

## **The Junior I.S. Paper**

For students working with Laura Sirot

The purpose of Junior IS is to prepare you in every possible way to successfully complete your Senior IS project. Central among these tasks in Junior IS is to write the IS Proposal, which will be the guiding plan for you as you undertake your research. This document is intended to provide guidelines for you as you prepare your IS Proposal.

### **This semester, you have four specific goals to accomplish for your Junior I.S.:**

1. You need to identify a topic of interest, and, eventually, a research question within that topic that will guide your IS research.
2. Conduct an exhaustive search of the literature on a topic that is of interest to you, and write a thorough but focused review on the topic.
3. Design a rigorous study within the framework of your topic (that can be feasibly completed either this summer or next fall/spring.)
4. Write a detailed and well-documented proposal on your intended study.

The entire package – literature review, statement of research question, and research proposal – will be the end point of your semester’s work: the Junior IS paper.

We will work one-on-one and in small groups this semester to accomplish these goals. We’ll use weekly meetings to brainstorm ideas, discuss relevant literature, check your progress, and work on writing skills.

My role, as your Junior IS advisor, is to help you along this path. Discerning and defining your IS topic is a real adventure! It will require thought, hard work, and insight on your part. But it will also equip you to start on your IS research, and provide you with the guidelines and the tools to underpin an effective and well-done IS project.

To accomplish this in the time available will require that you be well-organized, self-directed, and that you communicate with me well. To that end, you should begin your Jr IS by outlining a timetable which you will use to measure your own progress toward the final Jr IS paper. At the end of this document is a week-by-week outline of the semester ahead. You should spend some time in the next week thinking about the process ahead. At our meeting next week, I want you to bring in a copy of this timetable, to which you have added your own goals and marker points for the semester ahead. I will then expect that you will meet those self-designed deadlines in the course of the semester.

The paper you will ultimately produce will include the following components:

### **Part I. Literature survey.**

The goal in your literature survey is to become a reasonable authority on the area of biology within which your project falls. You search the literature to learn what is known, where the controversies lie, and how your topic interrelates with other subjects in ecology or evolutionary biology. In addition, you want to be able to use the results of similar or related studies in planning your project and interpreting your results. It is important that you understand the basic questions within the conceptual field where you are working, so you can put your research into a larger context. You will also need to know as much as possible about the basic biology of your organism(s); how to raise them, sample them, or otherwise manipulate them. Your literature search will take two tacks (at least): to search on the subject of the study and on the possible study species. But do not expect to find papers that exactly match your proposed research plan. Be very alert for analogous studies, work asking similar questions but on different species. These provide some of the best insights into refining your questions and improving your project design.

You should use current literature as a springboard into your topic. Do not simply rely on a computer search to locate information. Ask me for suggestions (I can often direct you to at least one starting paper), or look for review articles. A good review article will go a long way toward setting up your basic understanding of the subject.

The organization of your literature survey should be in the form of an inverted triangle; you begin large, and focus down in steps to reach the topic of your actual research project. In doing so, you will be making an ARGUMENT; you will be drawing together resources which set the stage, and which lead to the conclusion that the most obvious NEXT question is the one you are about to ask in your I.S. So you will need to synthesize, to marshal arguments, and to lead your reader along the logical pathway that results in your study project. You want to set the context, first; why is information about (xxxx) of interest? What questions remain unanswered, and why do we want to answer them? How is the field you are working in subdivided, conceptually, and what particular branch are you following? What do we know, and what are the gaps? What methods have been employed, and what are their virtues and weaknesses? And finally, what do we NEED to ask? What methods need to be used? The result --- YOUR I.S. project is born!

Your literature survey should include all of the necessary information a reader would need to know to understand the rationale for your study.

Below, I list what I consider to be the three important components of a good review. Please note that you do not need to label these sections "introduction", "conclusion", etc. But, I do highly recommend that you use topic subheadings to organize your writing (see below).

1. **Introduction:** This will be a short overview of your literature review—generally, a paragraph is sufficient. Start general and then focus in on the specific topic you'll address by the end of the first paragraph. Towards the end of the introduction, it is a good idea to lay out the path the rest of the paper will follow (that is, indicate to your reader what you will cover.)
2. **Body of the review:** Here, you will begin to provide necessary background for any biologist to understand your study. You will also begin laying the framework for your study (What have previous researchers discovered on this topic? What are some of the major hypotheses, theories, and conclusions on this topic? What are some of the remaining questions to be answered?) Go through examples from the literature, using appropriate citation style. Be sure to organize this section logically and use subheadings that help the reader follow you easily. The information you provide should flow from broad information to specifics of your study, and I recommend only beginning to write this section *after* you have constructed a logical and satisfying outline. I cannot stress the importance of this enough!
3. **Conclusion:** The final paragraph (maybe two) of your review should be specific to the project you plan to conduct. Here, you should provide a brief overview of your problem, relate to your reader why this topic is of interest, and then give a (very) brief explanation of *how* you will explore this question. (This doesn't need to be a long explanation of what's to come in your proposal. But, it should at least include the type of experimental manipulation you will use. (E.g., "I will use simulated territorial intrusions to explore whether male house sparrows modulate progesterone secretion in relation to aggressive behavior.") Your last sentence or two should contain your hypotheses/predictions.

