SCIENCE EDUCATION

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ABSTRACTS

The New IAS Fellowship Program for Secondary School Science Teachers. Walter A. Cory, Jr., Office of School Programs, Indiana University, Bloomington, Indiana 47405.——In an attempt to increase the science teacher's knowledge of a field of science, to enhance one's enthusiasm toward scientific research and teaching, and to foster communication between secondary science teachers and college/university scientists, the Indiana Academy of Science has instituted a fellowship program for secondary science teachers.

Teachers of science in grades 6 through 12 with at least two years of teaching experience who are members of the IAS are invited to consult with a college or university scientist at one of the graduate level institutions within Indiana and submit a proposal to the chairperson of the Committee on Secondary Science Teacher Fellowships by December 15 of the year prior to the summer the research is to be conducted. The fellowships consist of a stipend of $120 each week for up to ten weeks plus an allowance of up to $300 for supplies. In 1983, two teachers received support under this program. Cynthia Brown, a biology teacher at Hamilton High School, and Art Middleton, a chemistry and physics teacher at Rensselaer Central High School, performed research or development at Tri-State University and Ball State University, respectively. Cynthia and Art will describe briefly their efforts of last summer and explain how this experience might improve their teaching, help them work more effectively with student researchers, and so forth. In 1984, we hope to involve two or more additional teachers with financial support from the Academy and other agencies.

A New Zoo in Indianapolis. Richard G. France, Indianapolis Zoological Society, Inc., Indianapolis, Indiana 46218.——The current Indianapolis Zoo opened in 1964 and has shown steady growth in size, programs and services ever since. Like all zoos, it strives to offer good leisure time recreation and entertainment, be educational, conduct good practices that promote conservation of natural resources and carry out study projects to research areas of operation. It is an obvious focus of community pride.

The zoo has now reached a point where plans for a new facility are being developed. A 75-acre site on the west bank of White River in downtown Indianapolis has been identified as the location for the new zoo. Plans call for an animal census of some 2,500 specimens contrasted to the present zoo's 500 animals.

The zoo is planned to accommodate approximately 1,000,000 visitors annually. Planning teams of zoo, wildlife and aquarium authorities, combined with architects, construction designers, and zoo officials, are setting the themes and goals for a world premier zoo. The overall zoo theme strives to illustrate diversity of life and constant change in our environments. The design principle centers on major biomes of the world; the waters, the deserts, the plains, the forests, plus an animal encounters area and commons/people space.

The Indianapolis Zoo has always made education a keystone for its operation. The New Zoo is being planned to be as useful, flexible and pertinent for education as possible. Various groups of users and audiences, including educators from all areas, are meeting to discuss and examine all potential educational messages, programs, facilities and services.

The Master Plan program is completed and the schematics design phase is in progress, with facilities design to follow in the next several months. Construction of the zoo will begin in early 1985 and the scheduled opening is spring, 1987.

A Classroom-applicable Methodology for Evaluation of Maturation in Cognitive Structure. LINDA HAMRICK, Department of the Sciences, The Canterbury School, Fort Wayne, Indiana 46804.——Research has resulted in several methodologies for pursuing how closely cognitive structure in a student's memory parallels content structure, including digraph theory (R. J. Shavelson, The Journal of Educational Psychology, Vol. LXIII, 1972), word-association analysis (R. J. Shavelson, Journal of Research in Science Teaching, Vol. III, 1974), and computer-generated conversational maps (G. Pask, The British Journal of Educational Psychology, Vol. XLVI, 1976). These investigations have been particularly significant to science and mathematics instruction due to the volume and complexity of content covered, and the importance of clear interrelationships in order for technical knowledge to be useful to the learner. However, the complexity of these approaches effectively precludes their implementation in the classroom.

A technique has now been developed which can be utilized by the classroom science teacher, both to analyze students' cognitive structure as well as promote integration skills in learners at the same time. A course is analyzed by the teacher for the twenty to thirty major and minor concepts covered, with twenty or less recommended for the middle school level. The educator then arranges these concepts into a meaningful relationship on paper (e.g. electricity, nuclear reactions and mechanics would all be grouped under energy), which then becomes the criterion map against which student work is measured.

The concepts are then placed on cards which are shuffled and placed on the learner's desk, whose task becomes arranging the cards in the best way he or she feels the terms fit together. The students' resulting card arrangements, representing their cognitive structures of the concepts, are analyzed for similarity in grouping and sequencing to the teacher's criterion map. Results indicate that science students may be more proficient at perceiving relationships within concept groups, e.g. within the energy group, than between concept groups, i.e. perceiving the broader context of relationships. Over a four year period, however, from 5th to 8th grade, the ability of students to perceive relationships between major concept groups improved significantly with periodic cognitive-structuring exercises, while a control group did not exercise such an improvement. The indication is that through testing methods which encourage students to consider the structural interrelationships among concepts, it may be possible to both evaluate and promote structural knowledge; such a mechanism taps both definitional knowledge of single concepts and their interrelationships (G. M. Diekhoff, Journal of Educational Psychology, Vol. LXXV, 1983). The importance of interrelating and problem-solving in science suggests that the technique may be a useful one to science educators.

