Bioinformatics Bite #5:
Intro to Graph Interpretation: Bar and Line graphs

Teacher Edition

OVERVIEW

This worksheet is part of a set of short lessons to help students become familiar with the basics of bar and line graphs.

KEY CONCEPTS

- Graphs require basic components including axis labels, titles, consistent intervals, and proper scaling.
- Traditionally, the independent variable is plotted on the x-axis and the dependent variable is plotted on the y-axis.
- Bar graphs are used when comparing different categorical variables.
- Line graphs are used when trying to examine or establish a trend, particularly when the x-axis represents time.

OBJECTIVES

- Students will be able to define and identify components of a graph.
- Students will be able to interpret information from bar and line graphs.
- Students will be able to differentiate between the use of a bar graph and a line graph.

TEACHING TIPS

- Students may work individually or in groups.
- This can be supplemented with any graphs that might be more suitable for your students. The graphs chosen were selected as a connection to the GeneLab data repository and offer an example of how line and bar graphs may be encountered in a scientific paper.
- It is intended to complete parts 1 & 2, have a classroom discussion and then move on to part 3.
- A possible extension activity for part 3 would be to have students create mock graphs of the three situations or collect and graph data for your class.
- One possible extension activity would be to have students locate line or bar graphs in primary literature sources and present them to their peers.

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Part 1: What are the essential elements of a graph?

When completing a graph, you are creating a visual representation of data so that it is easier to understand. Some elements that need to be included in a graph are represented by the acronym "T.A.I.L.S."

T : Title - Every graph needs to communicate to the audience what the graph as a whole represents.
A : Axes - What does the X axis and Y axis represent on the graph?
I : Intervals - Each axis has to have evenly spaced intervals.
L : Labels - Labels need to be present for each axis and if multiple lines are included, for each line.
S: Scale - The data should be evenly spaced through the image by using a proper scale on each axis.

In most situations, remember that the x-axis will represent the independent variable and the y-axis will represent the dependent variable.

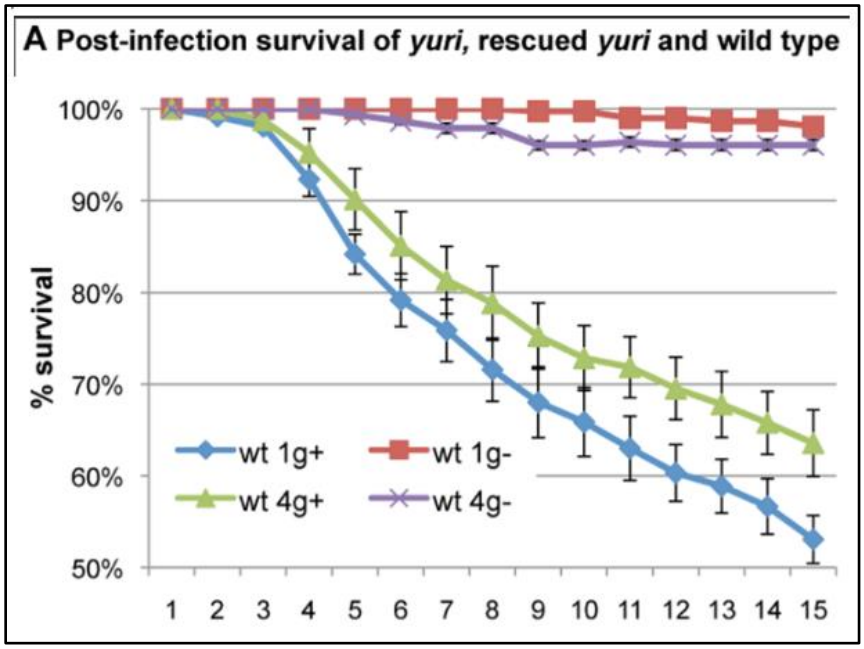
Why is it important to do this?

A graph is a visual representation of data. If it is not clear to the audience (because it is not labeled, small, has uneven and misleading intervals, etc), the data is not being communicated honestly and effectively.

Part 2: What information is conveyed in a bar or line graph?

Let's look at information from a study published from GLDS-1 (Expression data from *Drosophila melanogaster*) by Taylor, et. al. (2014).

This is an excerpt of figure 1, part A in the study.



What kind of graph is this?

Line graph.

What element is missing in this graph?

There is no x-axis label.

The graph compares wild type *Drosophila* in two different gravitational conditions (1g and 4g) and either infected with bacteria (+) or not infected with bacteria (-).

Which group has the higher survival rate?

Uninfected 1g.

Which group has the lowest survival rate?

Infected 1g.

