SCIENCE EDUCATION

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ABSTRACTS

An Experiment for Nonscience Majors: The Buffer Capacity of Humus Soil. MARSHALL P. CADY, JR., Department of Natural Sciences, Indiana University Southeast, New Albany, Indiana 47150.——Laboratory experiments for nonscience majors must meet a wide range of objectives. They must introduce students to new concepts, everyday applications of these concepts, and laboratory techniques which quantify the concepts. In this paper the general desirability of these goals is discussee in context of a specific experiment dealing with the buffer capacity of humus soil. The experiment has been performed by approximately 150 students with positive response.

Biology for the Citizen. CHARLES L. GEHRING, Department of Life Sciences, Indiana State University, Terre Haute, Indiana 47809.——The consensus (non unanimous) was that there should be a *single* course for majors and nonmajors, not separate courses (CUEBS News, Vol. IV, No. 3, Feb. 1968). When an introductory course is listed as a prerequisite to other departmental courses does it make sense to have general education/liberal arts students in that course? I think not. There are two distinct groups of students: (1) Those with career objectives that require mastery of biological concepts, processes and principles, and (2) those needing "people" biology. Obviously, there is subject matter to be considered; but more importantly there is a need to whet the student's appetite for additional information on biological topics, and they become scientifically literate.

How does one organize a meaningful course for nonmajors? What topics are included or excluded? It is a fact that 25% of the freshmen entering public colleges/universities drop out during or after the first year, and 65% will never complete a degree program. An introductory biology course is, in fact, a terminal biology course. Therefore, *general* topics are more appropriate than are the details of biochemical pathways, etc., such as are required in courses for majors. I use questionnaires, course/instruction evaluations, and discussion to determine what to offer in the nonmajors course. For example, the data from the Sex Knowledge questionnaire reveal a significant lack of formal sex education or parental discussion of contraceptives, VD, etc. My students do not read American Journal of Botany or Plant Physiology; however, I do encourage them to read Newsweek, Time, Playboy, Cosmopolitan, etc., and I assign readings in such publications.

Most often a course is what the instructor *wants* in terms of content/topics. Perhaps the priority should be determined by student *needs*. We must continuously ask ourselves, *why are we all here*? The answer always must be *to help students learn* (S.N. Postlethwait, JCST Vol. XI, #1, Sept. 1981).

In Quest of the Quark: Teaching an Introduction to Elementary Particle Physics. LINDA HAMRICK, The Canterbury School, Fort Wayne, Indiana.——Introductory

Elementary Particle Physics serves as an initiation to the emerging theoretical framework for matter/energy at the sub-subatomic level. It is not intended as, nor is there any pretense of its being, more than an introduction to basic terminology and principles of a field which can only grow in importance as the years progress. To arm students with enough background so that they may listen to and assess new discoveries as they occur is more than responsible, it is mandated in this rapidly developing field.

The course begins with a brief review of Newtonian Physics and then subdivides topically into eight main areas: 1) Classic subatomic particles; 2) Boson/Fermion distinction (analogous to Energy/Matter components) based on the Pauli Exclusion Principle; 3) Fermion subdivision into Leptons (pointal and conform to the Pauli Exclusion Principle) and Hadrons (can be further subdivided and do not conform to the Pauli Exclusion Principle due to the Strong Force); 4) Lepton types: electrons, muons, tau particles, their respective neutrinos and the antiparticles of each; 5) Hadron types: Baryons composed of three quarks (a proton belongs to this group as does the neutron) and mesons composed of two quarks; 6) Boson classifications as the units of Force (one example is the photon as the boson of the Electromagnetic Force); 7) The Four Forces: The Strong Force, The Electromagnetic Force, The Weak Force, and the The Gravitational Force; 8) Symmetry breaking at the beginning of the Universe, and the unification of forces and particles, historical as well as theoretical.

This course has been offered at various times over the past two years at both Indiana University's Special Abilities Program at Fort Wayne, as well as at The Canterbury School for youngsters ranging from grades seven to twelve. Even in age-mixed classes, with the leveling effect of a good basal review of Newtonian Physics plus a firm introduction to atomic theory and subatomic particle terminology, the student success level has been very high, averaging 95% on post-testing which includes objective, essay and problem solving questions. Interest levels have exceedingly high as well, in fact student interest in the subject from brief mentions of terminology like "quarks" in various printed and electronic media, was that which initiated the course originally.

The historical aspect of this area serves well for students in another manner, for it provides an example of the integrative nature of many scientific breakthroughs, and delves the past in terms of Galileo's work on Terrestial Gravity unifying with Kepler's work on Celestial Gravity, through Newton's insight in *Principia* (1687). The search is yet current, as we watch scientific history take shape in Heisenberg's Quantum Mechanics (1932), Anderson's discovery of the Positron (1936), Gell-Mann/Zweig's prediction of the quark (1963), and the Glahow/Salam/Weinberg work in Weak Interactions (1979).

The effort by Physicists to develop new terminology and theory in the evolving picture of matter/energy is not an attempt to make matter more and more complex, although the confrontation with new terminology sometimes leaves this impression. The effort is, of course, just the oposite. When all units of both matter and energy are contained (albeit theoretically) under the umbrella of a few quarks, leptons, and a handful of force-units called bosons, the entire structure of our universe assumes a marvelous integrity if not simplicity. This structure of Elementary Particle Physics can be utilized to complement Physics as the traditional behavioral underpinnings on which the various scientific disciplines are based.

Be Thankful for Your Science Teaching Problems. STANLEY S. SHIMER, Science Teaching Center, Indiana State University, Terre Haute, Indiana 47809.——At

the end of your teaching day, do you feel like a slick-sleeve Private, or a five-star General? This article may show how you can be a five-star General.

A General controls problems—ordering them around and making them obey him. A teacher deals with the problems of controling children, arranging materials, and providing a good learning environment. Solving these problems is half of the teacher's job; teaching is the other half. If it were not for things that go wrong, your principal could get someone to handle your job for half the price. Excellent teaching is hard work, but it is very satisfying to be able to go to bed each night as a five-star General.

A Report of the Indiana Energy Education Curriculum Project for Elementary, Middle and Senior High School (1979 to 1981). JOE E. WRIGHT, Energy Education Consultant, Division of Curriculum, Indiana Department of Public Instruction, Indianapolis, Indiana 46204.——Phase I (1979) involved developing three units for elementary educators, grades K-6. Energy activities were developed in four areas: Awareness, Understanding, Inquiry Skills and Participation. Evaluation of the materials in Indiana classrooms showed knowledge gains and positive attitudinal changes.

Phase II (1980) involved developing materials for middle/junior high school educators. Two units and a comic, Quantum Conserves, were designed, printed and disseminated. Evaluations by classroom teachers revealed administrative support, major usage in science, community support and potential for future use in 1982.

Phase III (1981) involves developing nine units and a teaching guide for sixteen subject areas for senior high teachers. Materials will be disseminated through ten regional workshops, Energy Education CADRE and local education agency coordinators.

Phase IV (1982) will involve developing and implementing State Plan. The major components of the Plan will include an Energy Education CADRE (Thirty classroom teachers), Community Networking Program, Home Conservation Program, Youth Conservation Program, School Conservation Program and Project NEED (National Energy Education Day).