Introduction to Graphing

Experiment #2a

OVERVIEW

- Scientific investigation requires the analysis and interpretation of data. Knowing how to graph and what the different components mean allow for an accurate analysis and understanding of data. In this investigation you will practice creating graphs and use some simple statistical tools to analyze graphs and datasets.

OBJECTIVES

- Create graphs from datasets, both by hand and electronically.
- Analyze the data in the graphs.
- Compare the slope of trendlines to interpret the results of an experiment.

Background

Significance of Data Collection

- Science requires the collection of data to **test hypotheses** in order to see if it supports or does not support
- Collecting data creates a record of observations from experiments that is needed to ensure the ideas in a hypothesis are **accurate** and **credible**
  - **Qualitative Data:** Qualitative data describes attributes or characteristics that cannot be measured numerically, focusing on descriptions, themes, and patterns observed.
  - **Quantitative Data:** Quantitative data consists of numerical measurements and counts, allowing for statistical analysis and comparison.

Variables

- **Variable**: something that can be changed within an experiment
- **Independent Variable**: something the experimenter has control over and is able to change in the experiment.
- **Dependent Variable**: changes based on its association with an independent variable.

Ex 1) Investigating the Impact of Exercise on Weight Loss

↳ How long?

- **Independent Variable:** Exercise Duration (how many minutes per day spent exercising)) input (x)
- **Dependent Variable:** Weight Loss (amount of weight lost in kilograms)) output (y)

Ex 2) Examining the Effect of Watering Frequency on Soil Moisture Level

- **Independent Variable:** Watering Frequency (how often plants are watered in a week)
- **Dependent Variable:** Soil Moisture Level (measured as percentage moisture content of the soil)

Different Ways To Present Data

Interval's Lower Limit	Interval's Upper Limit	Class Frequency
39.5	49.5	3
49.5	59.5	10
59.5	69.5	53
69.5	79.5	107
79.5	89.5	147
89.5	99.5	130
99.5	109.5	78
109.5	119.5	59
119.5	129.5	36
129.5	139.5	11
139.5	149.5	6
149.5	159.5	1
159.5	169.5	1

