

TEACHING PHILOSOPHY

I have developed and applied my teaching philosophy through experiences co-leading an astronomy lab course, leading discussion-based classes associated with an astronomy lecture course (during two Teaching Assistant appointments at the University of Wisconsin - Madison), as well as through coursework with the Center for the Integration of Research, Teaching, and Learning (CIRTL) DELTA teaching and professional development program, and as a mentor to undergraduate and graduate students (and as a student and mentee myself). My most important objective as a teacher and mentor is to challenge and inspire my students to think about their world, and indeed their universe, in new ways and with a scientific perspective. Comprehension and retention of physics and astronomy materials is vital, but understanding that the critical thinking and problem solving techniques applied within our field are also essential for a wide range of other disciplines is the glue that holds the knowledge together as a student is learning. Moreover as a physics and astronomy educator and mentor, my job is more than to just teach the traditional materials found in a textbook. My goal is to also provide my students with important skills, in applied mathematics, statistical analysis, computational and critical thinking and problem solving, that are essential for any career they choose to pursue. In the following, I attempt to outline the methods that I use and the philosophy with which I approach teaching and mentoring in order to achieve these goals.

INCLUSIVE CLASSROOM ENVIRONMENT : In my opinion, a critical ingredient for promoting learning is an open, inclusive and respectful classroom environment. I want my classroom to be comfortable, not only to motivate my students to participate actively in our discussions and to further their desire to learn the materials, but also to nurture a positive attitude towards learning science. In both my lab classes and my discussion sections, I regularly arrived early to class, stayed late after class, and held open labs and office hours, to give my students more opportunities to ask questions and share their opinions. Additionally, addressing students' different learning styles is key for developing an inclusive classroom environment. I use multiple different methods to present any given topic, including lecture format, images and graphs, demos, discussions and group work, written problem sets and hands-on activities. For example when I teach about stellar spectra, I tell my students about the history of discoveries, show them images of our Sun's spectrum, have them explore electronic libraries of stellar spectra for stars of different spectral types, and let them observe emission arc lamps through handheld diffraction gratings to see atomic emission lines first-hand.

ENGAGING STUDENTS : I also try to deliver my lessons with a positive energy and excitement that I hope my students will emulate. I can't help but recall my high school AP Physics teacher Mr. Wills, who was one of the most exciting and dynamic teachers I have ever had. Indeed my experiences in Mr. Wills class and his ability to engage us in the materials are some of the main reasons that I chose to become an astronomer. Although I certainly wouldn't expect all of my students to become physicists or astronomers, I can teach all of them that science is fun and important in their lives.

RELEVANCE TO EVERYDAY EXPERIENCES : I've found that providing real-world and hands-on examples can be very effective at solidifying a concept for students. Drawing these types of connections takes an abstract concept and makes it concrete. Furthermore it removes the incorrect stereotype that science only deals with theoretical concepts that have no relevancy to the real world, which can often dissuade students from pursuing careers in science. For example, in one lab, I had my students measure the mass of Jupiter using each of the four Galilean moons, and determine the uncertainty on their measurement. We then discussed how understanding measurement uncertainty has real implications, for instance, to gauge the validity of scientific results or the significance of political polls presented by the media.

ACTIVE LEARNING : Group work, which facilitates peer-teaching, is very effective at engaging students and promoting active learning. In my lab course, having students work in groups was natural, and students completed each lab in collaboration with others. In my discussion sections, which had a more traditional classroom set up, I also effectively engaged students in group work, for example, through “think-pair-share” activities. I also ensure that each class period includes time for discussion (whether within a lab or traditional classroom setting). For instance in my lab classes, I often have each group report their results by writing them on the board. Then towards the end of the class we compare results, discuss their different methods, clear up lingering questions and draw connections with the overarching themes of the class.

INQUIRY LEARNING : Though straightforward problems with well defined methods and solutions are important to reinforce a students understanding, it is equally important to provide students with opportunities to develop and test their own methods for problem solving. This inquiry-based learning gives the students a better sense of how science is really done, and that the scientific method is sometimes not straightforward, and is always iterative. It also awakens curiosity and makes the subject matter more interesting. For instance, while learning Kepler’s Laws, I ask my students how they would measure the mass of the Sun. The solution requires the use of Kepler’s Third Law, which is a function of the Earth-Sun distance (semi-major axis), and the period of Earth’s orbit. The period is easy to measure, but determining the distance to the Sun is less straightforward. Students brainstorm ways to determine the distance; in the past students have suggested using radar, geometry (given the distance to other planets), and some even recall the work of Aristarchus and Eratosthenes.

SCIENTIFIC WRITING : Developing a student’s writing skills is also a vital part of teaching science (though this is sometimes not expected by students). The ability to describe results of any project in writing is essential for many disciplines. I teach my students how to write concise and accurate descriptions of their work. These are valuable skills for students when applying for jobs and graduate schools, and indeed throughout their careers. Lab write-ups are a traditional method for developing scientific writing abilities, which I used in my lab course. I also have my students write observing proposals, similar to those that I write on a regular basis. Such projects provide a fun and more open-ended structure for science writing. As an extension, students can use the Global Telescope Network (<http://gtn.sonoma.edu/>) to obtain and analyze their own images of the objects in their proposals.

INFORMAL ASSESSMENT : In order to further refine my teaching skills and methods, assessments are vital. Group activities provide real-time feedback, allowing for a dynamic and constantly improving classroom environment. While students work in groups, I walk around the room and check in with each student. These real-time assessments allow me to gauge the pace and efficacy of my lessons, help specific individuals, and make adjustments to the lesson where needed, all of which improves my lessons and keeps students engaged. This constant informal assessment also reveals misconceptions that students may bring into a class, which, in turn, facilitates discussions and resolutions.

FORMAL ASSESSMENT : Of additional great importance are homework problems, quizzes and exams, which allow me to gauge both how well a student can independently investigate problems and how effective my lessons are at teaching the necessary methods and techniques. These formal assessments allow me to improve as a teacher from year to year. In the future I also plan to distribute my own course evaluation worksheets occasionally during the semester to get more personal feedback and suggestions from students on how to make their classroom experience more rewarding. I would look forward to continuing to improve and amend my approach to teaching as a faculty member at Carthage College.

The most rewarding part of teaching is knowing that I am helping to create a more scientifically literate society, where my students have the skills needed to make informed decisions, evaluate arguments and proposals based on facts and logic, assess the importance and significance of statistics presented in popular science articles and the press, and approach their lives with an inquisitive nature. It is for these reasons that I am excited about joining the faculty at Carthage College.