Teaching Statement

I have always considered teaching to be a central part of my academic career. I have had extensive experience teaching physics at the undergraduate level. As an undergraduate at UC Berkeley. I was a teaching assistant for the introductory physics lab for two semesters. As a graduate student at UC Santa Cruz I was a teaching assistant for four years (15 quarters). My responsibilities included running labs for introductory physics students and leading discussion sections. The classes I taught ranged from introductory astronomy to conceptual physics to the physics of music. I particularly enjoyed learning how to explain physics concepts to students with different backgrounds. In addition to my experience as a teaching assistant, throughout my postdoctoral years I have had several opportunities to develop and conduct lectures. However, I look forward to a career with more of a balance between research and teaching.

Central to my teaching philosophy is my belief that science, and in particular physics, is predominantly an approach to solving problems. Therefore, my goal in teaching is for the students to experience this approach so that they can apply it to the problems that interest them. Of course, physics and astronomy also constitute a large body of knowledge with which students should become familiar, but this is of secondary importance. A good example of how I implement this philosophy is my strategy in responding to questions asked in discussion sections or in office hours. My tendency is not to directly answer the question, but instead to ask the student questions that help lead them to the correct answer through their own reasoning. Underlying my use of this approach is my belief that students are likely to develop meaningful understandings of concepts when encouraged to think about them critically. Even more importantly, is my belief that when students first experience the scientific approach to problem solving under my guidance, they will later be able to successfully apply this technique when attempting to solve problems on their own. This approach can be difficult for some students and it is important to give them enough help and positive feedback so that they do not become frustrated while seeking the answer.

I am interested and qualified to teach: introductory physics and astronomy, physics and astronomy without math, extra-galactic astronomy, classical mechanics, cosmology and general relativity. In addition to these courses, I am also interested in developing courses that attract students who might not usually be interested in science. For example, I would like to have the opportunity to design a course on astronomy and mythology, as well as a course on the physics of science fiction. To date however, I have experience teaching courses that I would divide into three broad categories: courses for majors, required courses for non-majors and courses that try to attract students who are otherwise not interested in science.

I believe that courses aimed at students majoring in the field should make the students feel that the subject being studied is connected to current problems in the field. Too often, science courses are presented as if all research is historical and there are no open questions in the field. This approach runs the risk of failing to motivate the student instead of exciting them to the contributions they may someday make in the field. While certain subjects, like classical mechanics, are not areas of active research, they can be connected to topics like the density profiles of dark matter halos, or the dynamics of satellite galaxies, which are currently receiving intense research attention. Highlighting the limitations of our knowledge and areas of controversy make a course interesting and exciting for students and for myself.

Also for advanced students, it is important to offer a basic course in computing. In many programs students are expected to pick up all aspects of computing on their own, receiving little to no formal instruction in what is a significant component of present day research. By teaching these skills, students become more efficient researchers by being able to use the large amount of computer resources that are available to them. Such a course should cover data analysis, data visualization, numerical recipes, efficient computation and data structures. The benefits of teaching students good programming skills extend to others who make use of the student's work.

In introductory courses, I would modify my approach somewhat. It has been my experience that the vast majority of students in most introductory courses are fulfilling a science requirement and not taking the course because they have a strong interest in the subject matter. The major goal of such courses is for students to develop quantitative reasoning skills, however, this is not usually discussed in the course. Instead it is assumed that the students will have these skills and thus many students find the courses extremely challenging. I believe it is important in such courses to focus on how problems are solved by quantitative reasoning. By teaching this as a method and not just the discoveries that arise from such a method, students are more likely to develop these skills. Moreover, they can understand from where their confusion arises instead of concluding that they are just incapable of understanding science.

It is also helpful to keep students interested in the material by making it more accessible to their lives outside of class. For example in an introductory astronomy course it would be helpful to connect all of the concepts in the class to objects the student can see in the sky. While, for example, one can not actually see Sirius-B, the white dwarf companion of Sirius-A, being able to identify the place in the sky where there is a white dwarf allows students to feel more connected to the course topics. I think most students of introductory astronomy are disappointed that they cannot apply what they learn when looking at the sky. Enabling them to identify some objects which are related to the course topics will increase their connection to the course and therefore the ease with which they learn the material.

Technology is such an important part of life today that every person must have some familiarity with science. Unfortunately, many people feel they are unable to understand science and thus to a certain extent are unable to understand the technological world in which they live. I am very interested in courses that attempt to bridge this gap by teaching scientific concepts without using mathematics. At Santa Cruz I was a teaching assistant for a course on the physics of music. The course attracted music majors and taught them about the physics of sound and the neurology of how people hear. I think such courses are tremendously important for bridging the divides that often exist between the arts, humanities and sciences.

As I mentioned earlier, one such course that I look forward to developing is a seminar on astronomy and mythology. I envision this course as including an examination of the historical connection between astronomy and mythology as well as the way that myth has largely been replaced by science as a means of explaining natural phenomena. Myth differs from science in that its explanations always relate to human experiences. Students would be encouraged to relate modern discoveries in astronomy to their experiences and thus create modern myths. Such a course is likely to appeal to students who might otherwise not consider enrolling in science and thus gives them the opportunity to encounter scientific knowledge in a setting that is more comfortable for them.

Another course I plan to develop would address the physics of science fiction. The course would cover what is known about the physics that often occurs in science fiction. Topics like time travel, space travel, parallel universes and black holes could all be covered. Students in this course would be helped to discover what is actually known about these subjects, as well as come to recognize plausible explanations of undiscovered physics. For example, we would consider which authors of science fiction approached their make believe problems in the way a physicist would. This investigation is consistent with my view of physics primarily as an approach to problem solving, yielding techniques equally well suited for real and imaginary problems.