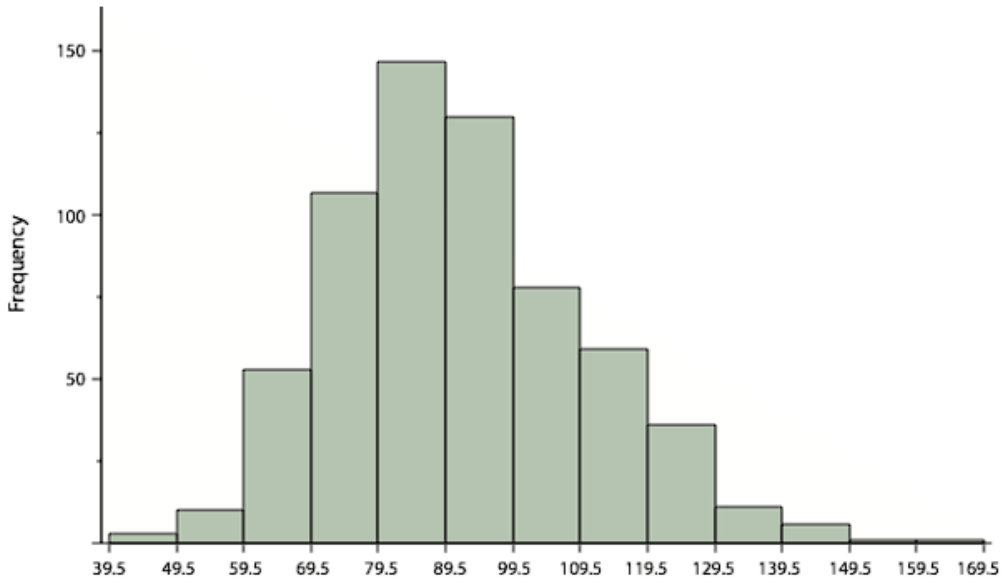
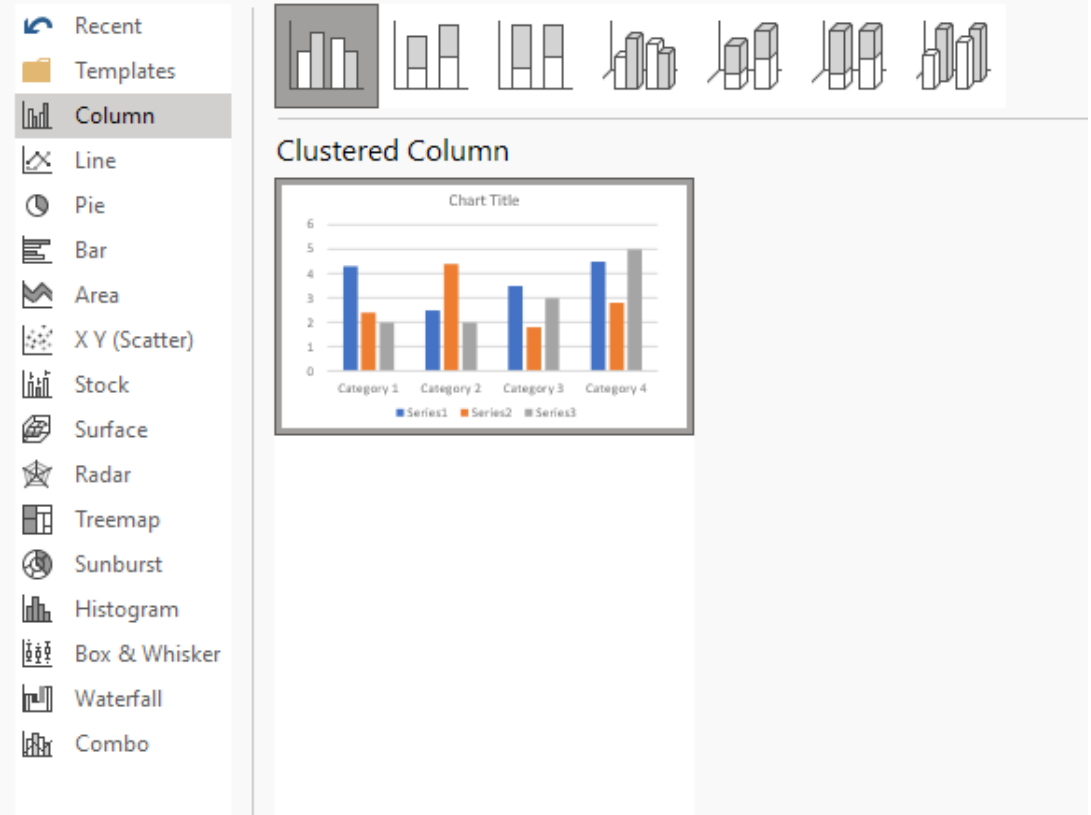


Figure 9. Histogram of scores on a psychology test.

Different Types Of Graphs



Bar Graph

- **Description**: Consists of rectangular bars with lengths proportional to the values they represent. The bars can be plotted vertically or horizontally.
- **Typical Application**: Bar graphs are ideal for comparing discrete groups or categories, such as sales figures across different regions or test scores among different classes.

Pie Chart

- **Description**: A circular chart divided into sectors, each representing a proportion of the whole. Each sector's angle (and thus its area) is proportional to the quantity it represents.
- **Typical Application**: Pie charts are used to display the composition of a whole into its component parts, such as the percentage distribution of different categories of expenses in a budget.

Summary of Statistics

Average: the sum of a group of numbers, divided by how many numbers were in the set.

Equation 1:

$$\text{average} = \frac{x_1 + x_2 \ldots + x_n}{n}$$

$$\text{average} = \frac{x_1 + x_2 + x_3}{3}$$

$$\text{average} = \frac{10 + 10 + 7}{3} = 9 \text{ cm}$$

Note: we won't cover standard deviation, error bars, outliers, and confidence intervals.

Procedure

Activity 1 – Graphing By Hand

Table 1.

