To: Students and Research Mentors involved in Biology 193, Introduction to Research (Summer)

From: Dr. Susan Koegel, Course Director

Subject: Obligations and Responsibilities

Biology 193, Independent Research, is designed to provide the student with an intensive experience in laboratory or field research. It is generally taken after a student has had some research experience (e.g. Bio. 93/94). Students taking Biology 193 for credit over the summer are expected to devote time equivalent to the 15-20 hours per week that students commit during an academic semester. Students are expected to be mature, independent, responsible, and conscientious concerning their work in the laboratory. Participants should take an active role in the design and execution of experiments and in the analysis and interpretation of data. They should be capable of "independent research" in the sense that they can conduct the experiments with little or no supervision. Students should also become familiar with related research in the current literature by regularly reading scientific journals.

Since universities are devoted to the open inquiry of intellectually interesting topics, we require that all student research for course credit be entirely unclassified. That is, any and all faculty members in the Tufts biology department must be able to freely read the student’s paper, and the oral presentations are open to the public. In the past, some commercial biotechnology/pharmaceutical companies have requested that faculty reviewers sign legal nondisclosure documents. Such agreements conflict with the open intellectual environment in the Biology department at Tufts, and we cannot sign such documents.

At the end of the fall semester, the student is required to write a detailed, well-organized report (8-15 pages) following the style of a scientific manuscript (Title, Abstract, Introduction, Materials/Methods, Results, Discussion, Literature Cited) and to give an oral presentation (15 minutes) of the results to a committee composed of faculty members of the Biology Department and the research mentor (if local). This presentation should be well-organized and concise. The committee will examine the student concerning his or her results, interpretations and general knowledge of the subject material. It is expected that the student will have reasonable understanding of the techniques and procedures used.

The written report will be graded on style and "readability" as well as scientific content and organization. Based on the paper and oral presentation (20% each) and the laboratory performance (60%), a letter grade will be awarded. Four copies of the written report must be given to the course coordinator by Thursday, December 8th. Oral presentations are
scheduled during reading period, **Tuesday, December 13th – Thursday, December 14th**.

On Fridays during the fall and spring semester, the Biology department sponsors a series of research seminars. Outside speakers, Biology department faculty, postdocs, and graduate students present their current research. Topics are diverse and the breadth of biological research is represented. These seminars are held in Barnum 104 at 4:00 PM, and are preceded by coffee and cookies in the lobby at 3:45 PM. They are a great way to learn about cutting edge biological research, and to interact with other biologists. We encourage you to attend.

**Students:** It is mandatory that you give a copy of this memo to your research advisor at the beginning of your research project.

If you have any questions regarding Biology 193/194, please contact the course coordinator, Dr. Susan Koegel at susan.koegel@tufts.edu or 617-627-3196.
The Bio 193/194 Research Paper

Write your research in the form of a formal scientific paper. You can only write a good paper if you read many papers before writing the report. When you begin working in a laboratory or in the field, usually your research mentor will give you several basic papers. Use the references in these to find other papers about your work. You should plan to read at least three papers per week while enrolled in Bio 193/194.

Write your first draft early enough so that your research advisor can read it and make suggestions. Give your advisor this draft at minimum 10-14 days before the paper is due. Your advisor is expected to act as a reviewer and editor but not as a co-author. This help from your research advisor is very important if you are to prepare an excellent paper. All parts of the text should be your own writing.

The length of the paper is **8-15 pages total**. Double space, use 12 point font, and have 1 inch margins.

Your paper will have seven parts: Title page, Abstract, Introduction, Materials and Methods, Results, Discussion, and Literature cited.

**Title:** The title, author's name, Bio 194, and the name and address of the research director should appear on the cover page. The research mentor also needs to sign the title page after the statement “I have read this paper.”

**Abstract:** Limit the abstract to 250 words or fewer. Summarize the introduction, materials and methods, results, and discussion. Be sure to include what question you asked; what study you undertook; what major conclusions you drew. Avoid abbreviations, diagrams, and references. The abstract must be complete and understandable without reference to the text.

