

Angela Speck - Teaching Statement

1. Teaching Philosophy

I would like to be remembered by my students the same way that I remember my favorite teachers, who are inseparable in my mind from the subjects they taught. I have three aims in teaching: (1) to stimulate interest in the subject; (2) to educate; and (3) to help students learn new ways of thinking and approaching problems.

Astronomy and astrophysics are subjects where most problems require a combined observational, theoretical and experimental approach. It is therefore important that all these aspects are addressed when discussing any given topic. Furthermore, it can be very effective to use analogy to enhance learning by relating new information to prior knowledge, which aids both in immediate learning and in long-term information retention. I like to use small demonstrations wherever possible. For example, the problems of differentiating between scattered light and absorbed light based purely on observed light extinction can be amply demonstrated using an overhead projector, two glasses of water, some black ink, some milk and two pipettes. Combining sketches, notes, animations, analogies and demonstrations enables me to give several approaches to understanding the same concept. Modern technologies provide many teaching aids which can be incorporated into any course. I have had a great deal of success using WebCT for my courses, as well as the many figures, animations and planetarium software provided by textbook publishers.

Introductory (non-science-majors) astronomy courses are particularly challenging and require different techniques or pedagogies from those needed to teach science majors. Many of the students are science and/or math phobic and the approach to such courses needs to reflect this. In particular, the point of an introductory course is to raise the scientific literacy of the non-science undergraduate population. With this in mind, both the teaching and assessment of astronomy must be conceptually-based rather than numerically-based, a shift in technique which is often alien to the average scientist. In order to develop my own ability to succeed in both improving scientific literacy and to stimulate an interest in both science in general, and in astronomy, I have attended two workshops run by the University of Arizona's Center for Astronomy Education¹ (most recently the *Advanced Strategies for Teaching Learner-Centered Astronomy Under Hawaiian Skies and The Great Observatories of Mauna Kea* in Kona, HI in July 2006), This has greatly improved my skills in teaching at the introductory level, especially with respect to implementing learner-centered teaching/ peer-instruction techniques and with respect to appropriate assessment techniques.

Whether I am teaching introductory, upper-level or graduate courses, I always encourage the students to participate in class, to help them understand principles rather than simply obtaining the "right" answer, and always to ask questions. Instead of directly answering a question, wherever possible I will reply with a series of easier queries which lead from the knowledge they already have to the bigger answer they are seeking. When grading I always make notes on the students' papers to help them understand why they did not get full credit if they didn't, and I also take particular care to achieve total consistency in giving partial credit when grading. I make myself available to the students outside class hours and I encourage them to come to me with any questions they may not have wanted to ask, or had not thought of, in class. This can also provide useful feedback regarding which topics were not well understood.

Since many students will go on to find employment outside the subject, a good education in Astronomy/Physics should provide training in transferable skills such as formulating hypotheses based on limited data, developing the means to test them, and the ability to present a well-reasoned argument clearly but concisely. The teaching of exam techniques, effective note-taking and effective listening are also valuable skills which apply in any subject and beyond academia. Furthermore, many students choose to take an introductory level astronomy class as the only science course of their college career. For these students, my main aim is to introduce the concepts of science and its methodology. One cannot claim to be educated without having some appreciation of what science and technology is. Additionally, the general public must play a more important and active part in dealing with those facets of our technological society that affect all our lives. Perhaps of more obvious benefit to the students, the processes of scientific thinking actually do apply to aspects of virtually any career students wish to consider.

Finally, returning to my opening statement and agreeing that imitation is the sincerest form of flattery, I wish to emulate the teachers who inspired me as a student, and to take elements from each to form my own teaching style. I will also work to improve my own knowledge of educational practice and theory. I will pay attention to both positive and negative feedback in order to achieve these goals as I gain in experience.

¹ <http://astronomy101.jpl.nasa.gov/>

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2. Teaching Experience

Since arriving at University of Missouri, I have taught five different courses (two introductory level, one sophomore/junior level and two upper level undergraduate/graduate level) and my teaching assessments are consistently among the best in our department (details available upon request) . These courses are:

Astronomy 1010: Introduction to Astronomy is an introductory level class designed for non-science majors with an enrollment of 100-150. Many of the students have little experience with math or physics and therefore the challenge is to break down astronomical problems to a level that is not so intimidating.

Astronomy 1020: Introduction to Laboratory Astronomy is a companion to Astronomy 1010 and is mostly computer-based. This largely consists of projects using software such as Redshift, Starry Night and Project CLEA to reinforce ideas and concepts learned in the lecture-based course.

Astronomy 3010: Introduction to Modern Astrophysics is a course for sophomore/junior physical science and engineering majors. These students have already learned the physics they need, but most have never studied astronomy. My aim with this class is to give the students a taste of the diverse nature of our Universe and of the different aspects of physics needed to understand it.

Astronomy 4180/7180 (also Physics/Geology 4180/7180): Solar System Science investigates physical states, interior structures and comparative geology of solar system bodies: terrestrial and Jovian planets, moons, asteroids, comets and the sun as well as solar system formation and evolution.

Astronomy 4250/7250: Stellar Astrophysics is a core astrophysics course on stars and stellar systems. We investigate stellar dimensions, radiation, spectra, energy, evolution and populations.

