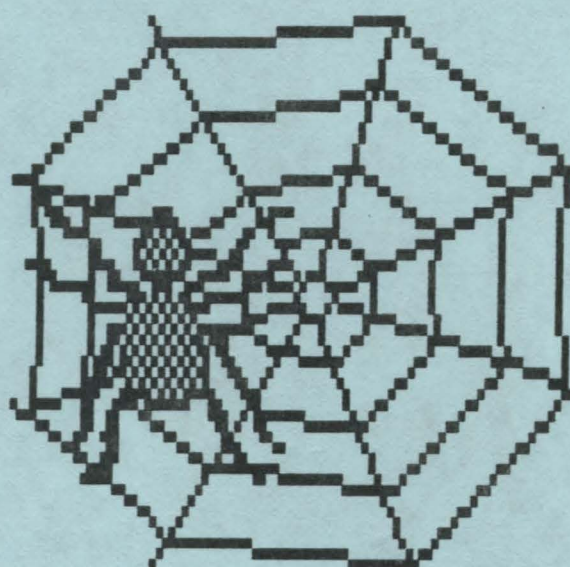
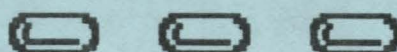


**MIDWEST
BIOSCIENCE**



**FEB 1986
VOL 12 (1)**

TABLE OF CONTENTS

	Page
Letter from the President	1
Message from the President	2
A Final Note to Participants of the 1985 AMCBT Meetings	3
Position Opening	4
Editors Note	4
The Importance of Laboratory Education in Life Sciences	5
Using Human Subjects in the Laboratory	10
Diversity of Benthos and Stream Quality	12
Teaching Taxonomy the Hard Way	17
Ideas from the North Country	18
Team-Teaching General Biology	19
Teaching History of Biology and Medicine	26
Poster Sessions at the 29th Annual AMCBT Meetings	27
The Science Honors Seminar Course at Millikin University	29
Confronting the Creation Science/Evolution Issue in Education	33

**DEADLINE FOR NEXT ISSUE
APRIL 1**

**PUBLICATION DATE
MAY 1
(WE HOPE!)**

AMCBT CENTRAL OFFICE
December 1, 1985

To All Members of AMCBT:

AMCBT has completed another successful meeting at Augustana College in Rock Island, IL. Many of those who attended have commented favorably on all aspects of the meeting. A visitor from one of the larger sister institutions was heard to comment in surprise on the quality of the presentations and the discussions which ensued. Shucks, we knew that all the time.

The weekend before Thanksgiving was used by the Steering Committee to assist next year's Program Chairman, Malcolm Levin of Sangamon State University, to lay out a skeletal program for the next Annual Meeting. This meeting will be held at Sangamon State University, Springfield, IL on September 25, 26, 27, 1986. Mark your calendars now, and plan to attend. Malcolm is planning to develop his program theme around "Science and Civic Affairs", and if you have any ideas on this topic you might like to see included, or if you yourself would like to participate, drop him a line (see Membership Directory for his address).

Since you may need to look up the address for Malcolm (or for other members), you can use the new Membership Directory which accompanies this issue of Bioscene. Please note one new feature of this Directory, your attendance at the Annual Meeting is indicated by the use of superscripts. Hopefully this will help you (and us) remember who that was you (we) were talking to at the meeting. If you find mistakes in the listings, please contact the Executive Secretary, his address is listed along with all the other Steering Committee members.

For some of you, sadly this may be the last issue of Bioscene you will be receiving. This week I will be sending out final dues and termination notices to some of you. To avoid being dropped, simply pay the amount indicated. If you do renew, and we encourage you to do so, you might wish at this time to also add next year's dues (\$10) to the amount you're sending.

I hope that the end of the semester, quarter, trimester, or whatever, finds all of you in the best of health and looking forward to the holidays. I wish you all a Merry Christmas and a Happy New Year.

Edward S. Kos
Executive Secretary

MESSAGE FROM THE PRESIDENT

The Association of Midwestern College Biology Teachers is alive and well as is evidenced by the excellent annual meeting held September 27th and 28th at Augustana College in Rock Island, Illinois. The Association owes a debt of gratitude to Ingemar Larson, for local arrangements, to Harold Wilkinson, program chairperson, to Ray Reed, our past president, and to the Steering Committee members. The outstanding efforts of these planners provided the guidance that resulted in the smooth operation of the annual meeting.

The Association's stated objectives - 1) to further the teaching of the biological sciences at the college and other levels of educational experience, 2) to bring to light common problems involving biological curricula at the college level and by the free interchange of ideas, 3) to endeavor to resolve these problems, 4) to encourage active participation in biological research by teachers and students in the belief that such participation is an invaluable adjunct to effective teaching and 5) to create a voice which will be effective in bringing the collective views of the teachers of the biological sciences to the attention of college and civil government administrations - were confronted at Augustana as we heard Dr. Joseph R. Larsen, Dean of the College of Rehabilitation, University of Illinois, state the case for the importance of laboratory experiences in biological education. We should heed his suggestions to increase, not decrease, hands on laboratory experiences in our institutions, to continue to seek experiments that work, to bring current research into the method as well as the instrumentation in the biological laboratory and to make ourselves aware of the special needs of the disabled student and to adapt our laboratory environment accordingly.

Your Steering Committee is at work again planning for the next annual meeting to be held at **Sangamon State University at Springfield, Illinois, on September 26th and 27th, 1986.** The Steering Committee met at the host institution on November 23rd to assess the local arrangements being prepared by Ann Larson and to help Malcolm Levin formulate the program. Tentatively, Malcolm is formulating plans around the theme "Roles of Biologists in Public Policy Issues" with an opening panel presentation on Friday followed by concurrent sessions on the various issues. There will be the usual sharing of ideas on "labs that work", teaching techniques and video materials.

