by amending it with healthy, organic soil.
  - B. Have students scatter wheat seeds throughout the bed. For example, in a 4' x 8' garden bed, approximately six handfuls of seeds are sufficient.
  - C. Have students use a leaf rake to rake approximately one inch of soil over the seeds.
  - D. Water the bed using a nozzle with small holes so water sprays like a "light spring rain" in order to not wash the seeds together or out of the bed (if it is an in-ground bed).
  - E. Cover the bed with netting or potting trays with large holes that will expose the seeds to sunlight, but will prevent birds from eating the seeds.
  - F. Each week have students come back to the garden to water their wheat plants.
2. Step 2: Measuring Growth Rate (over the course of a semester)
- A. Once the students' wheat plants have sprouted, bring the class into the garden.
  - B. Using rulers, assist students in measuring the height of the wheat sprouts/stalks in their garden bed.
  - C. Students will take ten random height measurements on a bi-weekly basis. Students will use these measurements to plot the average growth (the mean) over time during the growth period of the plants.
  - D. Additionally, students should make and record observations about:
    - Different growth rates among plants;
    - When wheat berry tops first appear;
    - What happens after the vertical growth stops;
    - The change in color as the plants die off.
3. Step 3: Plotting Data Points
- A. Have students create a booklet with their manila folder and graph paper stapled inside.
  - B. Instruct students to draw a graph (quadrant one only) in their booklet.
    - They should label the x-axis as time (independent variable) with units of days and the y-axis as height (dependent variable) with units of inches.
  - C. As they return to the garden and collect new measurements, students will plot each new ordered pair (data point) on their graph and calculate the slope between it and the previous ordered pair using *change in y over change in x*.
  - D. Students will then calculate the slope between each new data point and the origin.

- E. Students will create a table of values using the same data points, and compare the outcome to the slope formula.
  - F. Students will create an equation in slope-intercept form,  $(y = mx + b)$  between each new data point and the origin using the point slope formula.
4. Extensions: Have students relate information learned from this project to themes in their Ancient World and U.S. History classes. For example:
- A. Settlements and early farming: Where were these located geographically and why?
  - B. Planning for and creating a means for storing grains for future use (protecting the grain from the elements and/or predators).
  - C. Distribution infrastructure of wheat and other grains in the modern age.
  - D. Wheat food shortages (caused by droughts, etc.): What are the consequences of these shortages?

### Student Reflection Questions:

1. What have you learned from watching wheat grow over the duration of this class?
2. How did it feel to see something you planted as a seed grow fully into a plant that can now be used for food?

### Assessment Questions:

You measure your wheat plant after four weeks (28 days) of growth. The sprout is 2 inches tall.

1. Draw a graph (quadrant I only). Label the x and y axis appropriately and plot this as your first data point.
2. Using the origin as your second point, calculate the slope of the line formed by your data point. (**slope = 1 / 7**)

### Standards:

CCSS

**8.EE.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph.

**8.SP.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

**8.F.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

**8.F.3** Interpret the equation  $y = mx + b$  as defining a linear function, whose graph is a straight line.

**8.SP.1** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.