One indicator of the sophistication with which you understand your area of research is how you organize your literature review section. You should avoid, whenever possible, a paper-by-paper approach in which you say: "Johnson (1996) said ..... (one paragraph)." (new paragraph) "Miller (2003) said....." Rather, you should reprocess your reading and organize the various papers conceptually. For example:

"Root growth is often slowed in cold soils (Johnson, 1986; Miller, 1993) or in soils which are exceptionally acidic (Harold and Cohn, 2001). In her study of tundra shrubs, Gustafson (2004) showed that nutrient status is also important in root growth, and that nutrient levels interact strongly with soil temperature, especially at temperatures over 10° C."

You will note that the relevant parts of several papers are pulled together here. Any or all of these papers are likely to be cited not only in this paragraph, but throughout the literature survey section, wherever the authors have data relevant to the idea under consideration. This is a hard skill to master, but to have done so indicates that you understand your area, conceptually, and have really mastered the literature under consideration. For examples of introduction/literature reviews of this sort, take a look at papers in *Advances in the Study of Behavior* or *Trends in Ecology and Evolution*.

At the end of the literature survey, you should have progressively developed a discussion which focuses inexorably on the final question(s) which you are about to describe as your I.S. By that point, your discussion and argument should be so compelling that your reader (me) jumps instantly to the conclusion that YOUR RESEARCH is absolutely the next, most logical step in the march of scientific progress. If you have led your reader to that point, you have accomplished your first task.

Some final notes: First, when you read papers, it is important to take notes on them IN YOUR OWN WORDS. Resist at all costs the temptation to copy into your notebook the authors' absolutely felicitous words without putting them into quotation marks. If you are not fastidious about this, you are likely to end up plagiarizing (knowingly or unknowingly) another's work. You will look back at your notes as you write, and find this mellifluous phrase, and use it in your paper, and it will not be your own. Be VERY VERY careful. It is amazing how easy it is for me (or any other reader) to spot these. You must be able to restate your reading in your own words, although you will still cite the author for her/his ideas. But the key is in keeping your notes free of inadvertent plagiarism. The main defense against plagiarism – intentional or unintentional – is this: UNDERSTAND WHAT YOU READ. If you understand, then you are able to explain. You no longer need the words of your source; you are free to restate or alter, because you understand the concepts on your own terms.

Secondly, you should realize that the purpose of the literature survey is not to show me how many papers you found and read. I know how hard you are (or are not) working. The purpose is to create a narrative which supports and makes sense of your proposed research. There may be papers you send for, read, and never cite, or at least do not discuss at length. You should use only those papers that are important, relevant, and advance your argument.

## **Part 2: Proposal**

Here, you will discuss in detail the specific questions you will investigate in your research, and describe how that research will be carried out. This part may be divided into several sections. Typically, you would see:

1. **Experimental Design and Methods:** In this portion of the proposal, you will describe *in detail* the experiment(s) that you have designed. Depending on your topic, you may find it helpful to break this section up into subheadings as well. Note that you must include a section indicating what type of statistical analysis you will use to analyze your data—as you are probably learning in class, establishing your statistical design *before* you start a research project is essential (and will save you headaches later on).

2. **Outcomes and Interpretations.** This section should contain one entry for each possible outcome of the experiment, followed by a brief description of what you can conclude if this outcome were to occur (interpretation). An **outcome** is a summary of results (e.g., what results might you obtain?) You may use graphs if you wish, but you must also explain in words what the outcome might be. An **interpretation** is an explanation of the way in which those results address the question that the experiment was designed to answer. You should also include a statement of how probable you consider a particular outcome, and then provide evidence to support your assessment from the literature or from *a priori* reasoning. If warranted, you may also briefly suggest further tests that might resolve ambiguities or further corroborate the results.
3. **Caveats.** In this brief section, include a short description of any untested assumptions and/or identify any potential shortcomings of your study design. Though this may seem difficult to do, keep in mind that few experiments are perfect!
4. **Research Schedule:** This portion of your proposal is an important way to ground your project in reality: that is, given the time that you will have available to you, can you *really* get this project done? When will you do it? How will it fit in around your other obligations (e.g., summer jobs, classes, extracurricular activities)? Provide a rough (by week) outline of when you expect to get various components accomplished next year. Be realistic.
5. **Supply List and Budget:** What supplies will you require? Do we have them available here in the department, or will you need to purchase new supplies? Each of you will have a limited amount of money available to you from the Biology department's I.S. budget (\$400). Now is the time to determine whether or not you can conduct your project for that amount of money (or less), and whether or not you expect to also apply for Copeland funding to enhance your project. You may apply for Copeland funding in the Fall (or, in the spring if you are planning an expensive project during the summer).