	Height in cm					
Week	Wheat Plant 1	Wheat Plant 2	Wheat Plant 3	Rye Plant 1	Rye Plant 2	Rye Plant 3
1	2.0	3.0	0.0	0.0	1.0	0.0
2	3.0	3.0	2.0	1.0	2.0	1.0
3	5.0	5.0	3.0	1.0	2.0	2.0
4	6.0	6.0	4.0	2.0	3.0	3.0
5	7.0	7.0	5.0	3.0	4.0	3.0
6	9.0	8.0	7.0	3.0	4.0	3.0
7	10.0	9.0	7.0	4.0	5.0	4.0
8	10.0	10.0	7.0	5.0	6.0	5.0

Figure 4.

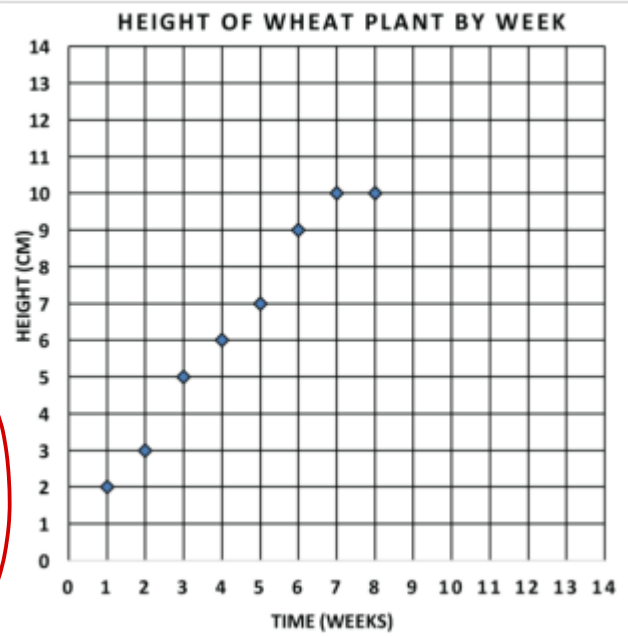
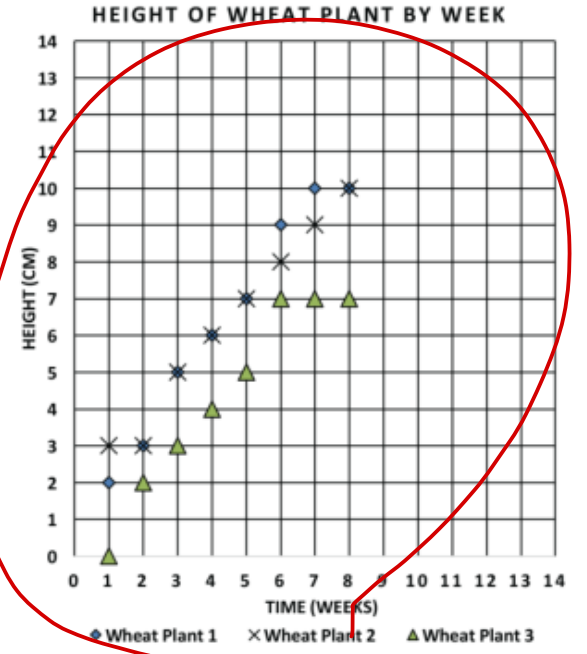


Figure 5.



Summary of Steps

1. Label the x-axis as "Time (weeks)" and the y-axis as "Height (cm)," ensuring to include measurement units.
2. Determine the graph's origin at the lower left corner, setting both x and y values to 0. Number the axes from 0 to 14.
3. Plot the data for "Wheat Plant 1," marking each week's height with a dot. Repeat for "Wheat Plant 2" and "Wheat Plant 3," using different colors or symbols for each.
4. Create a legend below the x-axis to identify the colors or symbols used for each plant data set, placing it for clear visibility.

