The Cutting Edge:
Current Topics in Astrophysics

(prospective syllabus for an upper-division physics course at a liberal-arts college in the San Francisco Bay Area)

This course is aimed at physics majors who have particular interests in astrophysics and a good background in basic astronomy (Physics 120 and 343); it will explore several areas of ongoing astrophysical research in which exciting new discoveries are being made every day. Possible topics include extrasolar planet detection and observation; theories of solar system formation and evolution; the "angular momentum problem" in star formation; dark matter, the acceleration of the universe, and the cosmological epoch of reionization; the origin and properties of gamma-ray bursts; new observational technologies including adaptive optics, interferometry, space-based arrays, and 10-meter telescopes; and computational advances including three-dimensional hydrodynamical, N-body, and radiative transfer codes. I will decide the exact topics to cover based on your input in the first week of class.

Course goals:

The fundamental goal of the course is to familiarize students with cutting-edge work in a variety of astrophysical fields in preparation for research internships and graduate study. Each student will undertake a semester project focusing on one particular problem of current interest in astronomy, culminating in a research proposal. Along the way, you will learn to

- use Internet databases to search for recent astronomical results
- efficiently read and find useful information in a scientific publication
- ask questions at a research colloquium
- contact colleagues to request information
- give a scientific talk
- write a scientific proposal

Course format and assignments:

The course will meet twice a week; one meeting will consist of a lecture and problem-solving session, and the other will be a seminar-style discussion. Because this course depends on a healthy interaction among the participants, regular attendance and participation are crucial to its success. I also ask that, to minimize distractions, students turn off cell phones and do not use laptops while in class.

There will be no textbook; instead, I will assign readings each week, sometimes handing them out and sometimes asking you to look them up yourself. In addition to the assigned reading, each

week you will choose and read one article relevant to the discussion topic published in a major astronomical journal in the last five years, then write a one- to two-page summary of the article to share with the class. We will compile these summaries into a course bibliography that will provide you with a guide to the most current astronomical research. I expect students to complete the reading assignments *before* each week's discussion.

In conjunction with your semester project (see below), you will also give one 15-minute presentation to the class. This should be similar to a scientific talk you might present at a conference: I expect you to use visual aids and/or handouts, provide references for the works you cite, and be prepared to answer questions from the audience. I suggest going regularly to departmental colloquia in order to become familiar with the standard talk format. We will schedule the presentations to coordinate with the topics discussed in class. In the week you give your presentation, you will be excused from the extra article assignment described above.

Finally, you will be required to attend (at least) one scientific talk during the semester and ask (at least) one question of the speaker. Physics department colloquia *do* count toward this requirement. I will also organize occasional field trips to other nearby institutions in San Francisco and the East Bay to attend talks related to our course topics; these are for your convenience and are not mandatory. Turn in a half-page summary of the talk you attended, along with the question you asked and its answer.

Semester project:

There will be no exams in this course. Instead, you will undertake a semester project on a course topic of particular interest to you. The final product will be a scientific proposal for research you might conduct in this area. You will be able to use this proposal in the future as a basis for graduate school admissions essays, fellowship applications, or proposals for telescope time.

During the course of the semester, you will work up to the final proposal in several stages. I will announce due dates and give more detail about each of these stages in class. I will be available to help at all times, and encourage you to consult with me frequently about the project.

1. Identify the broad field of your topic.
2. Read and summarize 5 journal articles in your chosen field (no more than 2 of these can be articles from my assigned list)
3. Select a researcher in your chosen field and contact him or her via email or telephone to ask a question or request information about his or her research.
4. Give a 15-minute presentation to the class on your topic (see above).
5. Write a one- to two-paragraph abstract of your proposal.
6. Write a draft of your proposal.
7. Turn in the proposal, along with a portfolio including all the work from the previous stages of the project.

Grading:

Your final grade will be determined from the following components:

Participation — 20%
(includes class attendance, article summaries, participation in discussions, and scientific talk attendance and report)

Presentation — 30%
(includes quality of presentation, appropriateness for the audience, and presenter's delivery, knowledge of the subject, and responses to questions)

Final Project — 50%
(includes completion of all project stages, thoroughness of research, appropriateness for the audience, quality of argument, clarity of writing, and author's knowledge of the subject)

Late work will be accepted only in extenuating circumstances.