Independent Project Syllabus
(Bio 188 - Special Studies in Biology)

In this course, you will conduct a research project from start to completion. Drawing on field experiences, readings, and lectures and more, you will pose a biological question that interests you and attempt to answer it. In the process, you will learn, or enhance your understanding, about how to do research. You will use the scientific method to answer a question. This entails doing observations (and possibly doing experiments), collecting data, analyzing data, presenting data and interpreting data, and making sense of your findings in the context of other work. As a result of doing your independent research project, you will learn about the world and may become enthralled with this endeavor. At the very least, you will understand better the potential and limitations of doing science. You will also further develop your ability to critically analyze and appreciate scientific findings.

evaluation and schedule

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Percentage</th>
<th>Due Date</th>
<th>Submission Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>project proposal</td>
<td>5%</td>
<td>day 34 (6:00 p.m.)</td>
<td>submit as “last name-prop.doc” e.g. “Smith-prop.doc.”</td>
</tr>
<tr>
<td>project write-up progress</td>
<td>5%</td>
<td>day 50 or day 55 (depends on which Peñas group you are in…)</td>
<td>get to your primary advisor</td>
</tr>
<tr>
<td>first submission (not a &quot;rough draft&quot;)</td>
<td>25%</td>
<td>day 64 (11:00 a.m.)</td>
<td>submit as “Last name-firstsub.doc” e.g. “Smith-firstsub.doc.”</td>
</tr>
<tr>
<td>peer review</td>
<td>5%</td>
<td>day 68 (11:00 a.m.)</td>
<td>get to author</td>
</tr>
<tr>
<td>final submission (electronic)</td>
<td>40%</td>
<td>day 73 (11:00 a.m.)</td>
<td>submit as “Last name-finalsub.doc” e.g. “Smith-finalsub.doc.”</td>
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<tr>
<td>symposium talk</td>
<td>10%</td>
<td>day 71 (8:30 a.m.)</td>
<td></td>
</tr>
<tr>
<td>scientific and logical rigor, originality, experimental design, completeness, effort expended</td>
<td>5%</td>
<td>determined at end of Program</td>
<td></td>
</tr>
<tr>
<td>voucher specimens and/or photographs labeled and submitted; chemical and bio waste dealt with correctly</td>
<td>2%</td>
<td>determined at end of Program</td>
<td></td>
</tr>
<tr>
<td>&quot;cooperation and clean-up&quot; (the extent to which you helped in general clean-up, cleaned and returned equipment, glassware, etc. that you used… etc.)</td>
<td>3%</td>
<td>determined at end of Program</td>
<td></td>
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Late policy. Because of past experience and because we are all on a tight schedule, we need to adhere to the above dates and times. If there are extenuating circumstances, we will gladly negotiate revised deadlines with you. Sometimes computer meltdown or power outages or illness requires that we move the deadlines. Nonetheless, for everyone’s benefit assume that the above deadlines are in force.

Note: class and excursion dates are subject to change.

Rev: 9/2014
Equipment, supplies, books and waste. You will be required to account for and return all program equipment and books that you have signed out and borrowed. Your advisor may set a time with you to return equipment day 63, 64 or 65. We will do a general clean-up day 73 at 1:00 p.m. Participation is mandatory. If you have equipment or waste at your homestay, you must deal with this before you return to the Station. If you go to homestay day 41, deal with your equipment, supplies and waste before day 55. If you go to homestay day 46, deal with your equipment, supplies and waste on or before day 60. Please retrieve everything that you placed into the field: flagging, traps, bags, and more… Normal wear-and-tear of equipment occurs when doing field biology. However, you should follow closely the advice and recommendations of bio-instructors with respect to care of equipment. If you mistreat things out of blatant negligence, and something gets stolen or broken, you will get billed for it. Please treat all things – living and non-living – with “tender, loving care.”

PLEASE NOTE: For all submissions – proposals, progress drafts, first submissions, final submissions – your documents must be submitted as Word documents (and as Excel documents, in some cases). If you work in Open Office documents, you must convert them to Word doc’s (and adjust them), before you submit them to bio-instructors.

Guidelines for Proposals

The purpose of a proposal is to state clearly the question(s) you wish to address and how you will answer it. Your proposal should include the following parts and be about 2-3 pages (double-spaced). The proposal and your papers should have page numbers.

INTRODUCTION Present a brief background for the project by stating what is known about the topic (A,B,C) and what is not known (D). Picture an inverted triangle as you go from the general to the specific. (Look at examples of proposals that we will post.) Cite relevant literature. Your study will discover this missing piece, fill the void or at least make progress toward this goal. The most critical element is that you state clearly your central question, which can be in the form of a question or hypothesis. The focus of your question should be sufficiently narrow and specific that you will be able to answer it in the time available.