Week	Wheat Plant 1	Wheat Plant 2	Wheat Plant 3
1	2.0	3.0	0.0
2	3.0	3.0	2.0
3	5.0	5.0	3.0
4	6.0	6.0	4.0
5	7.0	7.0	5.0
6	9.0	8.0	7.0
7	10.0	9.0	7.0
8	10.0	10.0	7.0

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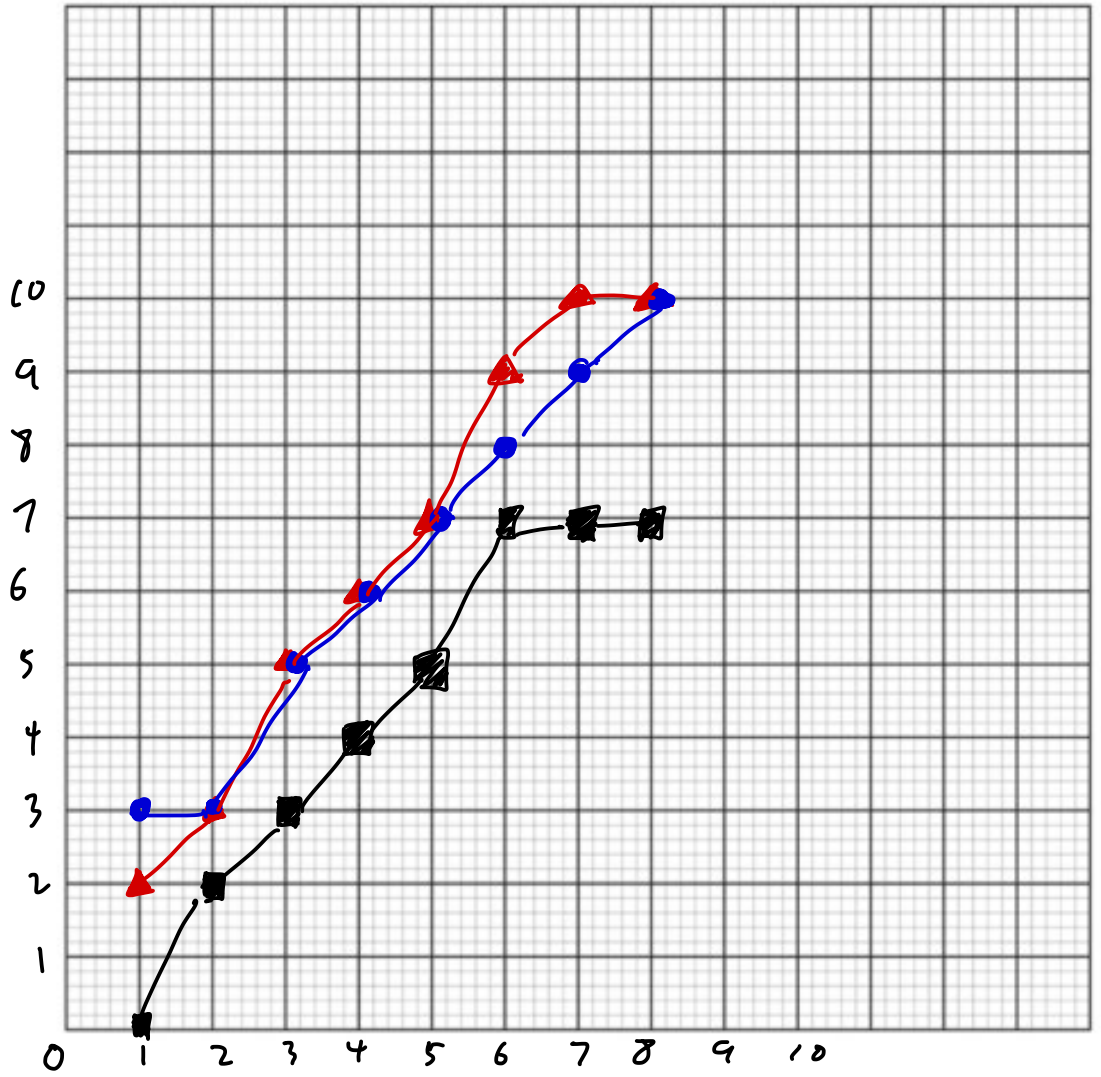
Title: _____

