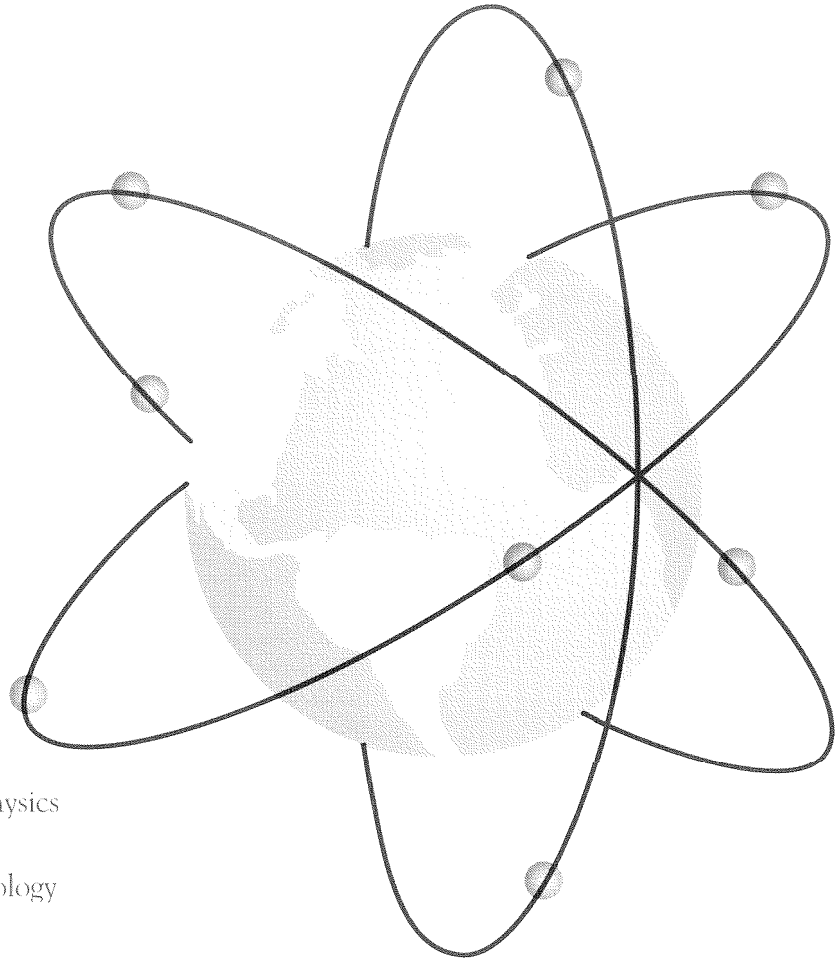
A NEW APPROACH TO TEACHING SCIENCE



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After several years of hard work, the faculty of Kennesaw State College has adopted and begun to implement a new core of courses to be taken by all undergraduate students. Central to the core philosophy is the integration of knowledge from a wide array of disciplines and the teaching of skills essential to a well-educated college graduate. Course sequences in the areas of humanities and the social sciences have been designed to meet these objectives, and the faculties of these disciplines have worked hard developing these courses.

At the same time, science education has received national attention and has been found in a number of studies to be lacking. One has only to read newspapers and magazines on a regular basis to realize that American students, when compared with those of other industrialized nations, rank well below the average in problem-solving abilities and science literacy.

We cannot even claim to be making advancements since, according to a study by the National Assessment of Educational Progress, the average performance of 17-year-olds declined between 1969 and 1986. Both the American Association for the Advancement of Science (AAAS) and the National Science Teachers Association (NSTA) have developed guidelines for essential science course content as have a number of individuals, most notably Robert Hazen and James Trefil of George Mason University. Almost all of the large-scale efforts to improve science education have been directed toward elementary and secondary schools, leaving a dearth of college-level programs.

With both of these in mind–the general lack of science literacy in the population and the development of a new core that emphasizes integration of disciplines–several members of the biology, chemistry and physics faculty have formed a Science Core Revision Committee which has met a number of times during the 1991-92 school year to discuss the shape and form of courses that would be appropriate for the science core offering at Kennesaw State College.

The committee, chaired by Professor of Biology Ben Golden, opted to explore the possibilities for a two-course sequence that truly integrates knowledge from all areas of science (including geology and astronomy) into broad themes and, at the same time, teaches the kind of basic analytical skills needed for empirical problem-solving. Associate Professor of Physics Gary Lewis and

Assistant Professor of Biology Gail Schiffer chaired the subcommittees, one for each new course, that began developing these courses. Each also received summer stipend grants to continue this development and to design lab and classroom activities.