Rationale and Tactics for Increasing Scientific Investigation by Secondary School Students. SUSAN M. JOHNSON, Department of Biology, Ball State University, Muncie, Indiana 47306.——Many secondary school students graduate without learning that science is a way of searching for understanding of the physical world, and that they themselves can become involved in intriguing investigations. These students are not alone, however, for many of their teachers also have seldom had the opportunity to define a problem, design an experiment, or experience the satisfaction of answering a question through investigation. The Indiana Academy of Science, through the Youth Activities Committee and its support of science fairs, the Science Talent Search, and the Junior Academy, has a strong tradition of encouraging secondary school students to get a taste of science. This presentation will address the growing Academy concern to help in-service teachers establish research programs in their schools. The paper also reports on the results of a program designed to give pre-service teachers: (1) firsthand experience in investigating a research question; (2) skills and experience in motivating and managing research efforts of ninth-grade science students who may have shown little previous interest in scientific endeavors; and, (3) confidence in their ability to incorporate a less-structured, more individualized research format in their teaching.

Oxygen Consumption and Osmoregulation in the Goldfish in the Student Laboratory. R. S. MANALIS, K. L. HOWARD and A. W. O'SHAUGHNESSY, Department of Biological Sciences, Indiana University-Purdue University at Fort Wayne, Fort Wayne, Indiana 46805——Oxygen consumption under various experimental conditions was measured for goldfish placed in a simple perfusion chamber. A glass cylinder (25 mm X 180 mm; D X L) contained the fish which was perfused with various solutions. The inflow solutions were saturated with air using a gas washing tube connected to an air compressor. The solutions were put into a 750 ml Kelly perfusion chamber, and the fish was perfused due to gravity. The control of the perfusion rate of this system did not require the use of screw-clamps, but, rather, the use of about a 15 mm length of 20 guage (I.D.) Teflon tubing as the outflow tube limited the perfusion rate to about 10 ml/min. The height of the perfusion bottle was varied so that a perfusion rate of 10 ml/min was obtained; during an experiment, additional perfusate was added in order to maintain a constant fluid level and, thus, a constant perfusion rate. The chamber was constructed in such a way as to permit the rapid exchange of solutions when necessary and, most importantly, to collect both inflow and outflow samples under oil. That is, before a 100 ml sample was collected, about 5 ml of vegetable oil was put into the empty Erlenmeyer flask, and the tip of a Pasteur pipette, for the inflow sample, or the tip of the Teflon tubing, for the outflow sample, was placed beneath the oil. In 14 consecutive measurements of oxygen consumption in which oil was alternately used and not used, the outflow samples collected under oil contained 13% less oxygen than did those samples collected in the absence of the oil. The presence of the oil did not present any practical problems when the Winkler method was then used to determine the oxygen concentration in the test samples. This is because the same Erlenmeyer flask was used during the subsequent analysis. Except for the concentrated HCl, all reagents were added by burettes, whose tips were placed beneath the oil. A magnetic stirring rod was used in order to improve the reproducibility of formation of the floccular precipitate and to reach the endpoint of the titration. In addition to measuring oxygen consumption in an animal, the students gained specific experience in the relationship between osmotic stress and aerobic metabolism.

A Summer Course in Physics for Gifted Junior High School Students. VAN E. NEIE, Department of Physics Education, Purdue University, West Lafayette, Indiana 47907.——The STAR program at Purdue University is a two-week intensive session during which gifted junior high age students enroll in two courses of their choosing from among several alternatives. This paper describes a course in the physics of light and color taught by the author. Materials and activities are described along with a discussion of the pecularities of teaching such topics to gifted adolescents.

How Teachers of Various Backgrounds Solve the Problem of Sequencing Four Masses with a Pan Balance. STANLEY S. SHIMER, Science Teaching Center, Indiana State University, Terre Haute, Indiana 47809.——Elementary and secondary teachers tend to use different problem solving techniques as they try to sequence four unknown objects according to their masses from the lightest to the heaviest. There were several techniques used by teachers. However, most of the elementary teachers used a double beam balance to compare one object with another. In general, the secondary teachers used the double beam balance to weigh each object and then to sequence them to solve the problem. The percentage of teachers who correctly sequenced the objects was higher for teachers who compared the weights than for teachers who weighed the objects.

A Simple Way to Produce 360° Holograms Using a Low-powered Neon Laser. F. R. STELDT, Indiana University at Kokomo, Kokomo, Indiana 46902.——A 360° hologram is a hologram which reproduces the front, sides and back of an object on one piece of film. The 360° hologram can then be viewed by walking around the transparent, cylindrical film holder. An apparatus has been designed, built, and tested which enables students to easily produce their own 360° holograms using a low-powered neon laser and the appropriate film.

The apparatus consists of reasonably priced materials most of which are readily available at local stores. The components can be assembled in just a few hours and the stability of the apparatus can be experimentally confirmed. The critical alignment for producing good 360° holograms will now take only a few minutes.

General Science Education in Indiana. ALBERT A. WILLIAMS, Department of Biology, Manchester College, North Manchester, Indiana 46962.——The scientific literacy of the general population has been criticized widely in recent years with important implications for the future of the United States. A survey of the science requirements of Indiana colleges and universities indicates that science is thought to be an important component of an undergraduate college education. However, the nature of the requirements and the curriculum choices available to students may not significantly improve the scientific literacy of the students after they graduate. Most institutions appear to provide a traditional discipline centered, content oriented approach to exposing non-science students to the natural sciences. A review of the available textbooks in my field (Biology) indicates that this approach is reinforced by the publishing industry, with most texts stressing the content of the discipline rather than the process of science. They, in fact, often make the process very difficult to discover.

The current situation is fixed in the nature of our institutional general education science requirements and course offerings. I suggest a rethinking, at the divisional level, of our goals in the science education of our non-science oriented students. Scientific literacy must be defined in realistic terms applicable to non-science graduates in light of what we expect years after graduation. The curriculum must then be structured to achieve these goals. An alternative to traditional content oriented survey courses is available and would benefit our students.