**Introduction:** The introduction should supply sufficient background information to allow the reader to understand and evaluate the results of the present study without needing to refer to previous publications on the topic. The introduction should also provide the rationale for the present study. Use only those references required to provide the most salient background rather than an exhaustive review of the topic. In the last paragraph of the introduction, summarize the major hypotheses and what experiments you did to test them, but do not state the results.

**Materials and Methods:** The methods section should include sufficient technical information so that the experiments can be repeated. For commonly used materials and methods (e.g., commonly used media, protein determinations), a simple reference is sufficient. If several alternative methodologies are commonly employed, it is useful to identify the method briefly as well as to cite the reference. For example, it is preferable to state, "cells were broken by ultrasonic treatment as previously described (9)" rather than to state, "cells were broken as previously described (9)". You should allow the reader to assess the methodology without constant reference to previous publications. Describe new methods completely and give sources of unusual chemicals, equipment, or microbial strains. When large number of microbial strains, mutants or species are used in a study, include tables identifying the sources and properties of the...
strains, mutants, or species. Be certain that each abbreviation used in your paper is defined after the first use of that abbreviation.

**Results**: The results section should include the results of the experiments. Include not only figures and tables, but also a written narrative of the results in which you describe the results and refer to specific figures and tables. Point out trends in the data and important qualitative and quantitative comparisons. Reserve any interpretations of the results for the discussion section. Number figures and tables in the order in which they are cited in the text, and be sure to cite all figures and tables. Be certain that all graphs have properly labeled axes and that all figures (graphs and pictures) and tables have legends. Legends should provide enough information so that the figure/table is understandable without frequent references to the text. Define all symbols and abbreviations used in the figure.

**Discussion**: This section should provide an interpretation of your results in relation to previously published work. Also, briefly describe any technical problems, unexpected results, and future potential experiments. Discuss any other challenges of the project here and proper solutions.

**Literature Cited**: Each listed reference in the Literature Cited section must be cited in the text. Arrange the literature cited section in alphabetical order, by first author. Cite each listed reference in the text by (first author, date). Remember that you must cite a reference for all facts and methods you did not invent yourself.

Use standard abbreviations of journal names. Follow the style shown in the examples below.


Zhang J, Wang X, Bove KE, Xu M (1999) DNA fragmentation factor 45-deficient cells are more resistant to apoptosis and exhibit different dying morphology than wild-type control cells. J Biol Chem 274: 37450-37454

**Do not cite any paper that you have not actually read.**

**Your paper must be written in standard English. It will be judged on grammatical correctness and clarity as well as on scientific content.**

Three books that will be useful when writing your paper are:
The Bio 193/194 Oral Presentation

Your oral presentation will be limited to 15 minutes, and you will be asked to stop if your talk exceeds 18 minutes. Following the presentation, the committee will probably ask you questions about your work, and will then ask you to leave while the committee asks your research advisor for an evaluation of your work. His or her evaluation counts for 60% of your course grade. The evaluation of the paper and talk each count for 20% of your final grade.

When preparing your talk, remember that the committee has read your paper, so it is not necessary to repeat every detail, particularly methodological details. Because most of the committee will be from outside the field in which you have worked, you should present a thorough background to your research topic, avoid laboratory jargon, and define terms that are specific to your work. Try to educate your audience and make your presentation as interesting to them as it is to you. Early in your talk, tell your audience what basic question you are asking and its significance.

Acceptable visual accompaniments to your presentation include the use of Microsoft Powerpoint, slides, transparencies, and handouts. Do not hesitate to use the blackboard.

Do not read your talk; rather, use a teaching style of presentation. Practice your talk several times, preferably before your research laboratory group and/or friends who have some background in science. Did they understand you? What did they find unclear? Be sure that your talk fits into the allotted time.

After your talk, the committee will question you about points that it finds interesting, puzzling, or unclear. There may be questions about the approach you used and the significance of the data. You may also be asked questions to see if you understand the basic science and techniques involved in your research. Stay calm; no one is out to get you! All scientists must be prepared to defend their work when they present it.