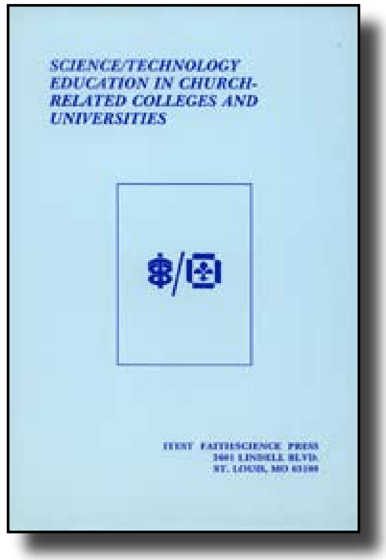

Science/Technology Education in Church-Related Colleges and Universities

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In What Way Can Science/Technology Education Enrich The More General Liberal Arts Emphasis of Many Church-Related Schools?

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In What Way Can Science/Technology Education Enrich The More General Liberal Arts Emphasis of Many Church-Related Schools?

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Education in science and technology has always been carried on within the context of the liberal arts curriculum of colleges and universities which specialize in educating their students in the liberal arts. Indeed, it is the context of the liberal arts that endows the science and technology embedded in this matrix with the possibility of discovering the human potentialities of scientific findings.

Some years ago, the National Education Association, recognizing the fact that "the values and modes of thought which underlie science and technology also are becoming pervasive in the world," recommended that schools should promote the "understanding of the values on which science everywhere is based." It also noted that "the values of science are the most complete expression of one of the deepest of humane values - the belief in human dignity."[1] More recently, an editorial in *Perspectives in Biology and Medicine*[2] attributed to the new biology a central role in the liberal arts education of the future. It asserted that biological knowledge and the attitude generated from it will profoundly affect our thoughts and concepts of person and consequently of the direction that society will take.

Such statements should be of deep concern to us as scientists and educators interested in the ways that science can enrich our liberal arts curriculum. We, as science educators, face the challenge of bringing to our scientific thought, which is such a force in human life, [3] those human values which acknowledge the dignity and destiny in God of all persons. We believe that the human values by which we promote the scientific and technological advances today will determine the kind of society we will have tomorrow. For what we choose to believe and to teach about the value of human life will have social consequences. [4]

Church-related schools, with stated missions to educate their students in such a way as to honor the humanity of each individual as a creature of God, are particularly well-equipped to narrow the gap that presently exists in academia between scientific "truth" and human values. As Pope John Paul II has observed, "science develops best when its concepts and conclusions are integrated into the broader human culture and its concerns for ultimate meaning and value."[5] Likewise, the humanities are enriched by the understanding and appreciation of our universe as a whole with which the scientific disciplines endow us. This dynamic interchange between the sciences and humanities can encourage the drive toward a unity which resists homogenization and relishes diversity, and can reveal those limitations which support the integrity of both disciplines.

This dynamic interchange can take place in the liberal arts school both within and outside of the regular course curriculum. It can take place between and among science majors and non-science majors. It can consist of exposure, thinking, reading, discussion and internalization which may eventually lead to practice.

The National Science Teachers' Association has divided the goals of science education into four general headings for purposes of discussion:

I.) Science for meeting personal needs. A person broadly educated in the sciences should be prepared to (a) cope with an increasingly technological world and (b) use science and technology to enhance the quality of life.

II.) Science for resolving current societal issues. While the issues may not necessarily be resolved completely, science education must have as its goal the development of a broad pool of citizens who are interested and functionally literate in science and its applications in society. [6] Daniel Yankelovich has expressed great concern with the "absence of an effective science presence in the public debate on which successful democracy in our age depends." [7] Even more pertinently, a goal of quality science teaching is to help prepare students to make the tough decisions they will have to make as the citizens of the future. [8]

III.) Science for assisting with career choices. Education in the sciences can give students an appreciation of the nature and scope of the wide variety of science/technology related careers and other careers which are strongly impacted by developments in science and technology. For example, students can be introduced to other aspects of the interrelationship of science and the humanities through the interests and research of their professors and mentors. [9,10,11]

IV.) Science for preparing for further study. The study of science on the undergraduate level can prepare a student to enter a variety of professional and academic pathways.

Goals I and II, in the liberal arts college context, can be applied to science and non-science majors alike, while those labeled III and IV are more appropriately applied to the science major.

One effective way of meeting goals I and II is through STS (Science, Technology and Society) education. The syllabus (attached) for a course, "Science and Society," which is taught by a chemistry professor at the College of New Rochelle is one such example of this type of education. The stated objective of this course is to provide an understanding of the principles underlying current scientific topics of interest with the hoped-for results of acquiring the ability to contribute thoughtfully to the current debates about scientific problems and come to some rational positions concerning their disposition.

