Institutional Agenda

Stetson has two pre-professional schools--Music and Business. Both require students to take one natural science course, and all majors in the College of Arts and Sciences are required to take two four-credit natural science courses with laboratories. We want these courses to be more than "hoops" that students must jump through in order to meet graduation requirements. Instead, we want our students to recognize the importance of scientific thinking to the civilized society in which we live. While always modest about the limits of their knowledge, we want them as citizens to be ready to engage complex issues that require scientific and technical analysis. We want them to be excited about the wonder and beauty of the natural world and strengthened by their ability to think mathematically and to test their thinking by experiment. Finally, because our vision of liberal education centers on the development of informed values, we want our students to be comfortable with the science that is necessary to citizens who are responsible for difficult ethical decisions about the environment, health care, access to scientific knowledge and information technology by under-represented groups, the importance of "basic research," and the critical need for science education (separating mock science from real and understanding the difference) for all citizens. In short, our thinking about engaged and active learning in undergraduate laboratory courses will ultimately lead us to "big-thinking" about the role of science in democracy and in the development of each liberally educated student.

The impetus for focusing our team initiative on courses for non-science majors is twofold. First, virtually all instructors who teach non-majors science courses at Stetson recognize that many students enter our classes with attitudes about science that range from apathy to active disdain. While all of us have changed at least some of these negative attitudes during the course of a semester, we continue to seek ways to reduce the fear and loathing that students sometimes bring to science and create a more positive image of science across campus. Therefore, we want to use the Goals for 150-level (i.e., courses designed for non-science majors) Natural Science courses (Appendix A) as a starting point for a conversation about how we teach, how we can improve, and how we can overcome resistance to learning science. Secondly, the structure of our non-majors courses has changed over the last several years due to the loss of faculty positions in Departments of Chemistry and Physics and an effort to increase the number of freshman and sophomores that are able to enroll in a natural science course. In at least some departments, (e.g., Biology) we now offer more and larger non-majors sections than before. While class size was traditionally capped at 24 students, we now have lecture sections of 48 (or 72) students separated into two (or three) lab sections of 24 students each. In some cases the lab sections have different instructors. These changes resulted from a desire to increase the efficiency with which these courses are taught, but there has been very little discussion of the pedagogical merits of such a shift. In addition, the impact on faculty teaching loads has not been addressed.

Based on these two areas of concern regarding the non-majors science curriculum at Stetson, we have identified four broad agenda items to describe our team initiative.

These are: 1) to assess how we presently teach non-majors natural science courses, 2) to use this assessment to critically evaluate our courses and consider methods for improvement, 3) to examine the existing general education requirements for natural sciences and the pedagogical impact of these requirements on class size and staffing, and 4) to consider how our plans for a new science building will facilitate the teaching of non-majors science. There are several questions that must be addressed to reach each of these general goals. These are discussed below in more detail.

Assessment of existing non-majors courses – We will develop an assessment tool, to be administered to all science faculty teaching non-majors courses, that will allow us to quantify how and what we presently teach. In general, the tool will address questions of how student understanding is assessed, what broad content is covered, and what pedagogical tools are utilized. More specifically, we will ask questions about the number and type of writing assignments required each semester, as well as the number and type of exams and/or quizzes. We will also seek to determine, for example, the extent to which students use computers, formulate their own hypotheses, analyze their own data, and make graphs. In addition, we will ask how instructors incorporate small-group work, use general audience books versus mass trade textbooks, utilize the internet, make science relevant to their students, and include active learning in lecture and lab. We also want to assess the degree to which faculty are familiar with our non-major course goals, the degree to which they agree with the importance of these goals, and the degree to which their courses address each goal. The goal of such an assessment is not to standardize the way in which non-majors science courses are taught, but to recognize the strengths and weaknesses of our existing curriculum, start a conversation about effective non-majors teaching across science disciplines, and to identify areas for improvement.

Consideration of improvements to courses – The assessment described above, and its subsequent dissemination to science faculty, will encourage instructors to strive for improvement in their individual courses. Members of this team will be instrumental in providing information and resources acquired through PKAL to interested faculty. For example, brown bag lunch discussions would be one way to maintain a dialog among faculty about what works and what doesn't in non-majors education. In addition, we anticipate the assessment is likely to reveal broad areas for improvement in virtually all non-majors science courses. We envision several such areas in advance of the assessment. For example, we must investigate ways to identify student misconceptions about science, dispel those misconceptions, and explicitly discuss the difference between science and pseudoscience and between religious beliefs and scientific facts.

Evaluation of natural science course requirements and structure – As described earlier, there have been some recent changes to the structure of non-majors science courses that have impacted class size and faculty teaching load. In addition, there have been recent requests from the School of Business and the Department of Teacher Education to the Natural Sciences for science courses without a laboratory component. Before we can suggest changes to the present course offerings, there are a number of questions that must be addressed. These include: Is there a negative effect of large class size (e.g., 72 students in a lecture section) on student learning of science? Can a science course without a laboratory achieve the jointly agreed-upon goals for all 150-level natural science courses? If so, what would such a course look like? Can a science course tailored to a specific student group (e.g., students in the School of Business) increase student interest in science? How can we most effectively utilize our faculty resources to create the most positive science experience for our non-majors? What do non-majors science courses look like at other schools of our size?

Capacity for new science facility to enhance non-majors teaching – The renovation of our science building is a priority of the University. We presently have architectural plans that were drawn based on faculty input from all departments included in the new facility. As we increase dialog related to the teaching of non-science majors among faculty from all science disciplines, we will do so with the knowledge that the physical space in which we teach is changing. In particular, the new facility will foster interdisciplinary education. A long-term goal, then, is to develop a lively vision of conversational and collaborative science that embraces non-science majors for our dreamed-of new science facility.