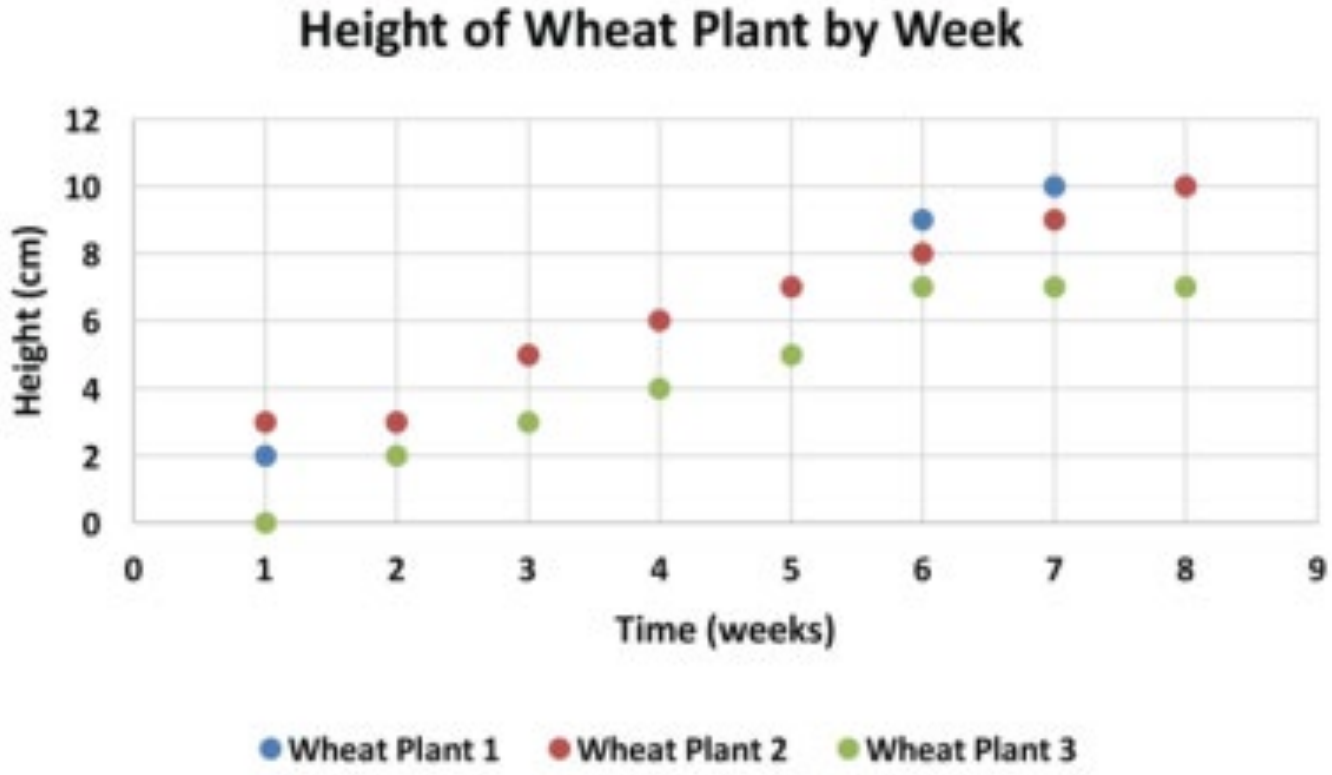
Label (y-axis): Height (cm)



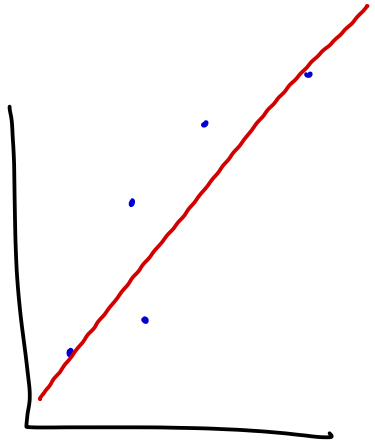
Label (x-axis): Time (weeks)

