HONORS BIOLOGY RESEARCH PROPOSAL GUIDELINES
(DUE MONDAY, NOVEMBER 10th, 2014)

BACKGROUND INFORMATION

Practicing scientists conduct actual research studies to add knowledge to the existing knowledge base. This is possibly the most difficult aspect of science, yet probably the most rewarding. One way of approaching the quest for knowledge is through the use of the “scientific method.” Although there is no strict list of steps that all scientists follow when performing a scientific investigation, there are some very important components including observations, questions or problem statements, hypotheses, tests or experiments, analyses of the data, interpretations of the data, and conclusions.

For the first part of your research, you will be required to develop a proposal for your topic of research and design an experiment that you can realistically conduct on your own. It is intended that this experiment be of no significant cost to you, so be sure you pick a topic that is realistic and feasible. In the spring semester, you will be performing the actual experiment and completing the rest of the research report. For the research proposal, you will basically be writing the first half of your research report.

Your proposal will include a title, by-line, introduction, problem statement, hypothesis, prediction, a description of the material and methods for conducting your experiment, and a references page. Each of these sections is described in more detail below.

REQUIRED SECTIONS

Title
By-Line
Introduction
Problem Statement
Hypothesis
Prediction
Materials List
Procedures/Measurements
Experimental Variables
References

TITLE

The title is a brief phrase that conveys the contents of the research. This will include the dependent and independent variables of your research. Often, the name of the study organism is also included in the title. The title should be bold-faced and centered.

Example:

“The Effect of Diazinon on the Capacity of Nitrifying Bacteria to Convert Ammonia into Nitrate”

BY-LINE

The by-line is a section that contains the author’s name (you), and the name and address of the research institution with which the researcher is affiliated (Blue Valley Northwest High School, 13260 Switzer, Overland Park, KS  66213). Like the title, the by-line should also be bold-faced and centered. The title and by-line will be the only items on the cover page of your proposal.

Example:

Jeremy Mohn
Blue Valley Northwest High School
13260 Switzer
Overland Park, KS  66213
INTRODUCTION

An introduction is crucial for understanding what other scientists have already learned in relation to your topic. During your exploration of current research, you will find an aspect of the topic that has no information...a question with no answer. When you find this, you have found a possible research topic! It is recommended that you start your search for a topic by simply browsing through current science-related periodicals such as OMNI, Discover, Scientific American, Science, and Natural History. These publications will give you a “feel” for various areas that could be looked into further. Pay attention to small articles about new findings that may cause you to ask yourself, “What do I still not know about this topic?” Other good sources of information are the Library Media Center, Biology Digest Indexes, Newsbank for Periodicals, and professional libraries on college campuses, hospitals, or medical centers. Read, read, read! The most difficult part of this entire project is finding a topic!

As you accumulate resources, make sure you have the complete bibliographic information for each of them. The introduction consists of a summary of the current research related to your topic. It helps the reader understand your investigation. As you write your introduction, make sure that thoughts, ideas, and findings that were not originally yours are appropriately cited. (See the section entitled “REFERENCES” below.)

PROBLEM STATEMENT

The problem statement formally, yet briefly, states why the experiment you are doing is worthwhile. This section of your proposal should guide the reader through the process you experienced as you developed your idea. Often included in the problem statement is a short, one-paragraph summary of the current research described in your introduction. Typically, a problem statement is not over one page in length and rarely consists of more than 3 paragraphs. You should not cite specific sources in the problem statement.

Think of this section as a quick summary of the more detailed information included in your introduction. Someone familiar with your topic should be able to skip your introduction and still understand the basis for your experiment by reading your problem statement. The problem statement should end with a question that is the focus of your experiment.

Example:

“Agricultural use of chemicals to fertilize crops and control plant and animal pests has steadily increased over three decades. As these potentially pollute streams and lakes, scientists are becoming increasingly concerned about the effects of these chemicals on the biological processes that make aquatic life possible. Of specific concern is the potential effect of pesticides in waterways. These chemicals, which are used to control weeds that invade cropland, may have the ability to decrease the capacity of nitrifying bacteria. These bacteria prevent stagnation of water by converting ammonia to nitrate, a compound that can be used by aquatic plants to synthesize protein structures.

Researchers have determined that pesticides do have a negative impact on aquatic plants and animals. However, little is known about the influence pesticides may have on the microbiological (bacterial) processes that allow water to remain suitable for plants and animals. Is it possible that the presence of a pesticide (Diazinon) in an aquatic environment may reduce the capacity of bacteria to convert ammonia to nitrate?”

HYPOTHESIS

The hypothesis is a suggested answer to your research question. It may help to think of your hypothesis as your “best guess” answer to the question you posed at the end of your problem statement.

