TEACHING STATEMENT — A. TSOBANJAN

The majority of my college-level teaching experience comes from the time I have spent as a graduate teaching assistant leading practical labs and problem-solving sessions (or recitations) for a variety of introductory physics courses. My teaching method has significantly evolved over the years. At first, I attempted to present the lab and recitation introductions in the "most logical way possible", where each step in the presentation follows from the previous ones almost by necessity. Through trial and error I have come to realize that this method takes too much time, is hard to adapt to the variation in the levels of knowledge of my audience and, most importantly, does not reflect the way anyone, including myself, actually learns. Today I treat the learning process as somewhat erratic and unpredictable, varying from individual to individual. For labs and recitations I try to prepare two or three distinct intuitive explanations for each novel concept: I use one of them during the initial presentation, supplementing it with diagrams and demonstrations, and reserve the rest for the discussion with students during the activity.

On several occasions grateful students have told me that they had learned much more physics from the labs and recitations than during the lectures. While I would love to take these confessions as a testimony to my own teaching prowess, a little reflection quickly reveals two simpler reasons for this reported experience: one—recitations and labs have much smaller sections than lectures, and two—they actively engage students in applying the material. Small section size allows the instructor to respond to individual learning needs of his or her students, who, in turn, are more or less forced to actively interact and learn together and from one another. Now it is probably difficult, though not inconceivable, to entirely replace lectures by lab-like activities; at the same time, it is completely fair to ask: can the lectures be made more like labs? I believe the answer is "yes": I have observed other instructors dedicate a significant portion of a lecture to group problem-solving activities and have personally led several recitations where I needed to introduce a considerable amount of material not covered in lectures. In both situations students were engaged and appeared to retain the new material.

Individual components of a course need to be designed with specific goals in mind; for example, introductory physics labs could be used to supplement the material taught during lectures with practical demonstrations, encourage students to develop problem-solving skills, teach experimental error analysis and so on. Given a recognized learning need I like to construct activities that address it. After grading a number of recitations during one particular physics course for life science majors, I realized that my students lacked the basic ability to communicate quantitative information and, what was worse, did not understand my objections to their written work. In response, I designed and implemented a three-part activity during a two-hour lab. In the first part, groups of students were asked to come up with a problem using specified laws of geometrical optics they had recently covered as well as to write a solution, with extra incentives for complexity and creativity. In the second part the questions were rotated and each group was asked to attempt to solve another group's problem; finally, each group graded the question they had constructed according to their own rubric. The aim of the activity was to illustrate to the students the utility of carefully and precisely wording problems and solutions in a way that their peers could follow.

Regardless of the pedagogical ingenuity and high-tech gadgetry involved in the lectures and labs, my experience as both a student and a teacher is that students will learn and prepare specifically for the way they are tested. So in order to encourage a deeper level of understanding, the progress-assessment needs to be frequent and the methods used need to be varied and flexible. For introductory courses I intend to use exams which combine multiple choice questions, allowing us to cover a wider range of topics, and questions requiring full written solutions with graphs and diagrams, testing in depth understanding and scientific communication ability. Good real-time feedback can be provided by recitation and lab reports, office hour discussions as well as regular quizzes. For higher level courses, that are typically more complex, I intend to use a combination of regular take-home and oral examinations. In fact, I am very interested in experimenting with different techniques for quantitatively assessing understanding and looking for a reasonable alternative to a long and thorough interview.

I try to shape my approach to teaching by understanding the ultimate goals that my students strive to accomplish through their degree. These goals usually fall into two broad categories—enlightenment and employability. The students are expected to broaden their horizons by being exposed to a wide range of ideas from a variety of academic disciplines and establish lifelong connections with educated people from different backgrounds. They are also expected to obtain specialized skills and knowledge required for employment or further specialized training, or obtain transferable skills applicable in a broad range of occupations. While physical science majors provide a scope to address all of these goals, the distinguishing features of these disciplines are the need for a strong foundation on which the more advanced and specialized knowledge rests and an enormous number of interconnections between different branches of a given science as well as between distinct disciplines, which serve to their mutual reinforcement. In addition to the benefits commonly associated with higher education, a key set of transferable skills the sciences offer are the abilities to conceive, develop and present complex ideas in specialized fields. Each individual course in these sciences must, in my opinion, serve a clearly defined subset of the above goals and fit smoothly within the curriculum prerequisite system; additionally, the students would enormously benefit from emphasis on the connections to related fields.

Experience has taught me to use a variety of intuitive and visual explanations when presenting new ideas and to draw students into active group discussions whenever possible. I try to tailor individual activities and assessment to a clear set of objectives that provide the foundation for further learning and supplement the long-term goals of my students.