

ACS Reform of Introductory Science courses for Non-Majors Course Mini-grants
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Reform of Introductory Science Courses for Non-Major Final Report

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Redesign of Exploring Earth; an inquiry-based studio format geoscience course

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1. Original Goals and Objectives

The goal of this project is to significantly improve the student experience in *Exploring Earth* through the redesign of the structure of the course and sequence of topics, and the reimplementation of major student projects that comprise the course. Specific objectives include increasing the role of student inquiry in shaping the scope and methodology of the projects, and making the geoscience content of the course more holistic. The redesign will include (1) developing a new introductory field-based project that poses questions and defines goals for the entire course, (2) reordering and recombining topics into a more articulated sequence of fewer but larger projects, (3) integrating the availability of TabletPCs into the projects as a quantitative tool and source of content information via Just-in-Time-Teaching (JiTT)¹, (4) developing a set of pre-project readings that provide focused content background and stimulate an inquisitive approach to each project and (5) developing a capstone project that provides students with a sense of closure and accomplishment in the course.

2. Revised goals or objectives

The biggest change in our plans involved the “size” of course projects. We initially intended to structure the course around fewer, larger projects. In our initial summer planning sessions, we decided to take a different approach, matching student attention spans with smaller “bite-sized” pieces.

- The course now meets for two, two-hour sessions per week, rather than the one hour “lecture” and three-hour “project” periods of past years.
- Many projects are one-hour in length or shorter, and are interspersed with lecture and discussion with the natural flow of topics.
- Shorter projects are completed in class and drive the flow of topics with immediate hands-on exploration of content material.
- Longer projects overlap multiple class periods and require additional reading or reference work and more substantial reports.
- Longer projects build in scale toward the capstone project.

During our initial planning, we also added the goal of introducing more environmental geology topics into the course. We wanted these topics to be fully integrated into the projects and field work of the course.

3. In what ways were goals and objective met

- We developed an introductory project derived from “Discovering Plate Boundaries”, a classroom exercise developed by Dale Sawyer at Rice University. This project emphasizes organization of observations about plate boundaries to produce usable models for interpreting global data sets. Students do this project in the second class meeting. They work in several groups, first examining specific map data involving seismic, volcanic or topographic features of the Earth, and then in applying those observations to a specific plate. This project accomplished three main goals. First, students in the class get to know each other and work together. This prevents the inevitable formation of static lab partner groups. The project also sets a global framework for all of the subsequent topics in the course. Finally, the project gets students asking questions and developing a curiosity about geologic topics. During this academic year, this project was conducted with hard copy maps. We have now adapted this project to the TabletPCs and will introduce those next academic year. The use of the PCs will allow students to more closely examine the maps, and to overlay different data sets in real time to reveal more details of the spatial relationships of seismicity, volcanic activity, topography, and plate boundaries.
- The reordering of topics and projects and the implementation of a strong content backbone have eliminated much of the “disjointed” feel of the course. Application and environmental topics and projects have been interspersed with rock projects providing immediate “usefulness” of rock interpretation skills. For example, a project on volcanic features and hazards now follows the project on igneous rocks and a project on ground water now follows the project on sedimentary rocks. This ordering has also eliminated the “we are done with rocks” syndrome that has plagued most introductory geology lab courses.
- We have successfully developed and implemented a capstone project that integrates observational and interpretational skills from all previous projects and field trips. Students, playing the role of geologic consultants, unravel the geologic history of a fictional region using maps, cross sections, rock specimens, thin sections, fossils and geochronologic data. They are asked to use their interpretations to recommend solutions to an environmental problem. We have developed two versions of this project and will add two more versions next year. This turned out to be more work that we expected as each version requires the construction of a “virtual geologic setting” complete with maps, cross sections and rock specimens. After next year we will rotate the four distinct versions of the project to combat “institutional memory” of the results.
- We have successfully developed and implemented an introductory field trip that is conducted in the first few weeks of the course. We have located several new field stops that are appropriate for students who have not yet examined rocks in a

laboratory setting. This field trip has accomplished our goal of raising student curiosity about rocks and minerals before introducing them in lab.

- The results of the project reordering and introductory field trips have been dramatically evident in student involvement and performance on the second field trip in the course. The ability of students to interpret an outcrop is substantially better than we have observed in any previous introductory course.

4. Describe the evaluation/assessment process used

Our evaluation to date has included student performance on the second field trip and capstone project, and the standard Trinity course evaluation instruments.

- Student performance on the second field trip has improved markedly based on instructor observations of students work in the field, the quality of student questions in the field and the quality of student interpretations of outcrops.
- Student performance on the capstone project is not as good as we had hoped. The best students have done extremely well on the project, and the average performance on the project is somewhat better than results of similar projects in other courses. We had hoped for a more dramatic overall improvement in the quality of geologic interpretations, particularly in light of the dramatic improvements we have observed in students work in the field.
- Despite the somewhat heavier work load of the revised course, and the non-traditional format of the course, student evaluations of the course on the standard Trinity course evaluation instrument are somewhat improved from previous introductory lab courses. The primary areas of student concern are the workload of the course and the somewhat hectic nature of the studio format where lecture and lab are interspersed in each meeting. A small percentage of students dislike the heavier reliance on the field trips, but this is offset by the numerous and very strong positive comments about the field work. We are currently revisiting the project list to see if the perceived work load can be lessened without the loss of important material.

5. What would we do differently?

I don't think we would do anything differently in the planning and implementation. We have been very adaptive in our approach to this course revision as evidenced by our change in the early stages from larger to smaller scale projects. That change, and the resultant reorganization of topics has delayed, somewhat, our integration of TabletPC use in the course. We are planning to have some "focus group" meetings of students who have completed the course. In retrospect, we wished we had done this after the first semester of the revised course.

6. Sharing of results

To date, we have shared our results with ACS colleagues with a poster presentation (and computer demonstration) at a workshop held at Millsaps College in November 2004. Informal discussions of our work have also occurred at the South Central Section meeting of the Geological Society of America and at the annual symposium of the Keck Geology Consortium. Once we have completed the introduction of the TabletPCs in the fall of 2005, we plan to make a formal presentation of the new

course structure in an education workshop at the annual meeting of the Geological Society of America.

7. Next steps

The next major step is the total integration of TabletPCs in the course. This will begin in the fall of 2005 and be complete by the spring of 2006.

We are considering the introduction of more topics relating to surficial geology. In particular, streams, floods and glaciers are topics that students in most introductory physical geology courses find very interesting. We are evaluation ways to incorporate these topics without increasing the workload or diluting the strong project base we have developed. One possible change that is being considered is the addition of a one hour discussion meeting each week. The course would increase to a 4 semester hour credit level which would match other introductory lecture/lab courses on campus. This separate meeting would also be used for films and exams and free up more time in the two-hour meeting for hands on work on the projects.

8. We hereby grant ACS permission to post our original proposal and any and all results of our work on the ACS Science Reform website.