As these plans develop share your ideas with us. If we are to continue to meet the objective of AMCBT, it is imperative that each of us share the responsibilities. Why not consider making a presentation at Sangamon State or consider submitting an article to the Midwest Bioscene. I'm sure many of us would like to have information concerning the discussions we are unable to attend either because we are unable to attend the meeting or because of the concurrent nature of the presentations. Bill Doemel, our editor, Wabash College, would welcome the material. Bill and the Bioscene Editorial Board deserve our special thanks for helping to keep us in touch between annual meetings through the pages of this publication. (Bioscene, c.o. W. Doemel, Wabash College, Crawfordsville, IN 47933.)

Our membership includes representation from fifteen states as we prepare for the Thirtieth Annual Meeting. It includes members from universities, colleges and community colleges as well as sustaining members from commercial firms. Why not recruit a colleague from your institution or a neighboring institution. Brochures about AMCBT are available through Ed Kos, our Executive Secretary, at Rockhurst College, Kansas City, Missouri 64110.

I am hoping that this academic year will see more people involved in our organization. We can continue to be a voice in the issues of Biological science, to foster better public understanding of science in general and to share our successful teaching techniques by such involvement.

Ted C. Michaud, President, AMCBT

A FINAL NOTE TO PARTICIPANTS OF THE 1985 AMCBT MEETINGS

As past program chairman, I would like to take this opportunity to make a final report to the members of this organization.

This meeting was attended totally or in part by over 80 persons. Many of these expressed their appreciation for the content and organization of the meeting. Judging from these comments I would say that those of you who were not in attendance missed out on some highly enlightening and rewarding information presented by the 41 participants. There were 15 seminars presented on subjects ranging from Ethics to Learning in the Soviet Union. The average attendance of these sessions was 11. There were six workshop/demonstrations and eight poster presentations which appeared to have been well attended. Five discipline sessions on Saturday morning allowed members to discuss and resolve some of the issues facing them in their particular fields of interest and four sustaining members set up exhibits that attracted many visitors. Finally, our two guest speakers presented stimulating talks on Laboratory Education and The Preservation of Blackhawk State Park.

I am sincerely grateful for the excellent work done by all of these participants and for all the wonderful comments I received in their behalf. I would be remiss, however, if I didn't acknowledge the work done by a few others who were hidden in the background. To the following people I give special thanks:

Ingemar Larsen	Facilities Chairman and Coordinator
John Becker	Film Festival
Jerry Foote	Poster Sessions Coordinator
Ingemar Larsen & Ed Kos	Exhibit and Sustaining Member Recruitment
Bill Doemel	Programs and Publications
State Membership Chairman	New Member Recruitment
Ray Reed & Neil Baird	Support and Encouragement

Thank you all for a very rewarding and fulfilling experience.

Honorary Life Membership is occasionally awarded by AMCBT to members who have worked for the organization over an extended period and who have performed exemplary service. If you would like to nominate a deserving member please include a thumbnail history and a paragraph describing your reasons for nominating. The nomination may be sent to President Ted C. Michaud, Biology Department, Carroll College, Waukesha, WI 53186, or to Jack Bennett, Biology Department, Northern Illinois University, DeKalb, IL 60115.

POSITION OPENING

"Tenure track faculty position available in September, 1986. Position requires broadly trained individual in life sciences to teach cell biology, developmental biology, comparative vertebrate morphology, and bacteriology (microbiology). Opportunities available to take part in general education and/or a course in specialty. Strong individualized study required of major enabling individual to pursue research in specialty. Liberal Arts experience (student or teaching) highly desirable. For more information contact David Allison, Chair, Department of Biology, Monmouth College, Monmouth, Illinois, 61462. (309) 457-2349. An equal opportunity affirmative action employer."

Editors Note

Joseph R. Larsen was the featured speaker at the annual meeting. Until recently, he served as Director of the School of Life Sciences (SOLS) at the University of Illinois. Born in Utah, Dr. Larsen completed his undergraduate and Master's degrees at the University of Utah. He earned his Sc.D. in 1958 from Johns Hopkins University. Now, Professor of Entomology and Director of the Division of Rehabilitation Education, he is an advocate of undergraduate laboratories.

THE IMPORTANCE OF LABORATORY EDUCATION IN LIFE SCIENCES

Joseph R. Larsen, Director, Division of Rehabilitation Education,
University of Illinois

Carl Sagan has said, "Science is a way of thinking much more than it is a body of knowledge." Science is exploring, searching for and answering questions, solving problems, understanding principles and processes together with their causes and consequences. If science is more than facts, information, knowledge and truth, the student experience with science should result in more than that also.

Science is a dynamic, exciting search for the understanding of patterns, regularities and principles. In no other place does this happen better than in the biology laboratory. In no other place can it be more indelibly impressed on the minds of fledgling scientists than in an introductory course in Life Sciences. I have been extremely concerned in my former role as Director of Life Sciences with the number of students who come to Illinois as transfer students who have had no laboratory experience in a biology course.

Recently the National Commission on Excellence in Education has generated a renewed interest in education, particularly in relation to scientific literacy. This then is an opportune moment for us as teachers of biology to examine our introductory college level biology courses and to look at our curricula and ask if our courses in introductory biology, or any level of biology, reflect science as a process as it can be studied in the laboratory. It is so essential to introduce the student to living systems, to teach them to ask how and why, which can only be done when they are looking at living material.

