Teaching and Learning Philosophy

I am a firm believer in active learning and I attempt to create a lively, engaging, and interactive environment in the classroom. A dominant idea in my philosophy is that education is a process of forming connections to integrate new information with the previous experiences and knowledge of the students. My goal as a professor is to work with students to help create these connections and form a cohesive understanding of the physical universe. I feel that learning is enhanced by connections between the instructor and the students, connections between students, and connections from the course material to the world outside the classroom.

Connections between the instructor and the student are enhanced by using a variety of instructional methods, including lecture, group discussions, think-pair-share short answer questions, small group worksheets, hands-on demonstrations and laboratory activities. Active learning methods provide students with a chance to experience physics with all of their senses. Some of my favorite moments as an instructor are when I have witnessed students undergoing an "ah-ha" moment in the classroom as they complete a connection between two ideas and gain understanding of a new concept. I particularly see the formation of these connections during small group activities; one student may be explaining the photo-electric effect to another when suddenly both students come to understand the material on a deeper level.

I believe that the exchange of information in the classroom should not be limited to one-way communication from the instructor to the students. I have found that having an accurate, ongoing assessment of current student learning helpful. Techniques such as Just-in-Time-Teaching allow me to tailor each class period to better meet the educational needs of the students. In my introductory physics courses, there is a daily set of "reading questions", a short set of concept-based and straightforward quantitative questions about the daily reading assignment. These questions are administered through the online course management system and are due by midnight on the night before the topic will be covered in class. The final question of each set is open-ended: "What did you like or dislike about the reading? What points are confusing or especially interesting?" Students are always willing to provide these details. I make broad use of the results of these questions when planning specific items to cover in detail for the next class meeting. For example, on a given day, I may have four 10 to 15 minute sections that I plan to cover in class. If the online questions indicate that many of the students have concerns or questions about one of those sections, I can spend more time on that area and discuss those concerns. In upper level courses, I have slightly modified these ideas. It can be difficult to create meaningful multiple choice questions on the topics in "Classical Mechanics" or "Electricity and Magnetism." In these courses, I assign a problem or part of a problem for each day. Often the problem takes the form of filling in the details in a derivation from the text or performing some calculations related to the topic. I then use the questions the student have on these activities as a starting point for class discussion. This keeps the students interested in reading the text on a daily basis and provides some details into questions or topics that the students may have about the topic.

Genuine interactions among the members of the classroom community lead to enhanced understanding of the material. There are several methods that facilitate interactions between students, such as think-pair-share and small group assignments. One technique that I have found

to be especially useful in introductory physics classes is Peer Instruction, as described by Eric Mazur. In this method, students have an opportunity to discuss physics concepts with neighboring students during class and collectively reason to an answer to a conceptual based multiple-choice question. In this way, students share in the understanding of ideas and have an opportunity to test their understanding of each concept with a peer. This process also gives students practice with communicating their scientific ideas and opinions to others. Communication of results and theories is a frequently overlooked component of science education, yet this skill is immensely valuable not only to future scientist, but to every member of society. Therefore, I emphasize writing and critical reading skills in all of my classes. For example, in “Classical Mechanics” I have my students read articles from the American Journal of Physics that use Lagrangian and Hamiltonian methods and have the students make a 15 minute class presentation on a topic related to mechanics.

I believe that diverse classrooms can benefit learning by providing differing perspectives on the topics covered in class. I find that each student is unique and brings his or her individual experiences and abilities to the classroom. This is one of the reasons I encourage working in small groups on assignments. In situations where one student does not comprehend a certain concept, a companion may be able offer an explanation to clarify the idea. Different points of view can lead to an active and engaged exploration of the topic that can then yield a better understanding of the material. I enjoy working with students from various backgrounds and strive to be inclusive in my teaching.

I have taught a wide variety of courses and have varied teaching interests. I have taught the entire introductory physics sequence, both for majors and non-majors and many upper-level courses, including “Mechanics,” “Electricity and Magnetism,” and “Advanced Laboratory.” I have also taught a variety of elective and special topic courses, including “Optics,” “Astrophysics,” and “Electronics.” I designed and have twice taught a special topic course on “Biomedical Physics,” my area of specialty. This course covers the physics of a variety of biological and medical applications, including biocompatible materials, diffusion, nerve conduction, radiation physics, medical imaging, and radiation therapy and has associated laboratory exercises. I have also taught courses outside the Physics major, including “Descriptive Astronomy,” “Introduction to the Liberal Arts,” and “Creation and Cosmology.” In each of my courses, I work with students to guide them in understanding the material.

I became interested in science as a young child, when my father, a former high-school physics teacher, would answer my questions about the color of the sky or how a light bulb works. My personal journey in physics carried me into medical physics, a field that allows me to use my knowledge of physics to improve the diagnosis and treatment of disease. I am eager to take the next step and guide students on their educational journeys.