

Principles of Graphing Lab

Teacher Version

As data is gathered during a laboratory investigation or experiment, it is often helpful to not only generate data tables, but to graph the data for further analysis, comparison, and interpretation. Graphs help to show relationships between sets of data that may be difficult to appreciate in a table format only. These data are called **variables**. **Independent variables** can be changed, altered, or modified by the scientist running the experiment. **Dependent variables** rely on the conditions of the investigation. Dependent variables are dependent on the independent variables and can be thought of as the outcomes of an investigation or experiment. The type of graph that will be used in this activity is line graphs. **Line graphs** generally show connections between two sets of data in which the independent variable is continuous.

Key Concepts:

- Understand the three components of a completed graph: (1) main title, (2) x and y-axis labels, and (3) using correct units of measurement.
- Distinguish between data representing **independent** and **dependent variables**.
- Analyzing and interpreting data that may be difficult to appreciate in a table format.

Materials:

- Graph paper (several sheets per student)
- Straight edges (at least one per student group)
- Pencils and/or pens

Part 1 - Pre-lab Questions

Q1. What are variables and how do they affect scientific investigations?

Variables can be thought of as factors or items (data) scientists test in order to determine potential cause and effect relationships in nature. Variables are part of the investigative process and can be modified, altered, or controlled by scientists (independent variables) to produce expected or unexpected outcome (dependent variables). In general, scientists choose to keep all variables constant (controlled for) during an experiment except one, which will be the focal point of the investigation.

Q2. Describe the difference(s) between independent and dependent variables.

A variable is independent when the scientist and not the events of the investigation control it. Another common name for an independent variable is the manipulative variable, because it is under direct control of the scientist. A variable is dependent because it depends on the conditions of the investigation. Dependent variables are also referred to as responder variables because they change in response to the manipulative, or independent, variables.

Q3. Which is the independent and dependent variable?

The temperatures in New York City on different days of a specific week

Independent Variable _____ Day of the week _____

Dependent Variable _____ Temperature in New York City _____

A boy's weight on his birthday from age 5 to 20

Independent Variable _____ Boys age _____

Dependent Variable _____ Boys weight _____

Relationship between hours of studying and grades on a test

Independent Variable _____ Hours of studying _____

Dependent Variable _____ Grade on test _____

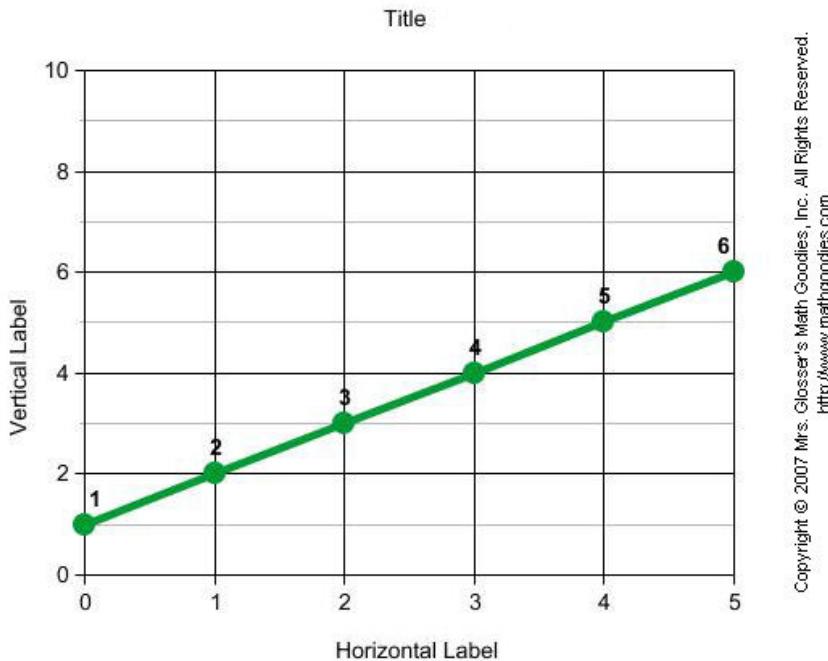
Q4. What are the three things that all graphs need to be complete?

- a. Main title that briefly explains what the graph illustrates
- b. X and Y-axis titles
- c. Proper units of measurement for the X and Y-axis

Part 2 - Making Line Graphs

It is difficult to clearly describe the different elements of a line graph. It is probably best to either do a complete example for everyone, or have the students work through the problems and learn by doing. In either case, try to follow the below steps for creating the line graphs. They are relatively easy to follow and give the students guidelines they can follow and refer to.

The graph below will be used to help us define the parts of a line graph and show where each part should appear on a graph.