I would like to share with you an experience I had in my early years as a professor at the University of Illinois. Having been assigned to help develop a new course in introductory biology, I went to the laboratories to take an inventory of existing equipment which I will share with you in its entirety. The inventory consisted of one rusty ring stand, twelve finger bowls, two Bunsen burners, and 100 gallons of formaldehyde. As we developed this new course which was a wedding of an old general zoology and botany course, the laboratory was the first thing developed. To me it was the most important element in that course. This is a course that runs for an entire year, 5 semester hours each semester. One-half of the entire credit or grade is attributed to the laboratory. It is not 4 hours on lecture and one hour on lab, but half of the entire grade depends on the student's performance in the laboratory.

I made a pledge then that the laboratories would, and did indeed, become a living experience. Our students would know that biology did not come out of a pickle barrel filled with formaldehyde. We worked with living plants, we worked with living animals, we brought in marine specimens; we invited the students to take them out, dissect them, look at them, watch them and have a hands-on experience with living material.

We tried to make our laboratories dynamic, constantly adding new laboratory material and new equipment. I realize that this requires a commitment from your administration which it is not always easy to come by. But, it is important for you who have gathered here today as biology teachers to perfect your craft, to go back and convince your administration that you need money for laboratory equipment. The cost of our laboratory course at Illinois is roughly \$40 per student, this includes personnel, TAs, hourly help, supplies and equipment. There is a total annual budget

in excess of \$27,000 for Introductory Biology 110 and 111. It is a majors course required of all undergraduates in Life Sciences. We feel gratified in knowing that all of our students go away understanding that biology is a living science.

College faculty involved in teaching biology in a laboratory setting share many common challenges--the need to develop interesting, reliable laboratory activities; to identify reliable suppliers of biological material, to maintain and manage living laboratory organisms--and this often does stretch tight operating budgets. We have a role to train assistants for laboratory teaching and to develop relevant laboratory materials. Commercially available laboratory manuals are usually based on traditional and often unreliable procedures and materials. Many published articles in biological education are more philosophical than practical. Recognizing these commonly shared concerns a group of biologists met at the University of Calgary in June, 1979 and founded an organization of laboratory biology teachers called The Association for Biology Laboratory Education or A.B.L.E. A.B.L.E.'s primary purpose is to facilitate communication between teachers actively involved with laboratory instruction in the various areas of biology. With approximately 40 charter members, A.B.L.E. has now grown to over 500 members from the United States and Canada. During its five years of existence, A.B.L.E. has tried to improve biology laboratory education mainly by identifying successful laboratory exercises that have grown out of our workshop conferences where participants have an opportunity to get hands-on experience with new kinds of laboratories. I will be talking more about A.B.L.E. in my session at 3:00 P.m.

The point I want to make here is that there is a large group of biologists out there who are making an effort to develop good laboratory material. We have developed through A.B.L.E. an extensive bibliography of 250 annotated volumes in a biology library of laboratory manuals. Throughout the five years, we have made an effort to identify papers from the research literature that can be modified into teaching laboratories. We have found that there are many current experimental procedures that adapt themselves well to an introductory laboratory education. If we can encourage more of our colleagues to specifically identify some of their research as having potential for a laboratory exercise, we would all benefit a great deal.

An editorial published in The Chicago Tribune stated, "The distressing fact is that the overwhelming majority of our population lives in a state of debilitating scientific illiteracy." I think that no other place is that more evident than in those students who go through a biology course without a laboratory experience. With a sharp decline in laboratory teaching during the 1st 10 to 15 years, what have we harvested? I think we will have a generation of young biologists who have memorized textual knowledge and who can master our machine designed examinations to prove it. However, they do not know how to do an experiment and even more damaging, they have little or no interest in learning. They feel little or no compulsion to apply principles of a controlled experiment in their search for understanding. They do not appreciate their heritage from research, they have become biologists who fail to recognize their dependence on research for their own ability to effectively search into the unknown.

Just one example that might help students, and you as teachers, realize and stop and think about the importance of laboratory education and knowing how to function in a laboratory. Virtually all that is known in the modern handling of cardio-vascular disease has evolved within our lifetime. Our generation has seen the emergence of almost 90% of what is known in modern medicine, thus accounting for almost all of a modern physician's ability to diagnose and treat disease. This has all come about as

a result of laboratory research. I wonder if we can convey this message to our students. I wonder if we help them realize the importance of learning to function in the laboratory. Do we infect our students with a sense of excitement for a stimulation of new knowledge? Do we stimulate their natural curiosity about the biological complexities they encounter everyday? I am afraid the answer to these questions are a resounding NO. Have we as a profession abrogated our reliance on the laboratory as the place to learn biology, responsibility for teaching the principles of the scientific method? Haven't we succumbed to the temptation to emphasize hand-outs, reward the student for memorizing their lecture notes? What is happening in the biology laboratory? How many students get through all the basic sciences today without seeing a vigorously beating heart surrounded by inflating and deflating lungs?

I recall my first course in physiology when we dissected a dog and studied circulation. What an excitement it was to feel the strength and coordinated rhythm of ventricular pumping! How many of you have personally experienced the dynamic changes in the ventricular pumping action at the onset of fibrillation? Compare and contrast in your own mind the impact of just reading about fibrillation in a textbook with that elicited by holding the heart in your own hand at the very instant fibrillation is induced. This is a living system, we should be excited and our excitement should be transmitted to the student. They will gain that natural, overwhelming curiosity to find out why it works. We have, in many cases, opted for the easier way of teaching. Some may argue that new ways are better, some will defend the teaching machine, the slide/tapes, the problem programmed computer. But if these are substitutes for the teaching laboratory, I cannot accept the argument. I do acknowledge with conviction that laboratory teaching is hard work; it is expensive in terms of time, effort and money; it requires total commitment from the best teachers in your department; and, it demands time away from your own research.

