

# GUIDELINES FOR WRITING A LAB REPORT (OR SCIENTIFIC PAPER)

The five sections of a lab report are outlined below. For more detail on writing and data preparation see *A Short Guide to Writing about Biology* by Jan A. Pechenik.

**INTRODUCTION:** The introduction should discuss observations (either from previous field data or lecture, or reported by other researchers) that led to the formation of the hypothesis. Usually a general hypothesis (an explanation of the observations) is stated and from this, specific hypotheses (precise predictions of possible results) are identified. A brief statement summarizing the experiment helps the reader to identify the independent and dependent variables. Results reported from other studies are cited.

**METHODS AND MATERIALS:** Typically this section gives a brief description of the techniques, instruments, sampling schemes, and study sites. You should be concise, yet provide enough detail to allow someone else to conduct a similar study. Common, widely used techniques (e.g. how to operate a microscope) should not be described. Describe how you conducted the study and include variables that were controlled (i.e. factors that are kept the same between treatments so that any differences in the dependent variable between treatments can be attributed to the change in the independent variable).

**RESULTS:** It is important to set aside an organized area to record the raw data as it is being collected. Often times this is done in a separate field or laboratory notebook. You should prepare a raw data table on a sheet (or sheets) of paper before you begin to collect data. The table should include a title. The raw data is usually not included in scientific papers because the data set may be so large that it would be difficult for a reader to interpret or because much of the data may not be relevant to the conclusions made in the discussion. Results are typically **summarized** as graphs, tables, and written statements of major trends. The results should summarize trends that relate directly to your hypotheses.

**Tables** often contain statistical summaries. Data can also be represented **graphically**. Graphs are especially appropriate when several measurements need to be compared simultaneously. Graphs are spatial representations of data that allow both you and the reader to quickly compare several measurements collected for two or more variables. The independent variable is usually plotted along the X-axis and the dependent along the Y-axis. Be sure to include a title and to label both axes.

A bar graph is appropriate (rather than a scatter graph of points) when the dependent variable is non-numerical (e.g. sampling station). The mean for each group can be represented by the height of the bar. Variation is often represented by two vertical lines extending upward from the top center of the bar and downward from the top center of the bar where the length of

each line is equal to the standard deviation. A scatter graph is appropriate when the dependent variable is numerical (e.g. length of feathers in centimeters).

Comparisons of data must also be **summarized in the written section of the results**. You must clearly and concisely tell your reader what are the most important trends summarized by each of your tables and graphs. Written results should not only refer to graphs and tables, but also describe the trends you believe important. For example, "there was a 75% decrease in dissolved oxygen with depth, with the greatest rate of decline occurring between 3 and 5 meters". You must be specific in order to convince your reader of your conclusions. Results of statistical tests are often summarized in written statements.

**DISCUSSION:** In the Discussion, you will describe how the reported results support your final conclusion. Remember, a hypothesis is only a possible explanation and that your conclusion may be to reject or not to reject a given hypotheses. Failure to reject the null hypothesis does not mean the experiment has failed. The entire purpose of a scientific experiment is to investigate an unknown phenomenon and regardless of the outcome, science is advanced. You should consider whether the experimental design adequately tests the hypothesis. If the experimental design is sound, then you can be confident about conclusions you make from the data.

As part of the discussion, write a few paragraphs that address the following questions:

Does the data support the null hypothesis or the alternative hypothesis?

If the null hypothesis is rejected, what may have caused the differences observed (i.e. why did you initially predict the independent variable would have an effect on the dependent variable in your original alternative hypothesis)?

If the null hypothesis is not rejected, why might this be (discuss other possible alternative explanations, experimental design flaws, or incorrect assumptions)?

How confident are you about your conclusions? How might you further test these explanations?

Don't be afraid to speculate in this section (but make sure it is clear to the reader what is speculation and what is not). No single scientific study is definitive. Thoughtful speculation is a key ingredient in the scientific process!

**LITERATURE CITED:** A full citation of all literature referred to in the paper must be included at the end of your paper. While exact format varies, most are similar to this format:

Hairston, N.G. and E. J. Olds. 1984. Population differences in the timing of diapause: adaptation in a spatially heterogeneous environment. *Oecologia*, 61:42-48.