Prior to my present faculty position, I have been involved in less formal teaching forums, e.g., an informal graduate research seminar on evolved stars at the University of Illinois; and guest seminars/lectures in Astronomy at University of Minnesota, and in Geology at UIUC and at MU. I also worked as a demonstrator (TA) in Physics for University College London for three years.

3. Advising/Mentoring

The table below summarizes the undergraduate and graduate students and postdocs with whom I have worked in an advisory capacity:

Name	Status	Graduation/End of Contract Date	Current Affiliation
Catharinus Dijkstra	Postdoc	December 2006	MU
Karly Pitman	Postdoc	August 2006	JPL
Adrian Corman	Doctoral Student	Summer 2008	MU
Basil Menzi Mchunu	Doctoral Student	Summer 2008	MU
Sarah Eyermann	Masters Student	Summer 2008	MU
Anthony Smith	Undergraduate	Summer 2009	MU
Caleb Wheeler	Undergraduate	Summer 2009	MU
Tikki Davis- Ab Rahim	Undergraduate	Summer 2009	MU
Chris Azmeh	Undergraduate	Summer 2008	MU
Kristina Wakeman	Undergraduate	Summer 2008	MU
Josh Tartar	Undergrad/Masters	May 2005/Left to join Army Fall 2006	Army
Ben Vega-Westhoff	High School Student	"Summer 2006"	UIUC
Kyle DePew	Masters Student	May 2006	U of Iowa
Duane Hamacher	Masters Student	December 2005	Australia
Addie Dove	Undergraduate	May 2006	U of Colorado
Grant Thompson	Undergraduate	December 2005	U of Kentucky
Karen Wilson	Undergraduate	May 2005	Washington U. St Louis
R. Bryan Reid	Undergraduate	May 2005	---
Blake Miller	Undergraduate	May 2004	UMKC
Melvin Mora	Undergraduate	KIA June 2004	KIA – Iraq
Danielle Moser	UG at UIUC	---	---

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I am currently supervising 5 physics majors on their independent study projects on dust around evolved stars; and I have acted as research advisor to a total of 12 undergraduate students since Winter 2002.

At present my research group also comprises two doctoral and one masters students; and one postdoctoral research associate. My work with students at all levels has been very fruitful, having supervised 28 (both national and international) conference presentations by students at six conferences since 2004. Peer-reviewed publications arising from student involvement in my research have also been forthcoming (see, e.g, publication list, 7, 14). In addition I have had the opportunity to take several undergraduate students observing (to Caltech Submillimeter Observatory, Mount Laguna Observatory (San Diego) and WIYN (Kitt Peak).

4. Curriculum Development

Until recently the Physics & Astronomy department at UMC was lacking in astronomy, in terms of both research and teaching, with just one astronomy teaching professor and no research outside of cosmology. Since my arrival, astronomy has been revived, with more course offerings (i.e. real astronomy courses, not just courses aimed at non-science majors) and significant research. This effort has effectively made me the director of astronomy and astrophysics studies in the department, with responsibilities including development of the curriculum and student recruitment. I am directly responsible for our recently implemented astronomy minor program (which will soon include an "emphasis" in astronomy for physics students). As part of this role, I am an active member of the department's curriculum committee, which is currently attempting to overhaul our physics curriculum.

I have reviewed sections of several introductory astronomy textbooks including the latest edition of "Astronomy" by Chaisson & McMillan, and more recently "Astronomy: Journey to the Cosmic Frontier" by Fix. Since research in astronomy is moving at such a fast pace, I believe it is important that researchers have input to revisions of textbooks, so that what is taught to students is always as up to date as possible.

5. Outreach & Related Experience

At the University of Missouri, we have a scientific public outreach program known as Saturday Morning Science. This is a forum in which scientists give talks to the general public. I have participated in this program several times including three talks in Fall 2003 and another in Spring 2005. I have given public talks at the Columbia Public Schools Astronomy Day, and for events organized by the local amateur astronomers associations (e.g., the Wake for Pluto). In addition, I have given regular talks to the Columbia Public Schools Gifted Program. This is a program for gifted children in 3rd-5th grade. In addition to attending and participating in the events outlined above, I also act as a regular source for several local newspapers, radio and television stations on anything astronomical.

As a postdoctoral assistant at University College London, I organized a one day conference in May 1999 on multidisciplinary aspects of space research, including contributions from astronomy, meteoritics, planetary and atmospheric sciences. I also participated in an educational television program on studying astronomy for the BBC.

6. Future goals

I believe that subject areas as broad as Astronomy and Astrophysics deserve stimulating and enthusiastic presentation, using wherever possible everyday, human-scale occurrences to demonstrate phenomena with the extremes of scale we encounter in these subjects. I want to develop and teach courses which will emphasize the links between different scales of interaction and different study areas (astronomy, physics, chemistry and geology) to produce well rounded physical scientists who will feel prepared for future study or employment, within or outside the subject.

With regard to specific courses, I would be comfortable teaching a wide range of both astronomy and physics courses. In particular, I look forward to teaching introductory courses as well as more advanced courses such as astronomical methods and techniques, stellar evolution, and the solar system. I would also be keen to develop an advanced level undergraduate/graduate level course in cosmochemistry. This is included in my pending NSF CAREER proposal and a preliminary syllabus is attached.

I also feel that encouraging research is important at both the graduate and undergraduate levels. I look forward to continuing my participation in research projects with students across all levels, from undergrad to PhD, and including more postdocs.