When I served as Director of Life Sciences, I deliberately assigned myself to teach in the introductory course in biology. I feel that our very best talent needs to be in the introductory course, teaching in those laboratories. Our students may get through basic sciences with virtually no research experience, often no laboratory at all. They are forced to depend entirely on sheer memory for all they know. It would be impossible for us to design a more intellectually, stupefying, stultifying framework in which to learn biology.

What are some of the tangible rewards for good laboratory teaching in biology? There are many but let's look at one or two examples. Eighty-five percent of all biology majors at Illinois are pre-professional, it may be higher—it may be as high as 90% in some years. It may be different at your schools, but I doubt it. Of that 85% less than 50% will get into the professional school whether it be medicine, dentistry, veterinary medicine, or allied medical sciences. As Director of Life Sciences for many years, I worried a great deal about these students and what they would do with their lives. In counseling with biology students, many times I have said to them in a group, "Not all of you are going to get into medical school." And one can see etched on their countenance the internal response to themselves, well I certainly feel sorry for the person to my right or my left, but he's certainly not talking about me. But the honest fact of the matter is less than 50% of them will be accepted into the professional school. In response to that, approximately four years ago I started a job placement service. I was told by many people that there was no job market for someone with a biology degree. I refused to accept that and after careful nurturing, searching, and casting about for potential job markets we have found that there is indeed a very viable job market for people with a biology major. We have gone to academic institutions, we have gone to industry, and we have gone to

the government at the local, state and federal levels. All of them have job descriptions and positions which indeed utilize people with a good sound degree in biological sciences. We routinely now have our graduates at Illinois interviewed by people from Abbott, Beatrice Foods, DuPont, Eli Lilly, etc. This brings me to the point I want to make about the payoff for good laboratory teaching. Every major corporation or government agency that has come to Illinois to recruit our students has said before they ever come, "We want laboratory trained individuals. Please do not put anyone on your interview list who has not been trained in the laboratory." There is a career, there are jobs, but there is no substitute for the laboratory experience. They have to know how to use the spectrophotometer, an analytical balance, an ultracentrifuge. Give them hands-on experience in the laboratory and they will find jobs! In a real sense, we are training them not only in a storage of knowledge and information but in practical techniques that they will take with them into the professional school or into the job market.

Another payoff for good laboratory teaching is found in the potential of bringing undergraduate students into your own individual research laboratory as an assistant. If you can generate in them the excitement and interest in biological systems through their experiences in basic biology laboratories, they will be filled with the excitement of laboratory experimentation. This can be extended into your own personal research. Collin Pittendrigh, the world authority on circadian rhythms, during his years as a professor at Princeton University had many post-doctorals working in his laboratory. But all of the research on circadian rhythms and eclosion was done with undergraduate students who had been excited about biology and who came to work on individual projects in Pittendrigh's laboratory. I recall the first time I visited his laboratory at Princeton his taking me into a room with 4 or 5 cots and all kinds of experiments on the laboratory benches. These students who were working on eclosion were sleeping in the laboratory, living, eating and breathing the excitement that was going on in a research laboratory. Many of them published joint papers with Pittendrigh. Each one of you, can you imagine the potential of developing a program in your own laboratory? Each student is a potential pair of hands with not only a desire but an excitement to work in your area of research. A year ago I was at Brigham Young university in the laboratories of an old post-doctoral student of mine, Dr. Gary Booth. He is an outstanding toxicologist and has been working on the sediments on river bottoms in the major waterways in the United States. He has at least 15 or 20 undergraduate students standing in line by his office door every year begging to go to work for him because they have been excited about their introductory course. They are excited about the biology laboratory. He has a tremendous manpower and can assign each one of those students a portion of a research project and generate a tremendous amount of work. I know you carry heavy teaching loads and there are administrative responsibilities, committees and duties at a university that take you away from that you most dearly love--research in biology. These students can become a powerful asset in your own individual programs. You really cheat yourself if you don't utilize that potential. They are eager, they are anxious to be involved and, I suspect I shouldn't dwell on this very much, you don't need to pay them anything. You can have them sign up for research credit; they can work in your laboratory and for their efforts go away with 3, 4, 5 hours credit and they are ecstatic because they have had an opportunity to work in a research experience.

These are just two of the many bi-products, if you will, or rewards for good laboratory teaching. The more general rewards are obvious. The students who do well in the laboratory will be accepted in the professional schools. They are the ones who will be successful in their careers.