The intent of these courses is to generate a new approach to teaching science to undergraduate students at Kennesaw State College. The courses will be constructed so as to move away from the conventional "dry science lecture" that tends to characterize many science courses, utilizing instead, or in addition, innovative teaching techniques such as group discussion, group projects, and both group and individual decision-making. These courses will be broadly-based across the sciences, and will emphasize how science works, how it affects people and how scientific decisions are made. The intended result is a graduate who is more knowledgeable about science and technology and is more equipped to make the decisions required of an educated citizen.

Based on extensive discussions of the Science Core Revision Committee, a tentative structure for a two-course sequence has been established. At present, this calls for dividing each course into three sections, with the following structure. The subtitles shown are possibilities for specific implementations of the overall themes.

SCIENCE I–MATTER, ENERGY AND LIFE

Part 1. How Science Works

Dinosaurs to the greenhouse effect: how science looks at the past, present and future

Part 2. Governing Principles for Matter, Energy and Life–a Search for "Conserved Stuff"

Food and fuel from natural resources: energy in biological and physical systems

Part 3. Systems, Structure and Function

Communication in natural and man-made systems.

SCIENCE II–CHANGE AND STABILITY

Part 1. Regulation and Equilibrium in Systems

Conflict and Accommodation/Stability, Growth and Catastrophe

Part 2. Beginnings, Evolution and the Future

Origins of Everything

Part 3. Limits to Science

Science and Non-Science

Our hope is that the final course will provide a supporting framework for both course structure and content, but allow for flexibility and initiative on the part of the instructors. The goal, on the one hand, is to build resource materials for the course to allow all of us in the science faculty to teach science concepts that may be outside of our specialty without feeling adrift with no lifeboat. On the other hand, the wide scope of the course should allow instructors to customize their own courses. The specifications of the courses will rely on general goals, with the choice of implementation left to the individual instructors. To provide support for the faculty, there will be one or (eventually) more sets of materials and activities for the instructors to use or build upon as desired.

A decision was made last spring to do a preliminary test of some of the methods and content of the new courses using the existing Biology 103 and 104 courses. We decided to implement one new section in each course, with the section chosen for the best fit with the existing course requirements. A double section of Biology 103 was team-taught by Ben Golden (biology) and Gary Lewis (physics) during fall, 1992. Ben and Gary are also teaching a Biology 104 class during winter, 1993 with a similar format.

The significant features of this trial were the use of a preliminary version of the second section of the overall course proposal, an emphasis on how science works and the use of group techniques with significant requirements for student writing.

We are convinced that the use of group techniques can significantly enhance student learning. We have experimented with several formats, and will continue to try other variations.

During the Biology 103 course, we divided the class into groups of four to five students each, with a different group each week. The groups were assigned, with no student choice in the matter.

There was considerable variation in the group activities. A typical activity might begin by requiring each individual member of the group to answer a set of questions relating to a specific topic, based on information from the textbook, handouts, demonstrations or other materials. Next, the group would discuss the questions, come to a consensus and fill out a group worksheet. This would typically be followed up by an in-class discussion and a short quiz on the material taken on an individual basis.

The format used in Biology 103 resulted in a tremendous amount of grading. We feel this was very helpful to us at this stage because of our need for a great deal of feedback. In Biology 104 we are moving to somewhat less intensive grading, but with an objective of requiring each student to do some writing every week. This should allow us to spend more time on demonstrations and hands-on experiences.

We are pleased with the results of the trial with Biology 103. As might be expected, the student response to the group format and the requirements for writing and extensive, daily participation was not good in the beginning. However, by the midpoint of the course, all but a very few students were positive about the course, with some very enthusiastic participants.

At this writing, we do not yet have the rolls for the winter quarter course, but a large number of the students in 103 have told us that they have enrolled in Dr. Golden's and Dr. Lewis's sections of 104 for winter quarter. In fact, several students complained that the sections filled up before they could register, and wanted to know when we would teach the same format again.

In addition to positive student attitudes, we are also pleased with the skills demonstrated by the students. We administered a science skills test at the beginning and end of the course. A preliminary look at the results shows some significant improvements in understanding experimental methods and analyzing scientific investigations. We also saw a significant improvement in writing and thinking skills during the quarter, based on our grading of essay questions and other student writing.

We will formally propose the new courses as Science 115-116 early in 1993. If this is accepted, we hope to offer several sections of the sequence beginning in fall of 1993. Based on our recent experiences, we are anticipating the next steps with enthusiasm.

Editor's Note: This article is a report of the work done by the authors to fulfill a requirement of a Summer Stipend Award received during 1992.