Experimenting with Planarians

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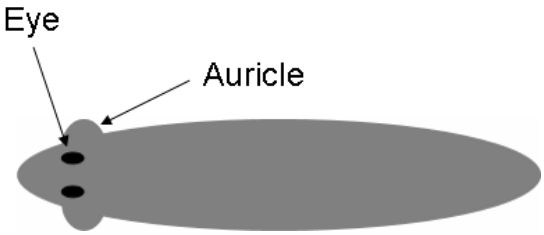
Organizing and Displaying Data: Tables and Graphs

Learning Goals:

- To formulate and test hypotheses regarding an organism responding to its environment.
- To gain experience collecting, organizing and presenting experimental data.

Introduction:

Planarians are model organisms that are regaining popularity amongst scientists due to their regenerative abilities and its relevance towards stem cell research. They are also valuable in the study of organismal responses to environmental signals. The capacity of an organism to respond to its environment is dependent on signal transduction pathways within and between cells of the organism. These signal transduction pathways are series of biochemical reactions that initiate with a signal and end with a response.



One of the most basic responses is the ability to move. Such taxis (movement toward or away from a stimulus) is an organismal response to signals in the environment resultant from many signal transduction pathways involving many cell types. Planarians are known to demonstrate phototaxis, rheotaxis and chemotaxis.

This lab contains a series of hypothesis driven exercises that will allow the student to reveal some basic features of the planarians ability to respond to environmental cues. Observations will be collected in lab, the results graphed and summarized to be passed in next week.

A specific question can be addressed with an experimental design that elicits an explicit result. In order for an answer to be convincing, the likelihood that chance alone accounts for your observations must be small. Therefore you should repeat your experiments a few times with different individuals, these runs are called replicates. Develop an experiment or series of experiments to address the questions outlined. You

will summarize and graphically display your data in written form to be handed in next week.

A. Planarians' ability to respond to water currents: Rheotaxis.

Question 1: Can planarians respond to water currents? Or: Where do planarians contain receptors that enable them to respond to water currents?
Hypothesis: *record in your notebook*
Methods:
Use a pipette to apply a current in each of the following directions. Record your results.

1. the head (anterior)
2. the tail (posterior)
3. the top (dorsal) side
4. the bottom (ventral) side

Record the details in your notebook.
Observations: *Record in your notebook.*
Conclusion: *Record in your notebook.*

Question 2: Once you observe how they respond to currents, determine: Is there a correlation in the intensity of response and the source of current? *How far do they move if you vary the intensity or the distance of the source of the current? Record the details in your notebook.*
Observations: *Record in your notebook.*
Conclusion: *Record in your notebook.*
What other questions do the experimental results generate? *Record in your notebook.*

B. Phototaxis in Planarians.

In order to address a broad question, multiple specific questions can be answered.
Question: How do planarians respond to light?

Devise 4 specific questions that can be easily tested in order to elucidate how planarians respond to light. Write them in the boxes below:

Question 1:
Hypothesis 1: *Record the details in your notebook*
Experimental Design 1:
Record Results:
Conclusion:

Question 2:
Hypothesis 2:
Experimental Design 2: *Record the details in your notebook*
Record Results:
Conclusion:

Question 3:
Hypothesis 3:
Experimental Design 3: *Record the details in your notebook*
Record Results:
Conclusion:

Question 4:
Hypothesis 4:
Experimental Design 4: *Record the details in your notebook*
Record Results:
Conclusion:

For your results you should establish a model describing photoreception in planarians based on your results. Also, explain what types of experiments could be performed to further clarify phototaxis.

References:

Caroline E. Stringer (1917) The Means of Locomotion in Planarians. Proc Natl Acad Sci U S A. December; 3(12): 691–692.

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Organizing and Displaying Data: Tables and Graphs

Tables and graphs are frequently used in scientific writing, to organize data and to visually display relationships between two or more variables. Before you leave lab today, you will consider some of the principles involved, and practice graphing using the data you acquired experimenting with the planaria. Use this information when writing your lab reports. There will be other example data sets to use to see how one produces other types of graphs.