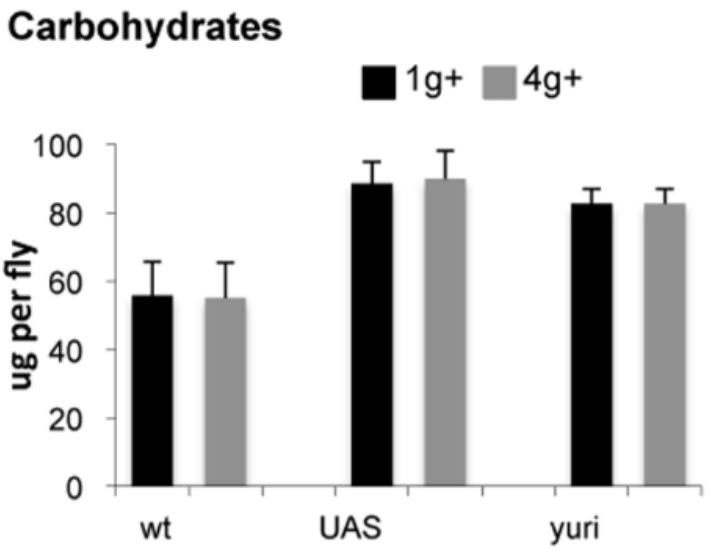
What happens to their survival over time? Do you notice anything else in the graph?

It decreasess for all groups, but at a higher rate in the infected groups. Students may notice that 4g survival drops when uninfected (compared to 1g) but is improved when infected (compared to 1g).

Why is this presented in a line graph?

The line graph allows the audience to see the trend in each group over time. This can then be used to compare the groups to each other. A bar graph could not show the differences in trends.

This is an excerpt of figure 1, part C in the study.



What kind of graph is this?

Bar graph.

The graph compares stores of carbohydrates in three strains of Drosophila in two different gravitational conditions (1g and 4g).

Which genotype has the lowest amount of carbohydrate stored?

Wild type (wt).

Do any of the genotypes show a meaningful difference in carbohydrate storage between the two gravity conditions? How do you know?

No. The bars in each pair are of a similar height to each other. Also, the error bar allows for interpretation of a range of values for each bar, and the ranges of each pair overlap making them essentially the same.

Why is this presented in a bar graph?

The bar graph allows the audience to see the comparison between each pair of genotype conditions. These values are single point values and can easily be compared to each other. The graph adds the visual component and helps also visualize the reliability of the data with the error bars.

When should you use a line graph and when should you use a bar graph?

Part 3: When is it best to use a line or a bar graph?

We have learned that there are sets of data or circumstances that are best represented by either a line or a bar graph.

Opportune uses of a bar graph include:

- Comparing different groups.
- Comparing larger differences over time (for example, population in 2010 vs population in 2020).

Opportune uses of a line graph include:

- Establishing a trend over time.
- Comparing various groups over the same period of time.
- Looking at rates of change.

For the following examples, determine what the better choice of graph would be (line or bar) and explain why.

Situation 1: A student has asked their peers what their favorite school lunch is and wants to report the data.

A bar graph would enable comparison of the favorites.

Situation 2: A class conducted an experiment where they grew two groups of plants, one group was grown in direct sunlight while the other group was grown in the darkest corner of the classroom. They want to show changes in growth of each group during the three weeks of their experiment.

A line graph is ideal because it can show the average height of each group each time they were measured or can show each plant's height each time they were measured.

Situation 3: Students were asked to log the time they spent doing different activities (homework, eating, sleeping, video games, etc) for a week. They want to show the results for the entire class in a graph.

A bar graph would show the comparison of total (or average) time for each task best.

Part 4: Learning Aims and Evaluation

Please rate where you personally are at, with regards to the learning aims, at the end of the lesson and why.

Rating Scale

1- I do not understand it at all yet.
2-I understand parts of it, but I need my teacher and/or classmates' support to answer questions.
3-I understand it and can complete an assignment by myself.
4-I understand it so well I can teach others and apply my knowledge to new situations.

Learning Aim #1: Students will be able to define and identify elements of a graph.

My Evaluation of Learning Aim #1 and Explanation:

Learning Aim #2: Students will be able to interpret information from bar and line graphs.

My Evaluation of Learning Aim #2 and Explanation:

Learning Aim #3: Students will be able to differentiate between the use of a bar graph and a line graph.

My Evaluation of Learning Aim #3 and Explanation:

NGSS Standards

MS-ETS1-3 Engineering Design
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

REFERENCES

GLDS-1 Publication: Toll Mediated Infection Response Is Altered by Gravity and Spaceflight in Drosophila
Authors: Taylor Katherine, Kleinhesselink Kurt, George Michael D., Morgan Rachel, Smallwood Tangi, Hammonds Ann S., Fuller Patrick M., Saelao Perot, Alley Jeff, Gibbs Allen G., Hoshizaki Deborah K., von Kalm Laurence, Fuller Charles A., Beckingham Kathleen M., Kimbrell Deborah A.
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