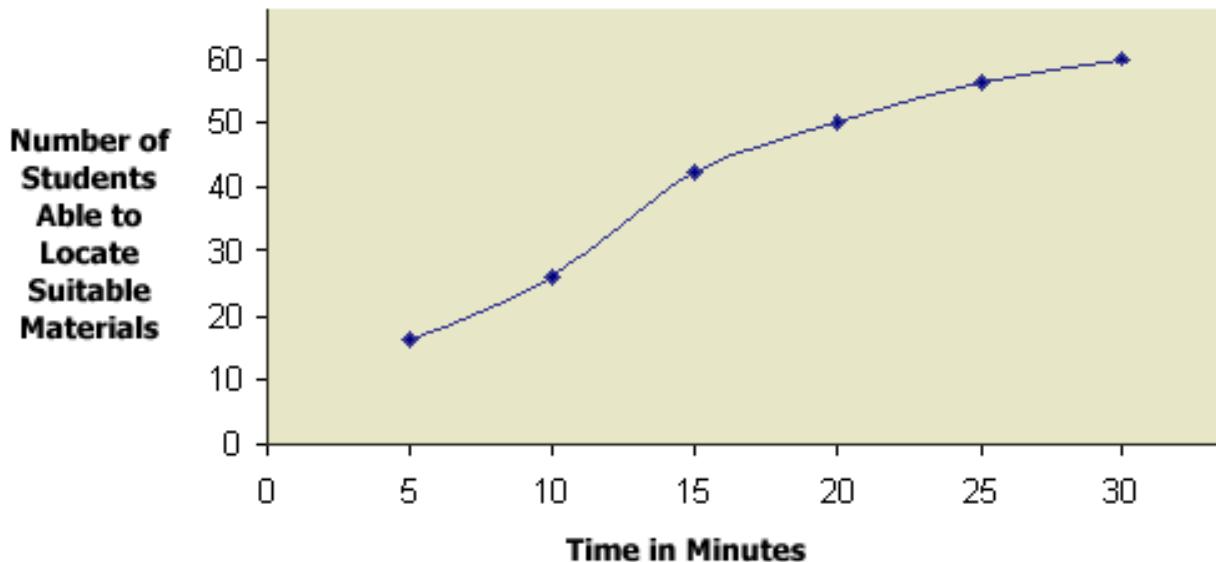
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Let's define the various parts of a line graph.

Title	The title of the line graph tells us what the graph is about.
Labels	The horizontal label across the bottom for the Independent Variable and the vertical label along the side for the Dependent Variable tell us what kinds of facts are listed.
Scales	The horizontal scale across the bottom and the vertical scale along the side tell us how much or how many.
Points	The points or dots on the graph show us the facts.
Lines	The lines connecting the points give estimates of the values between the points.

Example of a Line Graph

Time Needed to Locate Suitable Library Materials



http://www.galeschools.com/research_tools/images/src/LineGraph.gif

Steps for creating a Line Graph:

1. Put a Title at the top of the graph.
2. Identify the Independent and Dependent variables for the graph. The Independent variable will use the horizontal axis and the Dependent variable will use the vertical axis.
3. Identify the range of values for the variables.
4. Draw the vertical and horizontal axes of your graph. Make sure they are long enough for the range of values for each variable.
5. Label the vertical axis with the Dependent Variable and the horizontal axis with the Independent Variable include the units if appropriate.
6. Plot points.
7. Connect points to complete line graph.

Create line graphs for the following sets of data on a separate sheet of paper

1. People in a store at various times of day.

Time	Number of people in store
10am	2
11am	5
12pm	10
1pm	22
2pm	15
3pm	5
4pm	4
5pm	4
6pm	3



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Q5. What was the greatest number of people in the store and at what time did this occur?

22 people at 1pm

Q6. During what hours are more people entering than leaving the store? During what hours are more people leaving than entering the store?

More people were entering than leaving the store between 10am and 1pm.

More people were leaving than entering the store between 1pm and 6pm.

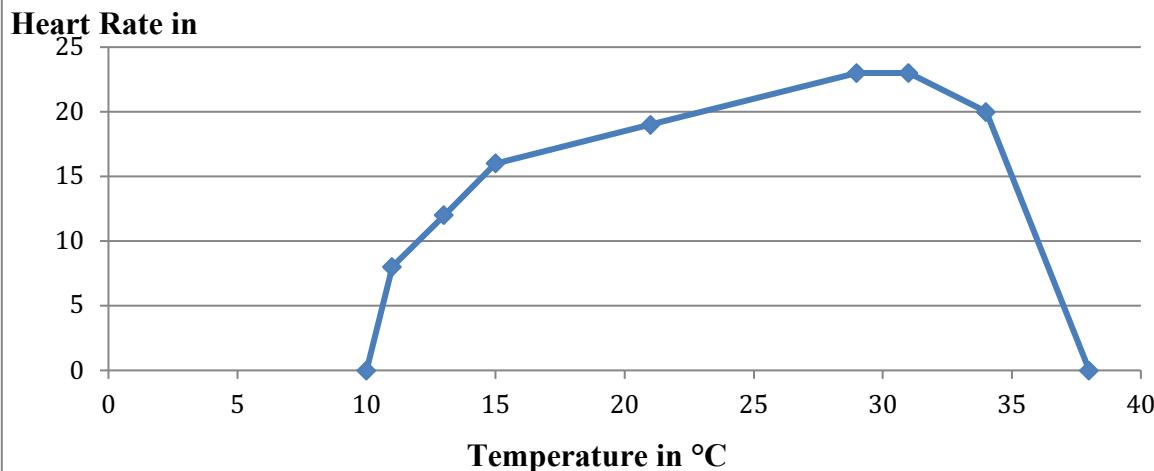
Q7. One employee is going away to college forcing you to reorganize your employees work hours. On which shift would it be best to reduce the staff: 10am-2pm, 12 pm–4pm or 3pm-6pm? Why?

