Activity # 9. Designing, Conducting and Reporting Your Own Experiment.

Learning Goals:
To complete the background research for your Team Investigation
To design and carry out your own Biology experiment
To use the principles of good experimental design
To understand the format and timetable for your Team Investigation Proposal, lab experiment, and individual Team Investigation Lab Report

Background:
In the real world, scientists must write grant proposals to secure funding for the experiments they want to conduct. A research proposal must state clearly the hypothesis to be tested, and must make the case that the experiment is important and represents the next logical step to build upon previously published work. The proposal also describes the proper experimental design at the big-picture level and at the level of specific reagents or manipulations to be used. The proposal also contains a detailed list of all the literature references necessary to support the experiment. Usually a single scientist does not have all of the necessary expertise or infinite time to do the work, so most science is done working in teams. For your Team Investigation, your research group will prepare an abbreviated version of a grant proposal. (See specific Guidelines for Proposal Format below).

Once a scientist is successful with her grant application, she must hire the needed personnel, order and prepare the supplies, conduct the experiment, document the process and the results, and write a final report or journal article to share the results with others. For your Team Investigation, you will have one lab period to conduct the wet-lab portion of the work. It is your group's responsibility to make sure that all necessary reagents are ordered and prepared ahead of time, with the help of your Professor. Then each member of the group will prepare his/her own Team Investigation Lab Report, modeled on actual scientific journal articles. You may work together to prepare data figures, but each team member should write his/her own text (See specific Guidelines for Final Report below).

Choosing a Topic for Research:
During this semester, we have conducted experiments and investigations of Molecular Structure and Function, Cell Structure, Enzyme Activity, Information Databases, Biotechnology, Mitosis & Meiosis, and Human Genetics. Now, you will put the Scientific Method into action as you follow up on one of the earlier experiments to extend your findings. You may work individually or in groups of up to three students. You will begin by choosing a particular topic from this semester, and researching the topic in the library and/or computer labs to gather background information. Using this new information and the skills and concepts you learned while performing the original experiment, you must write a proposal describing the experiment you plan to do. Be creative!

Some possible studies include

- Molecular structure--3-D analysis of different proteins using Chime software. Differences between diseased and normal versions of a protein.
- Microscopy--Examining structures present in different types of cells – different types of staining techniques, different kinds of microscopy.
- Microbiology--Investigating bacterial populations/densities in various locations
- Phosphatase--Investigating acid phosphatase activity at different pH, temperature, in the presence of competitive or non-competitive inhibitors
- Bioinformatics--Identification of genes in DNA sequences
- Mr. Green Genes--Analyzing pGLO with different restriction enzymes
- Biotechnology--Comparison of different DNA isolation methods, isolation from different strains of *E.coli*
- Your own original idea!

Guidelines for Proposal Format :

Submit the Proposal, 1 per student, with project title and the names of all group members in the Header at the top of the page.

READ these instructions and FOLLOW them. When you think your proposal draft is complete, go back through these instructions again to make sure your document complies with the instructions.

Remember that you need to read the full text of the scientific article (usually accessed as a .pdf file), NOT just the abstract that PubMed or Medline may give you. If you are unsure about the difference between an abstract and the full text of the article, review the information in your lab exercise on Finding Scientific Literature, and/or come ask your Professor.

Your proposal should include the following sections (all of them should be clearly labeled in bold followed by a blank line, as shown below). If necessary, you might add additional sections within each of the main sections. Have no fear about putting in too much effort, this text will also be used in your lab report! The more work you do now, the less you will have to do at the end of the semester. If you do a good job on your proposal, you should just have to fill in the results and discussion to complete your Final Report!

Title

The title should precisely state the subject of the research. The title is very important to capture the interest of the grant application reader. Avoid vague phrases like "Studies of" or "Investigation of". Even if your research is confined to one system or organism, a title that also makes a general statement about the issue to be studied is excellent.

Introduction

The introduction should include a general statement of the subject of study, placed in the perspective of our current knowledge of the field. It should immediately flow into the literature review, which should elaborate on what is known and what is not known on the topic of interest.

The sources of important information should be given proper attribution: for example, after a sentence that contains information taken from a journal article by Smith et al. that was published in 2006, you should conclude with (Smith et al. 2006). Note that the citation occurs at the end of the sentence but before the sentence's final punctuation.