Vision for Success

Our Leadership Initiative Team will develop clear plans for assessing the specific agenda items we have identified. In some cases, success will mean that we have adequately researched the questions and now have answers. In others, success is less tangible because it requires us to assess student perceptions and learning.

The development of an assessment tool for our present non-majors curriculum will require team members to think more holistically about non-majors courses. The success of this assessment will be based on: 1) a high response rate by faculty teaching non-majors courses, 2) the number of faculty participating in discussions about non-majors teaching, and 3) the identification of areas of common strength and weakness across 150-level courses. We do not intend the outcome of this goal to be a set of requirements for teaching a non-majors course. Rather, we envision the intention of this goal to be met when all faculty become informed about non-majors science courses across the curriculum and when we have enough information to help us evaluate the courses we teach and consider specific improvements.

Measuring the success of teaching improvements is perhaps the hardest thing to do. Pre- and post-tests administered at the beginning and end of a semester that address questions related to student perceptions of science, the relationship between science and religion, and specific common misconceptions about a particular content area will help determine whether we are creating a positive change. Other quantitative methods for measuring success include tracking the number of non-science majors who register for natural science courses as electives and the number who change their major to science after taking a 150-level course.

Our team's evaluation of the present size and type of natural science offerings for non-majors will be successful if we can answer the questions we describe above and if, upon arriving at those answers, we can effect change as necessary. To answer the questions we need to compare student learning in large and small sections of the same course and to assess student learning in pilot sections of courses designed specifically for students with a particular academic emphasis. To avoid reinventing the wheel, we would need to research what other schools are doing in non-majors courses and learn from their experience.

Finally, the success of our vision for non-majors science in a new science facility can only be realized when we have acquired the new physical space. In the short-term, however, this Initiative will help us develop a plan for a more integrated, interdisciplinary natural science experience for non-majors that should translate easily to a new building.

Our faculty and administrative team:

Grady Ballenger, Dean of the College of Arts and Sciences and Professor of English, leads Stetson's largest academic unit. For the past six years he has spearheaded the effort to design new science facilities and renovate the existing science center. He attended a PKAL meeting on facilities in 1999 and has since been a keen advocate of their views of STEM curriculum reformation.

Cindy Bennington, associate professor of biology and chair-elect of the department, chair of the University's Environmental Responsibility Council, and a specialist in native plant ecology. Cindy has just returned from a PKAL workshop for department chairs, and she'll be working this year with our current chair, Mike King, who is also a member of the PKAL effective faculty leadership group.

Terry Farell, professor and former chair of biology, and now head of COSM*S (committee on Science, Mathematics, and Computer Science), our interdisciplinary science group who have developed our plan for a new science center and are continuously looking at ways to improve the teaching of science at Stetson. Terry is an internationally known scientist of reptiles and amphibians, specializing in species native to Florida.

Missy Gibbs, assistant professor of biology and coordinator of our new Aquatic & Marine Biology program, a specialist in Florida native spring ecology.

Harry Price, assistant professor of chemistry, coordinates our biochemistry program and regularly teaches a science laboratory course for non-majors. Harry also has provided leadership in some of our efforts to partner with area community colleges and to broaden participation in the sciences by under-represented groups.

Kevin Riggs, professor of physics, chair of our University committee on undergraduate research and summer research grants for students, and CUR councilor in physics.

Dixon Sutherland, professor of religious studies and co-leader of the University's Values Council, has a longstanding interest in the role of science in ethical decision-making. He teaches our environmental ethics course and is regularly called upon for his expertise in medical ethics, including end-of-life decisions such as those recently facing the family of Terri Schiavo. As director of the University's Christian Ethics Institute, Dixon has been responsible for bringing major speakers to campus, including Bill Moyers, Jane Goodall, and Wendell Berry.

Appendix A. A list of goals for non-majors Natural Science courses at Stetson University. These goals were jointly accepted by faculty in all departments of the Division of Natural Sciences.

Goals for 150-level Natural Science Courses

Every 150-level course should:

* Teach a great deal about the methods of inquiry in the Natural Sciences. A diversity of methods (i.e. careful observation, experimentation, and modeling) should be addressed and students should understand the critical role of quantification and falsification in science.

* Contain at least one highly detailed example of the immense utility of analytical mathematics in the description of natural processes.

* Clearly distinguish between valid scientific methods and pseudoscientific studies.

* Provide a clear example of how scientific knowledge progresses. This necessarily involves a historical component and should reveal how science has been advanced by new data, new ideas, and new interpretations. It should also show how advancement has sometimes been slowed by an unwillingness to deal with changing paradigms.

* Develop the students' abilities to speak clearly and persuasively about scientific methods and results.

* Involve a large amount of active learning. All students should engage in a variety of learning experiences. The "laboratory" aspect of the course is critical to learning about both the concrete and abstract portions of a discipline.

* Develop a curiosity and interest in the natural sciences in students that endures well beyond the end of the semester.

To accomplish these goals, every 150-level Natural Science course should contain as many as possible of the following:

* A detailed example of the immense utility of computer simulations in understanding natural processes.

* Examples of consilience (the strong unity of knowledge among the different disciplines of the natural sciences) in the natural sciences. Specifically, the instructor should show how knowledge originally developed in a different discipline ultimately had strong influences on the field of study.

* Information that helps students develop an active appreciation of both the potential benefits and potential dangers of scientific advances.

* Examples of how scientific knowledge helps inform responsible ethical decision making. When possible, the course should empower students with the scientific knowledge needed to conserve our environment.

* Discussion of the aesthetic dimension of science--of what it means to seek an elegant theory and experiment. The students should develop a sense of the beauty of natural forces they explore and understand the need for commensurate beauty in scientific theory.