I am no longer director of the School of Life Sciences. I am currently Director of the Division of Rehabilitation Education at the University of Illinois, and so the last part of my talk I would like to impress on you the responsibility I feel that each one of you have to get students who have disabilities involved in science. For the past nine years, I have been involved in the National Science Foundation in developing programs around the concept that there should be more individuals with disabilities enter the field of science. For a long time, there has been a stigma that one should not go into laboratory or expect to do bench science if indeed they have a disability. It is important for you as teachers and I make a plea, an earnest plea, that you encourage students with disabilities to become involved in biological science. Teach them science, let them know that they can function. I will never forget Joe Lilienthal at Johns Hopkins, my physiology professor. When I returned to graduate school, after breaking my neck some 34 years ago, calling me into his office and sitting squarely in front of me and putting his nose in my face, saying, "Larsen, I am sorry you broke your neck, but if you're going to take my class, you're going to do everything everyone else does in the lab and I don't give a damn about your wheelchair." Well, I don't know whether he was trying to make me mad or whether that's how he really felt, but he was successful. He angered me to the point where my internal gut reaction was I'll show you, S.O.B. I went into the physiology laboratory that afternoon and saw the typical laboratory bench normally found in a dog lab. Tables high enough for "Kilroy" to peek over, I could have worked under the table more conveniently in a wheelchair. That night I returned to the laboratory with one of my friends and a saw. I took a laboratory table and cut 18" off every leg of one of the benches. The next day Lilienthal came into the lab. We had our dog at lap level and were carrying out an experiment in our group. He walked over and saw that his table had been cut down to my size and said, "What in the hell is going on?" Now I had a turn to look him straight in the eye and say, "You take care of the course and I'll take care of the student responsibilities." There was an embarrassing moment of silence, he walked out of the lab and never said another word. I believe in expediency, there is always a saw and hammer in my laboratory and whatever needs modified will be modified. It is important, as you work with people that have disabilities, that you encourage them to adapt themselves to the maximum. When they have reached maximum adaptation of self, then you modify the environment as necessary to meet their needs. You have to be careful in pressing them to independence. I recall one day as a graduate student needing a bottle of sulphuric acid which was located on the fifth shelf. I pulled the arm out of the chair, reached as high as I could and pulled the bottle to the edge of the shelf. As a five pound bottle of sulphuric acid plummeted toward the earth, I could hear someone behind me inhaling and as I caught the bottle in the cradle of my right arm he said, "My God, Joe!" If you need anything, just ask me. I'll get it for you." You will find that if you will be willing to make reasonable modifications that will not detract from that laboratory setting for anyone else, you will generate an excitement in many young minds who have been previously denied.

Probably the most difficult decision to allow me back into graduate school had nothing to do with the wheelchair or my functioning in the laboratory, it had to do with who was going to give up a parking place. There were only 11 spots and they were reserved for deans and administrators, and nobody wanted to give up their parking place. I encourage you to make whatever modifications are necessary to allow people who have physical disabilities to come into your laboratory. You will have a great, rewarding experience. I recall not long ago of having two dwarf people in class who could not function at a normal laboratory bench. They had difficulty climbing up on high stools and were very uncomfortable. During that week, I had the unpleasant opportunity to visit my local dentist for a little grinding and polishing, and as he

tipped me back in that luxurious lounge and pumped sweet music into my ear while he proceeded to destroy my mouth I noticed him going up and down on a hydraulic stool. When he had finished his torture, I inquired as to where he obtained that. He said from a dental supply house. I just press the button; it takes me up or down. I called the dental company immediately and told them I'd like to try, on a demonstration basis, two of those hydraulic stools. They brought them out, I explained what I wanted to try. The two "small people" used them with delight and efficiency. The dental supply company was gracious enough to leave them with me when they understood what the purpose was, at no charge. It's amazing what you can get done if you just give people an opportunity. Those two students did a tremendous job in the course. Both received As and for the first time they had been able to approach a microscope on a laboratory bench at their level.

We'll, I've exceeded my time. It's been good to be with you; I have enjoyed sharing with you my enthusiasm for laboratory teaching and I hope that as you go through your conference today and tomorrow addressing your theme of "Biology and Experimental Science" you will remember that biology is an experimental science and could not be so if it were not for the laboratory. Therefore, do not cheat your students at that most crucial point in their educational pathway of the laboratory experience in introductory biology. There they will truly realize that biology is indeed a laboratory experience and an experimental experience where they can gain hands-on excitement of life's processes.

USING HUMAN SUBJECTS IN THE LABORATORY

Loren Deney, Biology Department, Southwest Missouri State University

In a biology course for non-majors, or an introductory biology class, it is easy to "cook-book" the laboratory portion of the course. It is equally easy to use only dead specimens and thus have a course in necrology rather than biology. The following exercises can be used to involve students in collecting data about themselves. Details of procedure can be obtained from a wide variety of laboratory manuals. The listing is not intended to be all inclusive.

Eye Dominance:

Procedure: Cut a 2.5 cm diameter hole in a large sheet of cardboard. Using both eyes, sight a distant object through the 2.5 cm hole while holding the cardboard at arm's length. Hold the cardboard with both hands and move it gradually toward the face, keeping the distant object sighted. Determine which eye is used. Repeat several times. Do you always use the same eye to keep the object in sight? Is your dominant eye on the same side as your dominant hand? The dominant food-chewing side of the mouth? Make a record of eye, hand, and side of mouth dominance for your laboratory group. Does a consistent pattern emerge?

Depth Perception:

Procedure: Prop a large sheet of white cardboard (60 cm x 90 cm) about 5 meters in front of the class, and several feet from the front of the room. The top of the cardboard should be about 10 cm above eye level of the students.

Trial 1: Hold a strip of black paper 1 cm wide and 30 cm long, 10 cm behind the large white cardboard, with 5 cm showing above the card. Students are now to judge the distance

between the card and the black strip under four conditions:

- 1) looking with one eye, holding the head still,
- 2) looking with one eye, moving the head back and forth,
- 3) looking with both eyes, holding the head still, and
- 4) looking with both eyes, while moving the head back and forth.

Trial 2: Repeat the above procedure with the strip 30 cm from the card.

Trial 3: Repeat at 20 cm.

Trial 4: Repeat at 2.5cm.

Now repeat trials 1 through 4, but use a pencil instead of the black strip. Hold the pencil so that 5 cm shows above the card, use the same distances, but vary the order. Each student records his judgments (16 for black strip, and 16 for the pencil trials). After the trials are completed, students are told the actual distances and asked to compute their errors. What is the average error for the entire class? Which conditions produced the poorest judgment? Which the best? Were there any differences between accuracies of judgment with the black strip and for the pencil? Why?