Tables. For each one produced :

- There must be a clear overall title.
- Columns or rows must have appropriate labels.
- It must be clear what the numbers in the table represent. (Are they counts or measurements? What are the units?)

Graphs. For each one produced :

- There must be a clear overall title.
- Each axis must be clearly and appropriately labeled, and scaled in such a way as to accurately display any relationship between variables. For a linear-scaled axis, each increment of distance along the axis must represent an equal increment of change in the represented variable.
- It must be clear what the data points shown in the graph represent, including units of measurement.

Use the type of graph that is appropriate for the data. The two most basic types are the line graph and the bar graph.

Examples:

In the first data set below (Table 1; Figure 1), ocean water temperature is what is referred to as the dependent variable—that is, the water temperature *depends* upon the time of year, the independent variable, and not vice versa. By convention, the dependent variable is displayed on the y axis, and the independent variable on the x axis.

Line graphs are appropriate for data sets in which the independent variable is scalar—its values can be represented by points on a scale. Time (in this case, month of the year) is one example of a scalar independent variable. Other frequently encountered examples are temperature and concentration.

Temperature of ocean water at 1m depth, Seaweed Cove, Rocky Bay (2002)

Month	Temperature, Monthly Average (Degrees Celsius)
Jan	36
Feb	35
Mar	39
Apr	47
May	56
Jun	65
Jul	70
Aug	71
Sep	66
Oct	58
Nov	49
Dec	39

Table 1

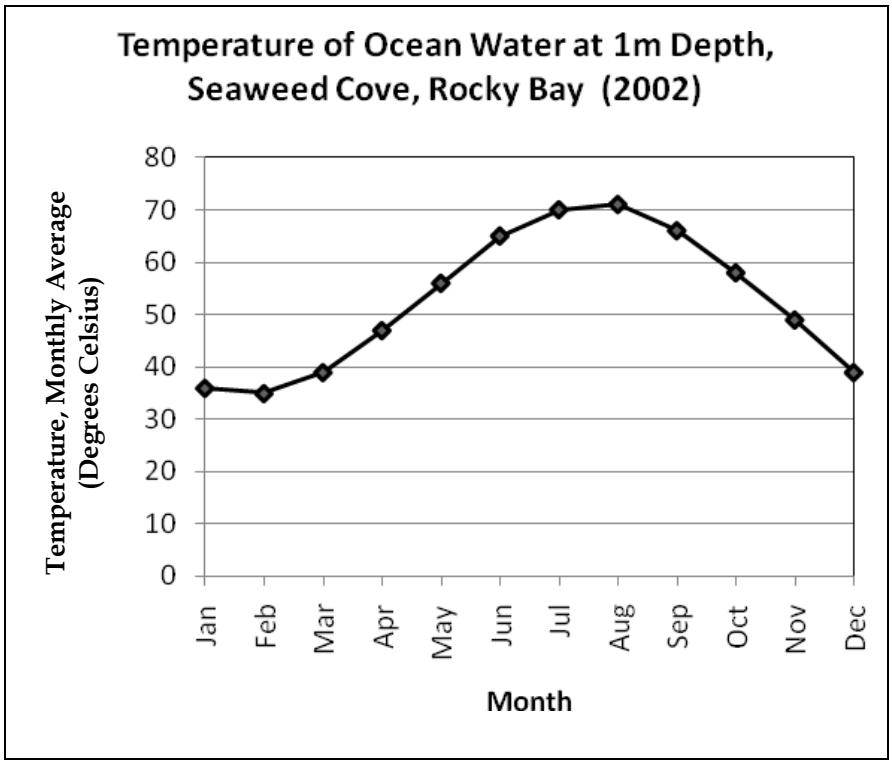

Figure 1

Bar graphs are used when the independent variable is *qualitative* (categories, as opposed to time points, for example), as shown below. Here, the independent variable is location.