Another curricular way of meeting goals I and II for science majors is to engage them in formal independent study or seminar study on issues of societal importance. For example, one junior chemistry major at the College of New Rochelle chose an independent study project on Robert Oppenheimer as a victim of McCarthyism (Spring, 1989). Many different societal issues came to light in this study; the student gave a full report to faculty and students at the annual Honors Colloquium at the end of the semester, thus generating a wide audience for debate and questions.

An extracurricular way of meeting goals I and II is through organized informal discussion such as the "Ethics Forum," an informal group of faculty, students, staff and alumni which meets on occasional Saturday mornings at the College of New Rochelle. Topics range from Biomedical Ethics to Business Ethics, but the biomedical area has had broad coverage during this past academic year. The format consists of a brief presentation of an issue by an invited expert, accompanied by copies of references and handouts of pertinent papers on the topic. About an hour and a half of discussion follows. Typically, 18 to 24 persons attend these sessions.

The preceding examples by no means exhaust the possibilities of meeting goals I and II. Indeed, some science faculty at church-related liberal arts colleges might even question the limitations of the stated goals above. In fact, it is our belief that much broader goals for science education in the liberal arts context should be formulated. These goals should be based upon the philosophical quest for truth, beauty and goodness.

With respect to truth, if science has become our god, it must be removed from the altar. It is Joseph Pitt's contention that scientific inquiry is an ongoing activity in which the so-called truths of the past are constantly being revised and rejected in the light of new theories and discoveries. Hence, no finished product of science can be enshrined as Truth. [12] The liberal arts context can emphasize the nature of science as a process constantly moving in the direction of Truth.

With respect to beauty, A. Truman Schwartz, in his paper, “Science: The Greatest of the Humanities?” [13] extols the virtues of science as contributing to a greater understanding of beauty, brotherhood and belonging. He also asks us not to forget that science, of its very nature, is ambiguous; that science mirrors the tension between the specific and general, the concrete and abstract; that a deep knowledge and appreciation of science ultimately leads to a deep knowledge and appreciation of ourselves as human beings.

With respect to goodness (in the moral sense), theologian Kevin O’Rourke questions whether we should not have something more to say concerning values relative to the new biotechnology of the medical sciences. [14] It is also encouraging to find such groups as the Women Chemists Committee of the American Chemical Society sponsoring a symposium on *Ethics and the Future of Chemistry*, during which they considered such topics as fraud in the chemistry laboratory, ethical behavior in academia, and ethics and chemical education. [15]

Finally, with respect to goodness (in the broad sense), Susan Snyder [8] makes two very important recommendations in the teaching of science which would be most applicable in sciences majors’ courses: (a) an examination of scientific knowledge in its historical context in order to discover how the information came to be accepted by the scientific community and (b) the need to study the inherent values of science: respect for evidence, demand for precision and verification, questioning of all things, and consideration of unstated assumptions and premises.

We think that goals III and IV should be broadened to reflect the search for truth, beauty and goodness inherent in scientific endeavor. We also think that it is possible to incorporate these broader goals into the science majors’ curriculum both formally and informally. Much ongoing discussion is needed in order to formulate specific recommendations.

In formulating these recommendations, we should keep in mind that religion and theology play a role which can be highlighted by church-related educational institutions: “The human quest for understanding requires us to draw on a diversity of different sources. Science is not merely a means to technical control or accurate prediction; religion is not just a matter of moral action or private converse between the individual and God. Each contributes to our understanding of the complex world in which we are set. The quest for understanding is thus necessarily a collaborative one in which the autonomy of the constituents must be respected.” [16]

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COR 051
SCIENCE AND SOCIETY
FALL 1988

DR. THOMAS VENANZI

I. INTRODUCTION: OBJECTIVE AND OUTCOMES

Science and Society is a course designed for non-science majors. Its object is to provide an understanding of the principles underlying current scientific topics of interest. Each of the topics chosen crucially affects not only the way we live but also the future of our society. In the course, we will emphasize the mastery of the principles rather than the relevance of the topics.

The course does not assume an extensive background in any of the topics we will discuss. The necessary scientific background will be provided within the context of the issue under discussion. For example, in the process of dealing with topics concerning the environment, the use of nuclear weapons and power, the computer explosion, drugs and the brain, and genetic research, basic principles dealing with the behavior of gases and acid-base behavior, nuclear reactions and electromagnetic radiation, electronics as a way of simulating logical processes, and the molecular basis of biological processes will be discussed.