Judging Weights:

Procedure: To determine the limit of man's ability to judge whether two objects are of different weight. Student closes his eyes and holds two 125 ml Erlenmeyer flasks, one in each hand. One is marked Control and the other Test. Each contains 50 gms water. Student reports if he considers them to weigh the same. Then the experimenter adds water to the test flask in 2-ml portions, each time handing the flasks back to the student but randomly mixing the right and left each time and asking the student to determine relative weights. When the test flask feels heavier, record the weight of water added. The difference between the weight of the test and control flask is the "difference threshold" for 50 gm. Repeat this procedure, starting with 100, 200, and 500 gm of water (using larger flasks). How fine a discrimination can be made in judging weights? Does the difference threshold vary according to the initial weights used? Make a graph, plotting weight of control flask on the horizontal axis and difference threshold on the vertical axis. Do the results vary much from student to student?

Heart Rate:

Procedure: Determine heart rate (beats/minute) using a stopwatch. Make several determinations. Plot a distribution curve for the class by graphing the frequency (number of individuals in the class) on the vertical axis against the heartbeat per unit time on the horizontal axis. Standard deviation or other statistics may be determined. Repeat with and without exercise. Plot time required for heart rate to return to normal following exercise.

Reaction time:

Procedure: Student holds thumb and forefinger of his preferred hand about 1cm apart while the experimenter suspends a new dollar bill vertically between them, with the center of the bill level with the thumb and finger. Student is to grasp the bill as soon as the experimenter releases it. (Most students are unable to do so.)

Now the student holds a meter stick between the thumb and index finger; then releases

his grip and then as quickly as possible tries to grasp it again. The distance the stick travels before it is stopped is measured. Repeat several times. Average distance the stick falls is a measure of reaction time. Compare your results with several other students. Repeat the test after chilling your hands in ice water. What effect does this have on the results? Why?

Simple and Choice Reaction Times

To show the differences between simple and choice reaction time, line up 10 students -- single file, with each person placing his right hand on the shoulder of the student in front of him. The first person raises his arm so that it can be seen by all. Students are told that each person will be tapped on the shoulder and that he is to respond as quickly as possible by dropping his arm. Instructor then taps the right shoulder of the last person in the line, starting a stopwatch at the same time, and stopping it when the last arm in line drops. --- Time ten trials. Average the results and compute the mean time taken for each person to respond. This is the simple reaction time. To measure choice reaction time, subjects place both hands on the shoulders of the person in front. This time subject is to respond by tapping the shoulder opposite the one which received the stimulus, but the location of the stimulus will be unknown in advance and will vary from trial to trial. Make ten trials and compare results with those obtained for simple reaction times.

Which reaction time is faster? What are the neural explanations for the differences in the two situations?

Vital capacity:

Procedure: Measure the vital capacity of each student with a respirometer. Average five trials for each individual. Plot vital capacity vs. height for males and for females. Plot vital capacity of athletes vs. non athletes. Plot vital capacity for smokers vs. non-smokers.

Using these types of exercises will raise the interest level of students and they will feel that the learning of principles of biology has more levelance when those principles can be related to themselves.

DIVERSITY OF BENTHOS AND STREAM QUALITY

Jerry D. Terhune, Associate Prof., Biology, Jefferson Community College of U of KY

Field Ecology classes have always presented a challenge to instructors. The ability to communicate the interrelationships of Man with his environment are a necessity if one is to allow the student to come to a realization of the actual problems confronting the conservationists. The stream is an ideal community to demonstrate the impact of man on the quality of life.

In this study I chose an urban stream flowing through a densely populated non-industrialized community. Beargrass Creek, Jefferson County, Kentucky, is plagued by the same problems that confront many streams in urban centers. Associated closely with urbanization is the disruption of existing watersheds. As the vegetation is removed, the surrounding terrain loses its ability to hold water and there is increased runoff and erosion. This results in rapidly fluctuating levels of flow, increased silting, coliforms, oxygen demand and other factors associated with the general deterioration of the stream.

Beargrass Creek originates in eastern Jefferson County, Kentucky and its 641 km of stream basin drain approximately 156 km² or 17% of the county (Figure 1). As urban growth and development has continued, much of the stream has been diverted, channelized, or modified. Beargrass Creek has also received considerable quantities of pollution from over 80 sewage treatment plants in operation within its drainage basin. The substrate of Beargrass Creek is predominantly limestone and buffers the pH of the water. The pH of the stream averaged about 7.5.

I established ten sampling stations and took four samples of the bottom fauna and water at each station. Station 1 is at the mouth of the stream and receives the accumulated silt and pollution from all three major branches of the stream. Station 2 was just below a major meat packing house and receives considerable discharge from the plant. Stations 3 and 4 are on Muddy Fork, a small sluggish branch of Beargrass Creek. Station 3 has been channelized and is heavily silted while station 4 is in a rocky riffle area. Stations 5 and 6 are on Middle Fork of Beargrass Creek. Station 5 has been channelized and is also heavily silted. Station 6 is in the middle of a large park and is relatively natural with riffles and a rocky bottom. Stations 7, 8, 9 and 10 are on South Fork of Beargrass Creek. All of these have rocky bottoms and riffles nearby. However, station 7 is in a more highly developed area with shopping centers and apartment complexes.

During the study I measured dissolved oxygen and temperature using a Hach oxygen meter. Conductance was measured using a Hach conductivity meter. Ammonia, nitrogen, phosphates and sodium were measured with colorimetric methods.