NOTE: It is essential to do preliminary observations. To be accepted, a proposal must have preliminary observations and data. The proposal should inform and convince the reader that the question is interesting and do-able. Your preliminary observations will be critical for that purpose. You will also get a better idea if you can actually do the project that you propose and get a better idea if you enjoy the field work that your project will entail.

MATERIAL AND METHODS - State the general approach you will take, the study site(s), the methods you will use and the supplies and equipment you will need. (Make sure that you know whether you need permission to work on a particular piece of land and how you will get that permission.) If you plan to conduct an experiment, describe the design of your manipulation. Specify what types of data you will collect. It might be useful to include a sample data sheet. State the statistical analyses you intend to use.

PROJECTED RESULTS - Relating to your introduction, what specific results do you anticipate? In addition to your written and oral reports, will you produce anything else such as species lists, reference collections, marked plants, a set of photographs, etc.?

LITERATURE CITED - Cite literature from introduction, etc.

TIME SCHEDULE - Provide a detailed schedule of fieldwork (day by day), lab-work, analysis and writing.

SUPPLIES AND EQUIPMENT LIST (include this list on a separate page with your name on it.) State what you will need to do your project. Indicate the source of the items needed (e.g. part of EAP equipment, to be borrowed from someone, to be made by you, to be purchased, etc.)
Guidelines for Papers

The format that is described below and that you will use in writing the paper for your independent project is what you would use if you were to submit your paper to the editor of a journal such as Biotropica or Ecology. Actually, the only other piece you would add is a cover letter to the editor. The specific requirements for accepting manuscripts for review differ among journals and are described in each journal.

Your papers (for first submission) should include the following sections:

- title, name, date BUT not on a separate page
- abstract - English (include a Spanish abstract in final submission in addition to English)
- introduction
- materials and methods
- results (includes prose, tables, figures, and figure captions
- discussion
- acknowledgments
- literature cited
- appendices (if appropriate)

**ABSTRACT** - The abstract should tell the reader what your study is about. It should include the purpose, methods, results, and conclusions of your study. It should be less than a page in length. You should write the abstract last.

**INTRODUCTION** - This section will be much like the introduction in your proposal. If you shifted emphasis or switched projects you should modify your introduction accordingly. You do not need to explain what you planned to do and why it did not work out. The central question you addressed should be stated clearly. The overall importance of your study should be stated and explained. Do this by referring to relevant literature.

State any assumptions you are making in your approach.

**MATERIALS AND METHODS** - Describe the study site. State any background natural history information that is relevant and critical to your study. In some cases, if you need to include extensive natural history, you could put this in its own section with a separate heading. Describe in detail your procedure - what you did and when. Include dates of observations, the study, etc. Describe or state the statistical tests you used in analysis.

**RESULTS** - State a result directly, and then follow the statement with statistical support. For example, state: "Tapirs were observed more frequently than peccaries (t-test, p < .05). Do not say " A t-test showed that tapirs were observed more frequently than ...." In some cases it is appropriate to state an overall result first and follow it with specifics. For example: "There were no significant faunal differences between pasture and forest for any of the parameters I measured. Species richness of birds, butterflies and mammals did not differ..."

For each fact you present, you can either:

1. state the data in the text;
2. present data in a figure (graph, map, diagram, histogram) etc.;
3. present data in a table (columns and rows).

Do not present data in more than one form. Try to minimize the number of figures and tables, but do not compress them so much that they are difficult to understand. Refer to each of them separately, directly after you state a result. "In both pasture and forest, daytime temperature reached a peak at 1:00 pm (Fig. 1)."

It is fine to include anecdotal data in results, but you should clearly differentiate qualitative vs. quantitative observations.

Tables and figures should go in the body of your paper, not at the end.

**TABLES** - Tables should have a title and a caption. Both go above the body of the table. The title of the table should stand on its own (e.g.: "Table 3. Summary of capture data of forest frugivores according to guild and migratory status. Capture rate is birds/100 mist-net hours."

Note: class and excursion dates are subject to change. Rev: 9/2014
FIGURES and FIGURE CAPTIONS - Decide on the content and form of figures by sketching them and showing them to other people – including your advisors. Final figures are best done in EXCEL and pasted into Word. Do figures in black, white and gray tones – unless you absolutely must use color.

DISCUSSION - The purpose of a discussion is (1) to relate your results to existing knowledge; (2) to make clear how your results modify existing knowledge; (3) to speculate/hypothesize about what remains unknown or unclear; and (4) to suggest directions for future research.