The staff should be reduced on the 3pm-6pm shift, because that is the time during which there are the fewest customers in the store and removing an employee would have the smallest impact.

2. Relationship of Water Temperature to the Heart Rate of Northwest Pacific Salmon

Temperature	Heartbeats/Minute
10°C	0/min
11°C	8/min
13°C	12/min
15°C	16/min
21°C	19/min
29°C	23/min
31°C	23/min
34°C	20/min
38°C	0/min

Relationship of Water Temperature to the Heart Rate of Northwest Pacific Salmon



Q8. In what temperature range does the salmon's heart rate stay the same?

From 29°C- 31°C

Q9. Assuming that a higher heart rate indicates the salmon is more comfortable in that temperature, would the salmon prefer that it is 7 degrees warmer or 7 degrees cooler than its ideal temperature? Explain your answer.

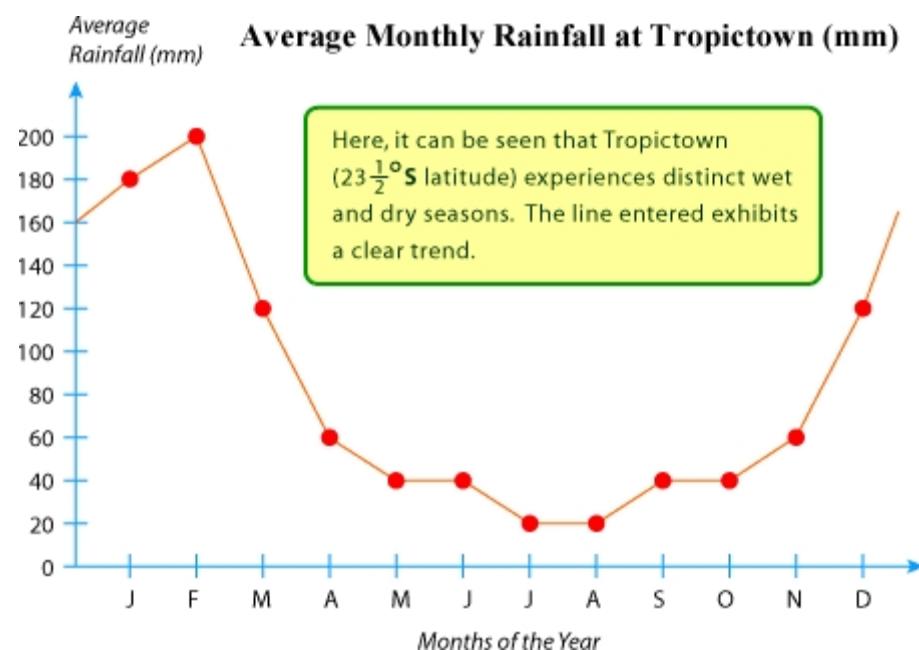
The salmon would prefer 7 degrees cooler than the ideal temperature. Their ideal temperature range would be from 29°C- 31°C. 7 degrees below this rate at 22°C their heart rate would be about 20 beats/minute and while 7 degrees above this at 38°C their heart rate would be 0 beats/minute.

Q10. During what temperature range does the salmon's heart rate decrease the most: 10°-11°, 31°-34°, or 34°-38°? By how many beats does it decrease?

34°-38° by 20 beats

3. The average monthly rainfall in millimeters in a tropical town.

Average Rainfall in mm	Month
180	January
199	February
116	March
55	April
38	May
37	June
20	July
19	August
35	September
35	October
53	November
110	December



Q11. When is the amount of rainfall increasing, decreasing, and staying the same?

January-February: _____ increasing _____ February-August: _____ decreasing _____

August-September: _____ increasing _____ September-October: _____ staying the same _____

October-December: _____ increasing _____

Q12. During what season is the rainfall the highest (Spring, Summer, Fall, Winter)?

Winter

Q13. In between which two months does the amount of rainfall change from decreasing to increasing?

August - September

References: Activity adapted from “Making Graphs” by MacMillan Publishing Co., Inc.