Bottom samples were collected by removing all the sediment and small rock in square foot sections. The samples were placed in preservative and brought back to the laboratory. They were sorted and identification was carried to the species level for most organisms using Ross (1944), Pennak (1978), Burks (1953), Usinger (1971), Eddy and Hodson (1969). Diversity estimates were calculated for each station using the Brillouin diversity formula (Wilhm and Dorris 1968). ($H = (1/N)(\log N! - \sum \log N_i!)$).

Increased quantities of ammonia, nitrites, nitrates, phosphates and sodium are generally indicative of pollution from sewage, fertilizers, etc. Conductance is a measure of dissolved ions. Increasing ionic content is also a good indicator of increasing pollution. Dissolved O₂ concentrations may be one of the best quick measurements to identify potential problems. Various types of organic and inorganic pollution can decrease oxygen concentrations through increased Biological and Chemical oxygen demand (BOD & COD).

Stations 1 through 10 were analyzed for each of these parameters (Table 1). Station 1 at the mouth, station 2 just below the meat plant, station 3 and 5 in channelized areas and station 7 in a highly developed area were the most heavily polluted stations. These stations had the highest levels of ammonia, nitrites and nitrates, phosphates and sodium. The dissolved oxygen concentrations were the lowest. If diversity of bottom fauna can be utilized as a measure of stream quality then diversity estimates at these stations should be the lowest. When the calculations were run, stations 1, 2, 3, 5 and 7 were the lowest, with a range of 0.00 to 1.65. While stations 4, 6, 8, 9 and 10 had a range of 1.70 to 2.08.

This study clearly illustrated the relationship of stream quality with diversity of bottom fauna. It is not a difficult study for students and will expose them to a

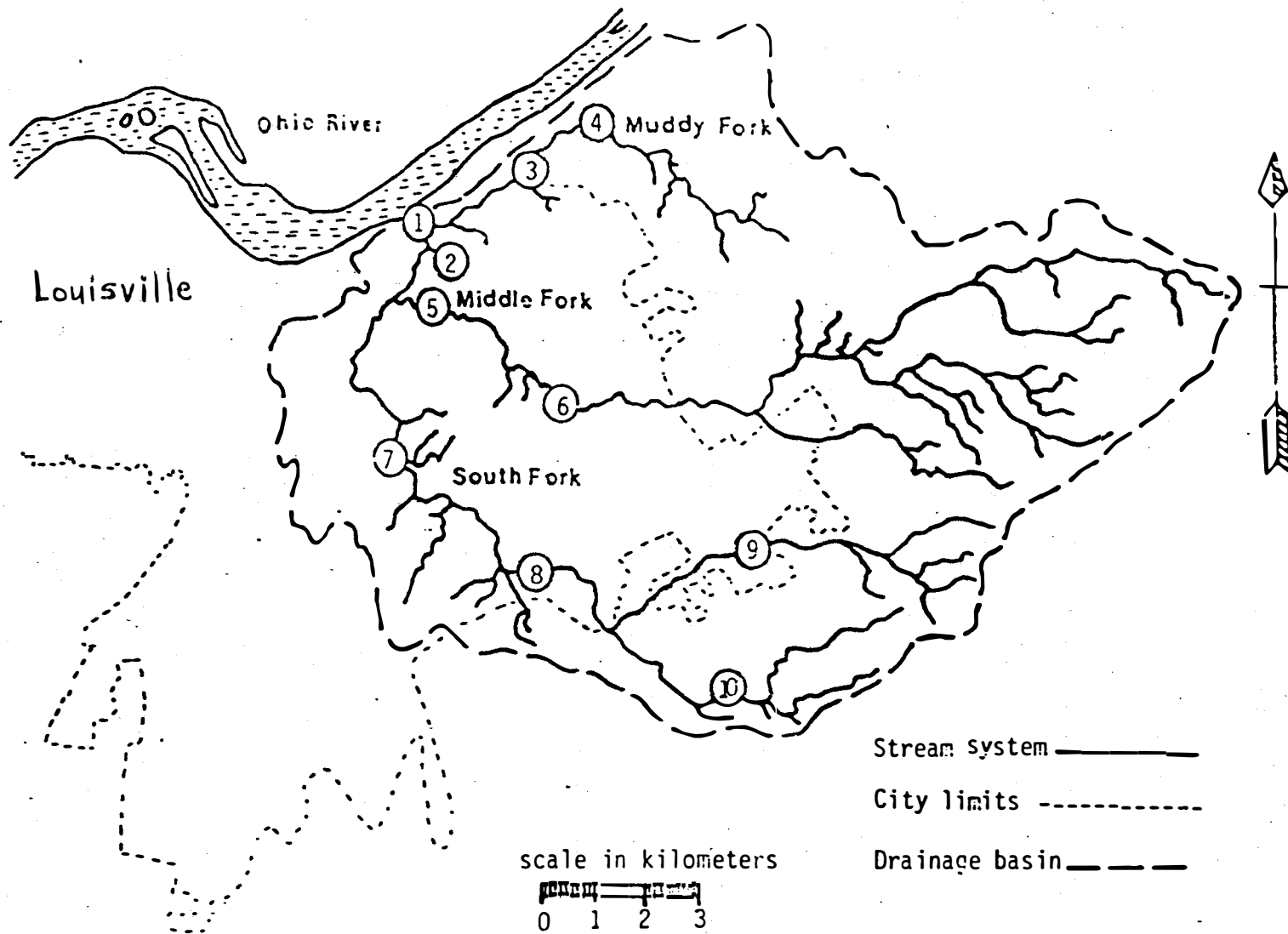


Fig.1. Map of Beargrass Creek, Jefferson County, Kentucky, showing locations of sampling stations and the relation of the stream to Louisville.