First, restate briefly your main results in a few sentences. Discuss and explain your results. If they corroborate the results of other studies, mention that and cite those studies. If they contradict either what you expected or other studies, try to explain why. Refer to your Results and tie them back to your Introduction. Your Discussion should answer or at least address the questions you posed in your Introduction.

You may state possible sources of error, but be careful not to get carried away.

Give specific suggestions for where this research could lead - what is the next step? What are the next questions that should be addressed and how could this be carried out?

KEY NOTE: Be VERY careful to cite other researcher’s work: their ideas, their data, their interpretations, etc. Be careful NOT to paraphrase or use other people’s words without citing them properly. Use quotation marks if you need to.

ACKNOWLEDGMENTS - Acknowledge those who gave you guidance, help with fieldwork, statistics, etc. Note landowners who allowed you to work on their land (including Estación Biológica Monteverde).

LITERATURE CITED - Be sure that the papers you cite in the text are cited in LITCIT and that everything listed in LITCIT has been cited in the text. Use a standard format such as for Biotropica or Ecology papers. Do not cite personal communications (pers. comm.’s) in LITCIT.

APPENDICES - Include appendices if appropriate. These might include raw data or anything else that you wish to be part of your paper, but perhaps do not want to deal with directly.

Some general comments/suggestions

(1) Write out numbers one through ten. For numbers greater than ten, use numerals. For decimal numbers, use numerals (yes: "1.2," not: "one point two").

(2) Use metric units.

(3) Convert your data to standardized units (e.g. g/cm, not g/plot).

(4) Define words briefly that are not generally used or may have ambiguous meanings or somewhat idiosyncratic meanings. Define them when you first use them.

(5) Use subheadings within the major sections of your paper if it will help the reader follow the flow of your paper. These subheadings could be used in Material and Methods, Results, and Discussion. They should come in the same order in each major section.

(6) Number all pages.

(7) Write dates as 12 October 1492, not October 12, 1492, nor 12/10/1492, nor 10/12/1492, nor 10/12/92.

(8) AVOID NON-SEQUITURS. A non sequitur is a sentence or phrase that is not directly connected to the preceding sentence or phrase. A single non sequitur distracts the reader from the main point. Many non-sequenturs will tire and irritate the reader.
Guidelines for peer reviewers

Please review the paper that has been assigned to you. Your goal is to help the author improve his or her paper. You - as a reviewer - will be evaluated on the effort and quality of your review. You should provide comments and suggestions that will help the author identify areas that need to be lengthened and areas that need to be shortened. Include comments regarding overall content as well as grammar and syntax. Also include comments on how to improve the presentation of results. As a guide consider following the "grading scheme." You should include a final note to the author that summarizes your principal suggestions, criticisms and positive comments. In addition to helping the author improve his or her paper, you will gain insight into how your writing is perceived by others. This insight will help you as you revise your own paper and as you incorporate the reviews of instructors and peers.

Grading Rubric and Scheme

First and final submissions will be evaluated according to these criteria and more. Please attend to these items.

(1) Is the title informative and appropriate? Are page numbers and headers included?
(2) Are the essential elements of the paper included in the abstract?
(3) Does the introduction include sufficient background material?
(4) Is the central question or hypothesis stated clearly?
(5) Does the materials and methods section include enough detail to assess the approach/experimental design of the study?
(6) Are key points included?
(7) Are the main results stated and presented clearly?
(8) Are the tables and figures clear?
(9) Does the author answer/address the central question/hypothesis?
(10) Are statistics used appropriately and stated clearly?
(11) Does the discussion adequately interpret the results?
(12) Does the discussion appropriately relate the findings of the author to previous works?
(13) Has the author made effective use of the available literature?
(14) Is the length appropriate?
(15) Does the literature-cited section match the citations in the text?
(16) Are citations complete?
(17) Is appropriate information included in an appendix?

VERY IMPORTANT REMINDER:

Please hand in these items by 11:00 a.m., day 73:

(1) If paper - first submissions with comments of your primary and secondary advisors. (Some reviews will be electronic, some will be paper.)

(2) First submission with comments by peer reviewers. These will be paper copies.

(3) FINAL SUBMISSION (single -spaced) and in proper format (submit a complete electronic version, saved as a Word document. Documents that have not been converted to Word documents will not be accepted. We will post several examples for you to follow.

Guidelines for symposium presentation

The purpose of a presentation in a symposium or conference is to orally communicate

  (1) the questions you addressed:
  (2) the methods you used;
  (3) the results you obtained;
  (4) and the importance of your research project.

The audience that will attend the symposium and listen to your talk will not overlap entirely (or at all) with the readership of your paper. Those persons present in the audience may be hurried, tired, bored, hungry or
generally hostile. Of course, they are present because they are at least moderately interested in hearing what you have to say. Take advantage of being able to present your project in person: make eye contact, use inflection to emphasize key points, and interact with the audience in whatever manner is appropriate and effective. Give the listener one to several take-home messages or punch lines that will stick. Your goal is to have the listener understand and remember what you found out, not remember only that you studied this or that organism...