Hopefully, as a result of our work during the semester, you will acquire certain competencies, such as, (1) the ability to understand and handle basic scientific concepts, (2) the ability to deal with simple quantitative measures, and (3) the ability to form scientific arguments. Furthermore, by the end of the course, it is hoped that each of you will be able to contribute thoughtfully to the current debates about the scientific problems which are discussed in our society. It is of utmost importance that each of us have the necessary scientific knowledge to explore the issue, understand it, and come to some rational position concerning its disposition. As we work together to explore each of these issues, it can only be hoped that the questions can be discussed in a comprehensive manner and, more importantly, new questions will emerge.

II. COURSE STRUCTURE

There are basically three levels of participation in the course: in-class participation, outside reading, library assignments, and semester projects.

(A) In-class Participation

In-class activities will include formal lectures, discussions, experiments and simulation exercises. Active participation is expected from all students; we have much to learn from each other. Class attendance and participation will count 20% of your final grade. More than two absences during the semester must be explained to the instructor.

(B) Reading Assignments and Commentaries

The in-class experience will be far more rewarding if all of us make an effort to come to class prepared. As you can see on the class schedule we will cover seven topics, all with a set of readings. The readings, which are drawn from Science, Scientific American, and Discover, among others, will be distributed before each of the units. A Reading List is attached to the syllabus. For five of the topics a commentary will be assigned which will be due on the date indicated. For each of the commentaries we will provide a set of questions which you may use as a guide. Your commentaries will vary in length because the readings for certain topics are longer than others. As a minimum, two hand-written pages are suggested. The commentaries will count 40% of your final grade.

(C) Semester Projects

In December each of you will present a poster session to the class. The mechanics of the "poster session" will be explained in detail during the semester and a list of possible topics will be provided. However, you may certainly choose your own topic. In this regard, it is strongly encouraged that you read the Science Times each Tuesday for a possible topic for your presentation. The poster session will count 20% of your final grade. In addition, during the examination period a final examination, counting 20% of your grade, will be given. Both the poster session and the final examination will be used to evaluate your ability to handle scientific concepts and construct scientific arguments related to current scientific issues of interest to society.

(D) Grading Summary

Class Participation	20%
Commentaries	40%
In-Class Poster Session	20%
Final Examination	20%

III COURSE SYLLABUS

DATES	TOPIC	COMMENTARY	DUE DATE
Sept. 8	Introduction		
Sept. 13	Unit 1: The Reporting of Science: Is Depression Hereditary?		
Sept. 20,22,27,29, Oct. 4	Unit 2: Genetic Research & Genetic Engineering		Oct. 13
Oct. 6,11,13	Unit 3: Drugs & the Brain		Oct. 27
Oct. 18,20,25	Unit 4: Nuclear Weapons		Nov. 15
Oct. 27, Nov. 1,3	Unit 5: Nuclear Power		
Nov. 8,10,15,17,22	Unit 6: The Environment: (a) Greenhouse Effect (b) Acid Rain (c) Depletion of the Ozone Layer		Dec. 1
Nov. 29, Dec. 1,6,8	Unit 7: The Computer Explosion		
Dec. 13,15	In-Class Poster Sessions		Dec. 15

READING LIST

GENERAL TEXT

M.M. Jones, D.O. Johnston, J.T. Netterville, J.L. Wood, and M.D. Joesten, *Chemistry and Society*, Fifth Edition, Saunders Publishing, 1987. The material for the lectures, especially for Units 4, 5, and 6 will be drawn from this text.

UNIT

"Searching for Depression Genes," L. Wingerson, *Discover* 1982, p. 60.
"Manic-Depression: Is It Inherited?", G. Kolata, *Science* 232, 575 (1986).

UNIT 2

“The Genetic Code,” F.H.C. Crick, *Sci. American* 208, 66 (1962).

UNIT 3

“Drugs and the Brain,” S. Snyder, *Scientific American Library*, 1986,
Chapter 1 and Chapter 4, pp 91-100.

UNITS 4 AND 5

“Nuclear Winter,” A. Ehrlich, *Bull. Of Atom. Sci*. . April 1984, p. S1.

UNIT 6

“Greenhouse Warming Still Coming,” R.A. Kerr, *Science* 232, 573 (1988).

“The Challenge of Acid Rain,” V.A. Mohnen, Sci. American 259, 30 (1988).

“Antarctic Ozone Hole: Complex Picture Emerges,” P.S. Zurer. *Chem. Eng. News* Nov. 2, 1987, p. 22.

“Ozone Hole Bodes Ill for the Globe,” R.A. Kerr *Science* 241, 785 (1988).

UNIT 7

The Sachertorte Algorithm, J. Shore, Penguin Books, 1986.

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