The literature review should lead to the specific issue or issues that need further investigation. Now is the time to state clearly why it is important to conduct additional research. The introduction should continue with a clear statement of the overall objectives or goals of the proposed project. It is very important that your proposal is feasible.

Research Hypothesis

The research hypothesis should be stated explicitly in a separate section. If you have more than one hypothesis you should state them sequentially. Remember that a good hypothesis is testable and makes predictions.

Methods

The methodology you will use to test your hypotheses should be stated explicitly and in enough detail that the reader could follow the instructions to conduct the experiment her or himself. First give an overall summary of your methodological approach. Then move to the specifics.

- Describe the experiment. Be sure to identify your independent and dependent variables, as well as your Positive and Negative Controls. You should also state your Null (H_0) and Alternate Hypotheses (H_A)

- Describe what materials and supplies will be needed – test tubes, pipettors, tips, spectrophotometer, electrophoresis apparatus, microscope, etc.

References

At least 1 primary and 1 secondary source/person, include your text and lab manual

To help you learn proper citation formatting, go to the Lycoming College library website Online Tutorial page and complete the Citation Tutorial using the Intro Bio style.

List all of the references cited in the text at the end of your proposal, in alphabetical order by the last name of the first author. Use this format:

- Author1 AA, Author2 BB. (Year). "Title of research article". *Journal*. Vol. #:pages.
- Author1 AA, Author2 BB. (Year). "Title of chapter" in *Title of Book* Editor1 AA, Editor2 BB, eds. Publisher, City. p. x-xx.
- Author1 AA, Author2 BB. (Year). "Title of Web Page" *URL (web address*). Date Accessed. Statement of authority (describe why you think this website should have valid information).
- Morrison ME and Newman J. (2013). "Bio 110 Laboratory Manual Activity #6 Mr. Green Genes". Lycoming College, Williamsport, PA. p. x-xx.

Here are some formatted examples taken from the Lycoming College Library Citation Tutorial for Intro Bio format:

For a journal article:

- Irvin N, Hoddle MS, O'Brochta DA, Carey B, Atkinson PW. (2004). "Assessing fitness costs for transgenic Aedes aegypti expressing the GFP marker and transposase genes". *Proceedings of the National Academy of Sciences of the United States of America*. Vol. 101:203-211.

For a book:

- Fisher L. (2008). "Trapped in the Matrix" in *Rock, Paper, Scissors: Game Theory in Everyday Life* Smith J, ed. Basic Books, New York City, p. 48-59.

For a web page:

- Williams JA. (2002). "Cell Biology" *The Biology Project (http://www.biology.arizona.edu/CELL_BIO/cell-bio.html*). November 18, 2008. This is a good Web site because it was developed by the biology department of the University of Arizona.

A note about web sites: Most web sites represent the personal opinion of the owner. Only web sites with peer-reviewed content will be allowed as references for the Team Investigation (e.g. OMIM entries, information from the Centers for Disease Control web site, etc.). Wikipedia entries DO NOT COUNT, as anyone can enter inaccurate information and it will be posted.

If you have a question about the validity of a web site, come talk with your Professor about it—BEFORE the Proposal deadline!

A note about plagiarism:

To detect plagiarism, all Proposals will be scanned using turnitin.com. If you have a question about the proper way to attribute information, come ask your Professor BEFORE the Proposal deadline. All instances of plagiarism will be reported to the Provost and Dean of the College, and may result in failure of the assignment, failure of the course, and/or suspension from Lycoming College.

A note about getting help in planning your Team Investigation:

Do not assume that the Professor will be available on short notice. Remember that there are numerous other groups also planning projects who need to meet with your Professor. Plan ahead and come to office hours or ask for appointments with your whole group early!

Guidelines for Team Investigation Lab Report Format:

Note that the format for the Lab Report is not exactly the same as the format for the Proposal. Make sure you're following the correct format for your final report!

Send your single Word file to your Professor via email no later than your lab day during Week 15. **The name of the file should follow this format:**

LastnameFirstnameTIReport.docx
For example: MorrisonMaryTIReport.docx

Each member of the group will prepare his/her own Lab Report. You may prepare your data figures working together, and you may discuss the general concepts for your text with each other, but the text of the report should be composed by each individual. **DO NOT exchange word processor files** unless you want to open yourself up to plagiarism charges. If your groupmates steal your text for their reports, you will still have to be brought in to the investigation during Finals week, so protect yourself from the beginning and **do not send your draft files to any other member of your group**.