"What did Ebenezer find out?"
"Oh yes, he studied what monkeys eat" versus "He found that white-faced monkeys eat anything that moves and that is smaller than they are. Sometimes they eat each other..."

You will probably be most effective in your presentation if you talk without reading directly or reciting in a mechanical, memorized manner. People are more captivated by humans that act like humans than humans that act like robots. You can refer to your own notes or cards if you wish. Alternatively, you can put all your cues on big sheets of paper (see below) and let the audience go through the same thought process that you go through when everybody sees a sketch of a dung beetle approaching a pile of horse dung. If you do decide to read from a written text, be sure to make eye contact with the audience.

The general organization of your talk can follow your paper's organization.

You will have a total of 12 minutes to present your talk and answer questions. You should plan to talk for exactly 9 minutes or less and allow 3 minutes for questions and answers. It is critical that you practice and time your talk several times before you present it. You should also practice it in the manner in which you will present it. If you practice and time it by reading from a text and then give the talk without referring to your notes, you could easily go over 8 minutes.

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The title of your talk and your name will be announced by the moderator of the session.

The introduction should grab the listener's attention, introduce the general topic, and immediately inform the audience of your central question/hypothesis/focus. Sometimes it is useful to write-out the questions or at least key words to help the listener get centered. It may also be effective to show or pass around some critical piece of the story. If you studied bat-pollinated flowers, let people smell one. Be careful not to let this take too much time or be too distracting.

Keep the methods brief. Diagrams are helpful. You don't need to delve into detail.

Results are the most important part. Allow plenty of time. Report the major results in a manner that the audience can grasp and retain. If you used statistics in your analysis, you can write the test and significance level or whatever on the sheet with the pertinent data. You need not dwell on minutia - either minor results or details concerning statistics.

Figures -graphs, sketches, drawings, cartoons - and tables should be presented as you report your results. Label them clearly. If you use a graph, label the axes and explain your axes before you talk about the data. For example, "The horizontal axis indicates number of hours looking for tapirs. The vertical axis indicates the number of tapir sightings. As you can see, during the first 500 hours, I saw no tapirs. However, after 500 hours I observed tapirs at an ever-increasing rate." The challenge is to provide an appropriate amount of information for the listener. Often, the speaker will provide too much information, the listener gets overwhelmed and then tunes-out.

In the discussion, you should explain your results. Address or answer the questions you posed in your introduction. Help the audience interpret and understand your findings. Help us learn what you learned. If time allows, mention important and unavoidable sources of error if necessary. However, be careful not to get carried away with qualifications or error analysis. Better to avoid mention of errors than to trash your study. Mention specific areas for future research.

If you wish and if time allows, briefly acknowledge those who helped you with your study, including landowners.

Note: class and excursion dates are subject to change.  Rev: 9/2014
Prior to your actual presentation, think about and anticipate potential questions that the audience might ask and prepare (in your head) brief answers to them. When answering questions, be sure that you understand the question and try to address it concisely. If someone asks what seems like a silly question, do not trounce the person. The goal is to convey information and ideas, not to "defeat the enemy."

Clearly end your talk. After your last point, say something like "Thank you for your attention."

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Your talk should have no hint of apology whatsoever. There is no point in saying things like:
  "My sample size is so small that all of this is probably wrong..."
  "I got sick on Wednesday and didn't collect any data that day..."
  "The design of my study is so flawed that I need to do it over..."

You should exude enthusiasm and confidence about your project.

**A few logistical/mechanical details:**

- The symposium will start at **8:30 am** at the Monteverde Institute, day 71.

- The time limit of 12 minutes per talk is enforced.
EAP Symposium
evaluation sheet

9 minutes for presentation
3 minutes for questions and answers

day 71

Time beginning:_______
Student's name_________________________
Title:__________________________________________________
Evaluator:______________________________________________

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<th>Grade</th>
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Background( Introduction and set-up)    ______   (1) _________________________
Purpose (Question/hypothesis/predictions) ______        (1)  _________________________
Materials & Methods (and experimental design) ______   (1) _________________________
Results (address question/hypothesis) ______   2) _________________________
Visuals (effectiveness, balance, composition ______       (2)    _________________________
Interpretations and Conclusions ______      (2)    _________________________
Clarity (vocalization, projection, answers to questions ______     (1)   _________________________

TOTAL ______                    (10) ______________________

Time ending:_______ Talk Duration:_______

Additional comments:

Note: class and excursion dates are subject to change.
Rev: 9/2014