Example:

“Diazinon will reduce the nitrification rate of nitrifying bacteria in an aquatic system.”
PREDICTION

After forming your hypothesis, use it to make a prediction concerning the results of your experiment. Your prediction should be written in the “If...then...” format: IF (restate your hypothesis) THEN (state the results you expect to observe). A good prediction describes the specific outcomes you expect to observe and how you will ultimately determine if your hypothesis is correct.

Example:

“If the presence of the pesticide Diazinon has a deleterious effect on the ability of nitrifying bacteria to convert ammonia to nitrate in an aquatic system, THEN the rate of nitrification, as measured by the presence of nitrate in the water, will be significantly lower in systems exposed to Diazinon, as compared to unexposed systems.”

All parts of the remaining sections should be extremely detailed, so that another scientist could replicate your experiment exactly.

MATERIALS LIST

The materials list should include a complete list of the equipment and supplies you will use for the experiment, including the specific quantities of each. Your materials list should be presented in either alphabetical order or in the sequence the items will be used.

PROCEDURES/MEASUREMENTS

Describe the exact steps needed to conduct the experiment. Each step should be numbered and in sequence. Explain what you are going to do, when you will do it, and why you are doing it (when necessary). Be sure that you also explain how you are going to measure your results (volume, mass, length, time, temperature, color change, etc.).

EXPERIMENTAL VARIABLES

In this section, you will list your independent, dependent, and controlled variables. The independent variable is what you change between the two groups in your experiment. The dependent variable is what you plan to measure. The controlled variables are what you intentionally kept the same between the two groups in your experiment. Avoid ending your list of controlled variables with “etc.” Just list all of the controls you notice that could possibly affect your results.

As you design your experiment, remember that a controlled experiment can only test one independent variable. Therefore, you should plan to set up two groups—a control group and an experimental group—with only one difference between them (your independent variable).

Example:

“The independent variable is the presence of Diazinon in the aquatic environment.

The dependent variable is the rate of nitrification (obtained by measuring the presence of nitrate in the water over time).

The controlled variables include the temperature of the water, the salinity of the water, the type of aquariums used, the quantity of water in each aquarium, the type of light used, the amount of nitrifying bacteria originally present in the experimental and control aquariums, and the number and type of macroscopic organisms (fish and snails) originally present in the experimental and control aquariums.”
REFERENCES

WHEN ARE REFERENCES NEEDED?

You will need to cite references in the introduction section of your research proposal. Any time you directly copy paragraphs, sentences, or even parts of sentences, you should cite the original source. You also need to cite any thoughts, ideas, and research findings that are not your own.

You will include a “REFERENCES” page as a separate page at the end of your proposal. Throughout your introduction, each citation must be linked to a specific entry in the list of references on your reference page. The essential elements of an in-text citation are the author’s last name (or the document’s title, if no author is identified) and the date of publication.

Example:

“According to earlier research, the level of Diazinon in suburban aquatic ecosystems can reach levels as high as 250 ppm (Jones, 1999).”

FORMAT FOR REFERENCE PAGE

Put the word “REFERENCES” in bold at the top center of the page. The list of references should be arranged in alphabetical order by author’s last name and/or titles. Each entry is single-spaced and an extra space is added between entries. Also, notice that the second and third lines of each entry are indented 5 spaces.

FORMAT FOR REFERENCES

Journal or Magazine Article


Article from an Internet Database


Book


Book Article or Chapter


Encyclopedia Article


Website

GENERAL FORMATTING GUIDELINES

DOCUMENT FORMAT

The first page of your proposal should contain the title and by-line. The introduction begins on its own page and is followed immediately by the problem statement, hypothesis/prediction, experiment, etc. These sections should all begin with a labeled heading that is CAPITALIZED, bold-faced, and “centered” prior to the contents of that particular section. The entire proposal should be double-spaced, 12 pt font, with 1-inch margins.

LANGUAGE AND STYLE

Science writing is extremely formal in language and style. Because of this, it is usually considered boring by the general public. However, this style does successfully achieve the goal of communicating very detailed information and knowledge in a direct and unambiguous manner. Furthermore, this style of writing is important to learn for any person having scientific aspirations.

Science research is written using “passive voice” as opposed to “active voice.” In passive voice, the author of the text is abstracted from the writing. The text is not written in first, second, or third person (No “I,” “we,” or “you.”). If you must refer to yourself, use the phrase “the researcher” in place of “I” or “me.”

Example:

“To ensure consistency between the two groups in this controlled experiment, the researcher will obtain water from a local stream to fill both the experimental and control aquariums.”

“Research is to see what everybody else has seen, and to think what nobody else has thought.”

Albert Szent-Gyorgi

“The best way to have a good idea is to have lots of ideas.”

Linus Pauling

“If we knew what it was we were doing, it would not be called research, would it?”

Albert Einstein