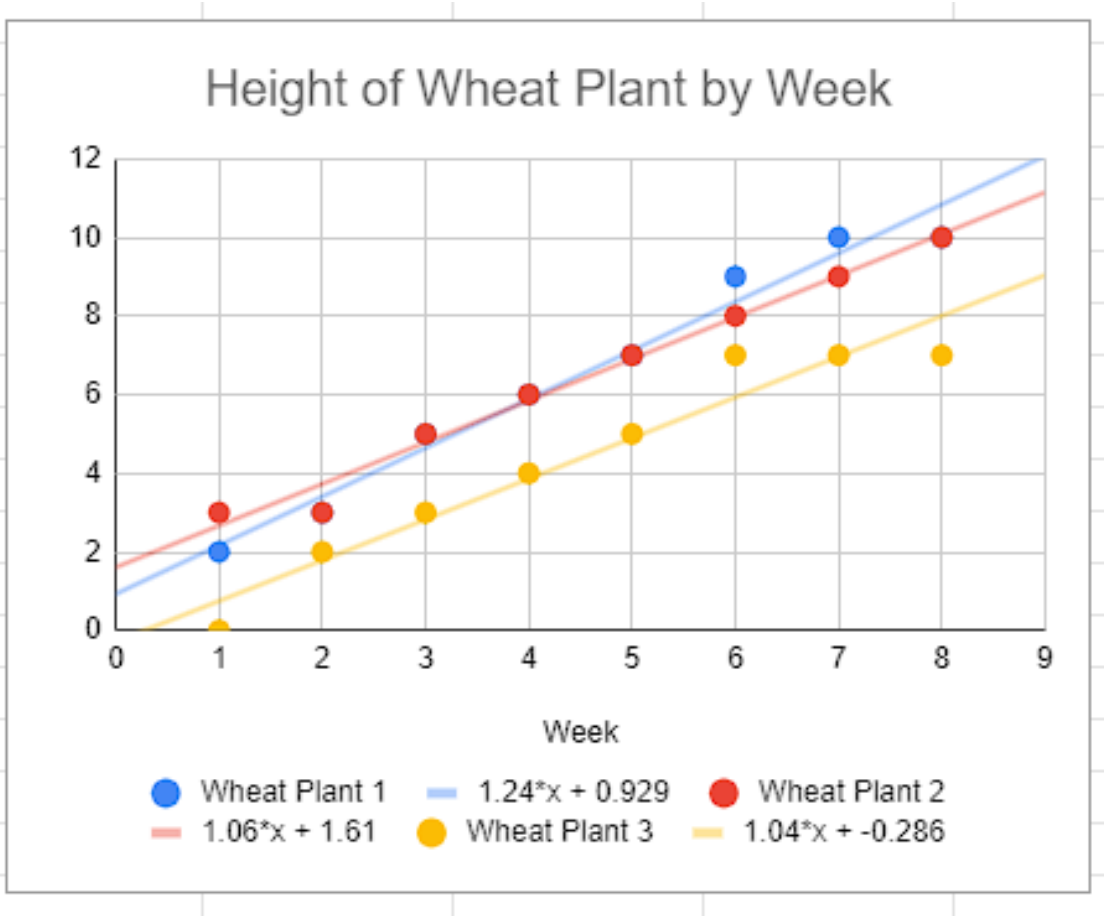
Activity 2 – Computer Graphing

	A	B	C	D	E
1	Week	Wheat Plant 1	Wheat Plant 2	Wheat Plant 3	Ry Plai
2	1	2	3	0	
3	2	3	3	2	
4	3	5	5	3	
5	4	6	6	4	
6	5	7	7	5	
7	6	9	8	7	
8	7	10	9	7	
9	8	10	10	7	
10					
11					



Activity 3 – Linear Regression





Data Table.

Wheat Plant 1 trendline equation	$y = 1.0357x - 0.2857$
Wheat Plant 1 trendline corrected	
Wheat Plant 2 trendline corrected	
Wheat Plant 3 trendline corrected	
Wheat plant with fastest growth	