CWSEI – PHYS & ASTRO Newsletter

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Our department has always been committed to high standards in education. Recently, with support and leadership from the Carl Wieman Science Education initiative, we have made increasing progress in successfully implementing research based educational methods in our classrooms. An increasing number of our faculty are showing keen interest in these developments. In response, we will distribute this monthly newsletter to keep you up-to-date with the latest CWSEI efforts.

In this issue, Brett Gladman is discussing the changes implemented in the past two years in ASTR310: The Solar System. This course is offered in both Fall and Spring terms.

Mona Berciu

Professor Brett Gladman (ASTR310)

ASTR 310 is a course dominantly taken as a science elective by students from the faculty of arts and the business school (and cannot be taken for credit by students in science or applied science). Revision of ASTR 310 began in the summer of 2008 with major revision of the course learning goals. Given the student spectrum, the goals were designed to attack three main groups of topics:

(1) Simple geometric concepts suffice to explain a wide variety of everyday phenomena (the Sun's path through the sky on different days of the year, the distance scale of the Solar System, the phases of the Moon and motions of the planets).

(2) Using the abundant examples from the history of planetary astronomy, how do scientific theories change, and how does science work?

(3) What is the forefront knowledge on how the Solar System formed and how do planets evolve? This last topic uses planetary atmospheres as a fertile ground to explore the issue of planetary climate via comparative terrestrial-planet discussion (the different atmospheres of Venus, Earth, and Mars) and to link this to current discussions of global warming as a further example of how science works.

These changes required radical redesign of the curriculum in order to create cohesion amongst these elements throughout the course. In addition, the previous tutorial activities were discarded and six new tutorials were created, with help from CWSEI STLF Peter Newbury. The new tutorials are integrated strongly with the lectures and develop in much greater depth topics that are both very important to the course goals and benefit from smaller group activities. This approach addresses past experience indicating that students were confused by these topics. The tutorials are:

(1) the celestial sphere,
(2) lunar phases,
(3) Solar-system scale and planetary motion via a human orrery,
(4) the scientific method,
(5) planetary impact cratering, and
(6) characterizing extra-solar planets.

These tutorial activities have now been through 4 iterations. In the 2009/2010 academic year pre-tests and post-tests were used to show strong improvement in student learning on the six topics in question. TA deployment has also changed radically during the last two years. Before this period ASTR 310 TAs functioned more traditionally, leading tutorial activities as though they were labs. Now many of the activities are structured so that TAs set up student learning experiences. In the scientific method tutorial many TAs are used in each section (one TA per 6-8 students) so that smaller group discussion activities can be driven successfully. The long-term success of these transformations will clearly consist on having good communication of knowledge during transitions of instructors and TAs. The idea of using a 'senior TA' or 'super TA' who has seen the course material before seems indispensable for a course on this scale (enrolment in the 160-200 student range, with 4-6 TAs). Having the course be flexible enough to change instructors (so that each can give their own unique spin) while holding onto the core topics is a challenge that will await the near future.

PHYS-ASTRO Science Education Research Team