Pollutant X in Ocean Water Samples

Location	Pollutant X Concentration (ppm)
Ogunquit, ME	10
Boston Harbor	150
Hyannis, MA	15
Block Island, RI	19
New London, CT	230

Table 1

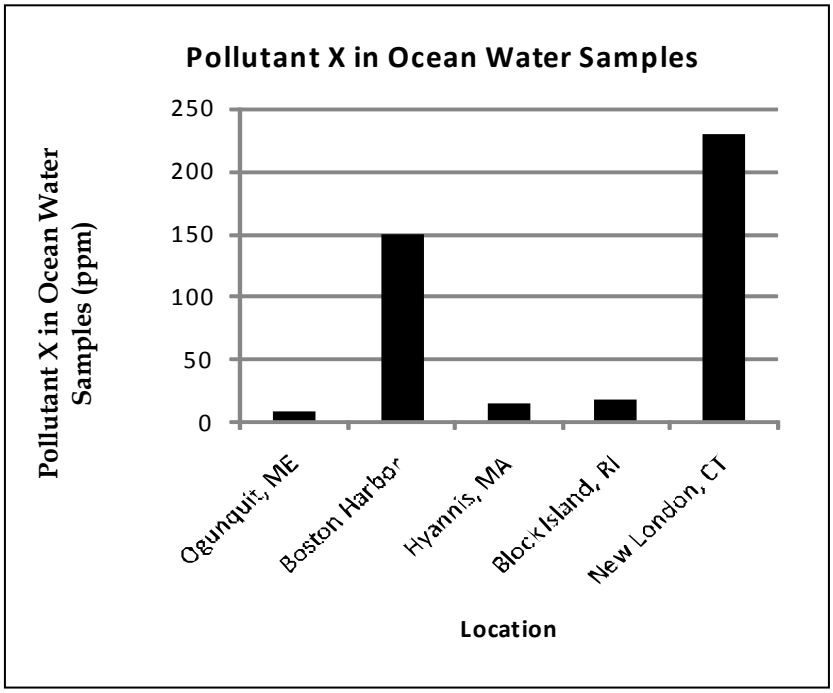

Figure 2

Do you have scalar planarian data to present?
Do you have qualitative planarian data to present?

Your instructor will help you determine if your ideas for graphically displaying your data are appropriate. You should prepare two graphs by hand before you leave lab.

Graph them using the appropriate style of graph, and keep in mind the conventions and guidelines as explained above. It is usually best to master the principles of graphing by hand first, before learning to use computer software to produce graphs. Once you have hand drawn graphs you can use the computer programs to generate graphs, but today you must first do them by hand.

1. Produce one line graph and one bar graph by hand, using the graph paper and rulers provided, to be checked by your TA before leaving. Consult with your TA as needed. You may also find the link below useful for information on graphing basics: http://www.ncsu.edu/labwrite/res/res-homepage.htm
   If this link doesn't work directly, copy and paste it into your browser.

2. If time permits, see the tutorial at the same link on using the program Excel to produce simple graphs using the computer. Your instructor may ask you to try to reproduce one or more of your hand-done graphs using this software program.

Guidelines for Lab Report.

See the appendix for general guidelines on writing lab reports, and be sure to ask your TA in advance if any clarification is needed.

Report on two hypotheses that your group tested (for rheotaxis and/or phototaxis), and address the following in your report. Your TA may assign additional specific questions that your report should cover.

1. Clearly state the hypotheses tested.

2. For each hypothesis, clearly describe how you tested it. What was your experimental variable? Include a diagram if you would like to.

3. What experimental controls did you include, and why?

4. Present the data from this experiment in correctly formatted tables and at least one graph of the appropriate type for each hypothesis.

5. Interpret your results. Do your data support or do they falsify your hypothesis? Why or why not? Explain.

6. Was your experiment designed and executed in such a way that you can confidently draw conclusions from it? If you could try again, would you do it differently, and why?