You will want to be as detailed and as clear as possible. Picture yourself going out into the field (or into the lab) to study your Question. Imagine the clipboard or field book in your hand, the pencil poised. What will you write down? What notes will you take? What will you measure, how and why? And then, what will you do with the data to summarize it, to analyze it, and to apply it to your hypotheses? Will the data you are collecting in fact answer your question (this is not an easy thing to be sure of)? What kind of data are you taking? Nominal? Continuous? Is it parametric or non-parametric? Will you do a regression, and ANOVA, or a G-test? What results do you expect, based on the literature, and if you get them (or don't get them), what will it mean? Obviously, you don't know exactly what you will find. But you set up your sampling, or your experiments, to test some hypothesis. What data will support that hypothesis, and what outcomes will contradict it? You need not write this part of the paper in formal statistical (null hypothesis) language, but you need to understand what your data are, what they will tell you, and how to get them to talk.

One final caveat. There is no such thing as good writing in science. There is only good REwriting. You should expect to write more than one draft of your junior and senior I.S. documents. I am willing to read and critique text as you go along. However, please do not give me haphazard work, work which you know yourself to be less than your best. This will slow down the actual progress you are making with unnecessary turn-around times. Do your best, edit it, revise it yourself, and I can then help you to improve it. The end result should be a project which is sound, well-carried out, beautifully written up, and convincing - an I.S. you can be proud of!

Jan Pechenik's "A Short Guide To Writing About Biology" should be your handbook for the Junior I.S. paper. This book covers all aspects of preparing a paper like this, so to answer questions about approach, literature citations, and the like,

consult this book first. The Junior I.S. paper should be formatted like a research proposal, with one exception: it will contain a free-standing Literature Review section that would not be part of a normal grant proposal. Within this context, *you are free to organize the paper into subsections or other divisions* that make sense to you, and that help to organize your thoughts appropriately. The final document should be double-spaced, 12-point type, and printed on both sides of each page.

**Length:** In the range of 20-25 pages plus or minus a few pages.

## **APPENDIX A: ADDITIONAL GUIDELINES FOR JUNIOR I. S.**

Over the years there have been a number of problems that have arisen with student I. S. projects that we hope to avoid. These problems generally have to do with things that the students may feel are beyond their control. Often times these messy situations can be avoided if one assumes the worst and prepares for it ahead of time. As such, we have put down some guidelines concerning research projects that should help you approach your project in an organized and realistic fashion.

### **1. CONCERNING RESEARCH PROJECTS THAT USE ANIMALS.**

These projects can be very exciting but they do require a lot of paper work before you can begin. You want to avoid having your I. S. turning into a Kafka nightmare (if it does, you may consider submitting your observations as an English I. S.). Thus, you will have to fill out the necessary paper work before you turn in your final I. S. proposal. The final proposal must contain the paper work (complete but not necessarily approved) or it will be considered incomplete. This paperwork must be submitted to the Animal Care and Use Committee at the end of the spring semester so that your project can be approved (hopefully) at the earliest opportunity in the Fall. A copy of all necessary paperwork must be included with your submitted I. S.

### **2. WORK OFF-CAMPUS.**

If you desire to work with a scientist off-campus then you must arrange a meeting between that scientist and your advisor during the spring semester (of your Junior IS year and as early as possible). Talk to the individuals involved for what will constitute a meeting (it may be a phone call in some cases). This will hopefully avoid complications that may arise if an off-campus advisor should be unreliable.

Because planning and writing your Junior I.S. document entails juggling a number of different tasks, I advise you to set small, digestible goals for yourself—including outlines and drafts of the review and the proposal. Below I have inserted a calendar with some important steps already listed as deadlines. You should fill in the remaining blocks with smaller deadlines that you set for yourself. Once you have done this, I will hold you accountable for your chosen deadlines during the semester.

JUNIOR IS TIMETABLE  
Spring 2013

NAME: \_\_\_\_\_

February 11-17	
February 18-24	**Copy of this completed calendar with personal deadlines
Feb 25-Mar 3	
March 4-10	**Topic, rationale and general design for your project (1/2 – 1 pg summary)
March 11-24	<b>SPRING BREAK</b>
March 25-31	**Deadline to apply for Copeland funding for summer projects is <b>around now.</b> **Annotated bibliography
April 1-7	
April 8-14	
April 15-21	
April 22-28	
April 29- May 5	Final Junior IS paper due, Friday, May 3, 5:00 pm