
CHAPTER 4: RESEARCH PROPOSAL GUIDELINES

A primary objective of introductory biology labs is to introduce you to, or enrich your understanding of, the scientific method. At various times throughout the semester, you will be testing hypotheses by conducting experiments or studies of your own design. These exercises give you a chance to be creative. At the same time, they require some advanced planning on your part. Prior to conducting your own study, therefore, you will be required to turn in a **research proposal** that justifies and describes your proposed research. This writing exercise helps you “think through” your experiment, and the proposal itself can be useful when writing your final lab report because you will have already begun writing some sections that will be included in your final report. The guidelines provided here are to help you prepare a research proposal. *Note that while these guidelines are to be used for Biology 131/132 proposals, the format for upper level Biology courses may vary slightly, according to preferences of individual professors. Thus, it is recommended that you consult your professor for the appropriate proposal format for that upper level course.*

This chapter is presented in three sections, Proposal Format for Biology 131, Proposal Format for Biology 132, and a Sample Proposal. The Proposal Format is presented twice in order to convey inherent differences between field studies and lab studies; the first presentation is with Biology 131 examples, and the second with Biology 132 examples

Research Proposal Guidelines: 131 Perspective

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PROPOSAL FORMAT

- All sections in your proposal, outlined below, should be identified with corresponding headings.
- Use FUTURE TENSE consistently throughout the text when referring to your proposed research, as you are writing about activities that you will conduct in the future. *Note that this is in contrast to your lab report, in which you will use the PAST tense, because your research will be complete when you write the formal report.*

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- If you are working in a group, use first person plural (we), otherwise use first person singular (I). E.g. We/I will count the number of flowers produced at the end of an eight week growing period. The passive voice may also be used. E.g. The number of flowers produced will be counted at the end of an eight week growing period.
 - All text within your proposal, including the methods, should be written in concise, but complete, sentences and organized into paragraphs.
 - When providing the scientific name of a plant or animal for the first time, remember to use upper case (capitalize) the first letter of the genus (the species remains in lower case), and either underline or *italicize* both the genus and species. After the first citation, you may simply refer to the common name, or the abbreviated scientific name. For example, “We propose to examine floral structures of cardinal flowers (*Lobelia cardinalis*)”. Thereafter you can just refer to the organism as the cardinal flower, or as *L. cardinalis*.
 - Number each page and staple or paper clip the pages together, before you hand your proposal. Check with your instructor on their policy/preferences for line spacing and printing on the blank side of used paper.
 - Refer to the Sample Research Proposal for an example that demonstrates the desired format, writing style, and approximate text length.
 - The format for research proposals outlined in the Student Survival Guide will not be used in this course. Instead, follow the formatting we provide to you.

PROPOSAL CONTENT

The proposal does not have to be long, but it should be complete, and include all of the following components: Title, Introduction, Hypotheses, Variables, Methods, Expected Results, Literature Cited, Data Record Sheet.

Title The title should be brief but specific. For example: Flower production in full sunlight- and shade-grown sunflowers (*Helianthus* spp.) You should not include the title as a separate page (save the trees!), but it should head the first page of your proposal. Also include your name, date and pledge on the proposal.

Introduction For our purposes, a short paragraph (5 – 10 sentences) that provides a theoretical context for the proposed research will suffice. This will include background information to justify your hypotheses and proposed methods, such as what is currently known about the topic. For example, you might cite a textbook that discusses why sunlight is important for the production of non-photosynthesizing plant organs such as flowers, or a study showing that

sunflowers require more exposure to sunlight than shade-tolerant bluebells (*Mertensia* spp) for growth and development.

Hypotheses Hypotheses are possible explanations for observed phenomena. In your proposal, you will state both a **null (H_0)** and **alternate (H_A)** hypothesis. (Note that in formal lab reports, it is customary to state only H_A). H_0 is the hypothesis of “no difference”, while H_A predicts that there will be a difference or association within the data.

For example, in our sunflower experiment, we want to investigate whether flower production is enhanced by exposure to sunlight. In this case, the hypotheses might be stated as:

H_0 : Sunflowers grown in full sun produce flowers of equal number as those grown in shade. Another way to say this might be "Light level has no effect on flower production in sunflowers (*Helianthus* spp.)."

H_A : Sunflowers grown in full sun produce more flowers than those grown in shade.

One cannot “prove” H_A , but data can be gathered and analyzed in an attempt to disprove, or test, H_0 . If our experiment yields data that give us sufficient reason to reject H_0 , then we accept H_A . For example, suppose we grow 10 potted sunflowers in full sun and 10 potted sunflowers in shade, while keeping all other factors (e.g. sunflower variety, soil moisture or fertility) the same. If, after statistical analysis, we find that the mean number of flowers produced per plant is significantly higher for sunflowers grown in full sun than those grown in shade, then we could reject H_0 in favor of H_A and conclude that sunlight enhances flower production in sunflowers. Conversely, if we found that there was no difference in mean flower production between sun- and shade-grown plants, we would *fail to reject* H_0 . This does not mean that we are disproving H_A , only that we do not have the data to reject H_0 .

NOTE: While you will always be testing H_0 statistically, your proposed hypothesis (and the one that you will write about in your final lab report) is really H_A .

Variables A *variable* is a characteristic that may differ from one entity to another. In our experiments, we will be testing the effect of an **independent** variable X on **dependent** variable Y. Technically speaking, the magnitude of the dependent variable (Y) is assumed to be a function of, or affected by, the independent variable (X). For this reason, the dependent variable is also referred to as the **response** variable.

In the sunflower example, the dependent variable is flower production (mean number of flowers produced per plant) and the independent variable is light