Place the title of the experiment and your name in the Header at the top of each page. If you have done your homework and prepared a strong Proposal, you will be able to cut and paste many of its sections into your Lab Report.

Pay close attention to the correct tense for each section.

Title

The title should precisely state the subject of the research. The title is very important to capture the interest of the grant application reader. Avoid vague phrases like "Studies of" or "Investigation of". Even if your research is confined to one system or organism, a title that also makes a general statement about the issue to be studied is excellent.

Introduction (present tense) **(**worth 25 points)

The introduction should include a general statement of the subject of study, placed in the perspective of our current knowledge of the field. It should immediately flow into the literature review, which should elaborate on what is known and what is not known on the topic of interest. You should incorporate information from all of the literature from your entire group here, not just the articles you personally located. Remember that your textbook, lab manual, and lecture notes are reliable sources of information.

The sources of important information should be given proper attribution: for example, after a sentence that contains information taken from a journal article by Smith et al. that was published in 2006, you should conclude with (Smith et al. 2006).

The literature review should lead to the specific issue or issues that need further investigation. Now is the time to state clearly why it is important to conduct additional research. The introduction should continue with a clear statement of the overall objectives or goals of the proposed project. It is very important that your proposal is feasible.

The research hypothesis or question being asked should be stated explicitly in the introduction. If you have more than one hypothesis or question you should state them sequentially. The general format of this statement is "Our hypothesis is that …. To test this, we …."

Conclude with an overall summary (a few sentences) of your methodological approach.

Methods (past tense) (worth 20 points)

Describe exactly what you did (past tense) in enough detail that the reader could follow the instructions to conduct the experiment her or himself.

Write in full English sentences, not 1. 2. 3. "lab manual-ese."

Be sure to indicate what your independent and dependent variables are, as well as your Positive and Negative Controls. You should also state your Null (H_0) and Alternate Hypotheses (H_A) (predictions).

Results (past tense) (worth 25 points)

Describe your observations in full English sentences.

Organize data in tables and graphs where appropriate, and number sequentially in order of appearance within your text.

All Figures should have descriptive legends beneath them (e.g. Figure 1. The structure of the GFP protein.). All Tables should have titles at their tops, with any necessary details spelled out using superscripts within the table and explanations located beneath the table.

When you refer to a Figure or Table in your text, either identify it at the beginning of the sentence or place its identity in parentheses at the end of the sentence.

Stick to the data in the Results section, do not present arguments about it or putative explanations/interpretations for it—that material belongs in the Discussion.

When pasting images in to your Word document, make sure to use the appropriate resolution. Most printers can only distinguish about 150 dpi (dots per inch),

so using any higher resolution is a waste of memory that will make your document unnecessarily large. Review the image handling tips in the Mr. Green Genes lab, then come to your Professor if you still have questions about how to insert your images.

Discussion (past and present tense) (worth 25 points)

Describe the conclusions, significance, and implications of your experiment. What did you learn? Did your results support your hypothesis? Did everything go as planned? What other follow up experiments could be done?

Refer to specific Figures and Tables where appropriate to help your reader follow your line of thought.

Relate your findings back to the information in your Introduction to put them into context.

References (worth 5 points)

(at least 1 primary and 1 secondary source per person, include your text and lab manual—so a 3-person group would have AT LEAST 3 primary sources, 3 secondary sources, the lab manual, and the textbook in its reference section) (include ALL references used by your whole group)

- Author1 AA, Author2 BB. (Year). "Title of research article". *Journal*. Vol. #:pages.
- Author1 AA, Author2 BB. (Year). "Title of chapter" in *Title of Book* Editor1 AA, Editor2 BB, eds. Publisher, City. p. x-xx.
- Author1 AA, Author2 BB. (Year). "Title of Web Page" *URL (web address*). Date Accessed. Statement of authority (describe why you think this website should have valid information).
- Morrison ME and Newman J. (2013). "Bio 110 Laboratory Manual Activity #6 Mr. Green Genes". Lycoming College, Williamsport, PA. p. x-xx.

Submitting your Lab Report

Before you submit your lab report for grading, go back through the instructions and check off each point, making sure that your report conforms to the guidelines.

Send your single Word file to your Professor via email no later than your lab day during Week 15. **The name of the file should follow this format:**

LastnameFirstnameTIReport.docx

All lab reports will be scanned to detect plagiarism using turnitin.com. See Proposal Guidelines above about plagiarism.