Table 1. Average of analysis of four samples taken June, July, August and September, 1985.

Station #	Temp. & O ₂	Conductance	NH ₃	NO ₂ & NO ₃	PO ₄	Na	Diversity Estimate	Total #	# of sp.
1	23 3.9	549	1.97	2.65	8.63	29.25	0.24	206	4
2	23 1.2	777	1.97	2.51	26.75	70.83	0.00	0	0
3	24 8.4	581	0.58	2.39	5.50	14.85	1.65	129	7
4	24 9.3	556	0.32	1.64	3.02	18.76	2.08	129	10
5	25 6.2	526	1.24	2.42	4.73	10.90	1.25	92	5
6	25 8.9	485	0.38	2.05	2.73	9.58	1.96	755	9
7	25 6.7	570	1.05	2.01	5.30	12.84	1.15	192	6
8	25 8.7	540	0.34	1.38	3.77	10.83	1.70	129	7
9	24 10.0	463	0.37	1.15	2.30	9.20	2.03	580	14
10	24 9.6	485	0.48	1.85	2.90	8.37	2.01	450	11

* Temp.,-degrees Cent., dissolved oxygen, ammonia, nitrogen, phosphates and sodium in mg/l

Table 1. Invertebrate species list for Beargrass Creek.

Turbellaria		Diptera	
<i>Planaria</i> sp.		Psychodidae	
Oligochaeta		<i>Psychoda</i> sp.	
Tubificidae		Culicidae	
<i>Limnodrilus</i> sp.		<i>Anopheles punctipennis</i>	
<i>Tubifex</i> sp.		<i>Culex pipiens</i>	
Hirudinea		<i>Culex restuans</i>	
<i>Helobdella</i> sp.		<i>Tarophora ciliata</i>	
Isopoda		Simuliidae	
<i>Lereus</i> sp.		<i>Simulium</i> sp.	
<i>Asellus militaris</i>		Chironomidae	
Amphipoda		<i>Chironomus attonuatus</i>	
<i>Gammarus</i> sp.		<i>Clinotanytus</i> sp.	
Decapoda		<i>Nanocladius</i> sp.	
<i>Oreocetes</i> sp.		<i>Pentaneura</i> sp.	
Ephemeroptera		Heleidae	
Caenidae		<i>Culicoides</i> sp.	
<i>Caenis simulans</i>		Empididae	
Baetidae		<i>Hemerodromia</i> sp.	
<i>Baetis</i> sp.		Muscidae	
<i>Neocleon</i> sp.		<i>Lispe</i> sp.	
Hemiptera		Pelecypoda	
<i>Corixidae</i> sp.		Sphaeriidae	
Trichoptera		<i>Sphaerium</i> sp.	
Hydropsychidae		Cyrenidae	
<i>Cheumatopsyche</i> sp.		<i>Corbicula milleri</i>	
<i>Hydropsyche</i> sp.		Gastropoda	
Hydroptilidae		Physidae	
<i>Agraylea</i> sp.		<i>Physa integra</i>	
Coleoptera		Pleuroceridae	
Halipidae		<i>Goniobasis livescens</i>	
<i>Psephenus</i> sp.		<i>Lymnaea stagnalis</i>	
Hydrophilidae		Planorbidae	
<i>Hydrophilus</i> sp.		<i>Helinoma trivolis</i>	
Elmidae		Ancyliidae	
<i>Dubiraphia quadrinotata</i>		<i>Ferrissia</i> sp.	
<i>Stenelmis sexalineata</i>			
Psephenidae			
<i>Psephenus herrioki</i>			

variety of ecological concepts and problems.

REFERENCES

- Anonymous, 1979. Methods for Chemical Analysis of Water and Wastes. United States Environmental Protection Agency.
- Burks, B.D., 1953. The Mayflies, or Ephemeroptera, of Illinois. Bull. Ill. Nat. Hist. Surv. 26:1-216.
- Eddy, S., and A.C. Hodson, 1969. Taxonomic Keys to the Common Animals of the North Central States. Burgess Pub. Co, Minneapolis, Minn. 162 pp.
- Hynes, H.B.N., 1970. The Ecology of Running Water. University of Toronto Press. Suffolk. 555 pp.
- Pennak, R.W. Freshwater Invertebrates of the United States, 2nd ed. John Wiley and Sons, Publ, New York, 803 pp.
- Ross, H.H., 1944. The Trichoptera or Caddisflies of Illinois, Bull. Ill. Nat. Hist. Surv. 23:1-326.
- Usinger, R.L., 1971. Aquatic Insects of California. Univ. of California Press, Los Angeles. 508 pp.
- Wilhm, J.L., and T.C. Dorris, 1968. Biological Parameters for Water Quality Criteria. Bioscience, 18 (6):477-450.

TEACHING TAXONOMY THE HARD WAY

Harold W. Hansen, St. Olaf College, Northfield, Minnesota

No one wants to do anything the hard way so only the truly curious will read beyond this line. A course in Plant Taxonomy in the usual academic year presents some real problems in Minnesota. Our classes end about May 15, too early for significant field trips especially with the usual pile-up of end of the semester work. A late spring would make it even worse. At the other end of the year, an early frost can be a problem. Moreover, fall flowers, with the preponderance of composites, are not the easiest nor the most interesting for beginning taxonomists. With these beginning and ending problems, my taxonomy class wound up midway between them, in the January Interim which could make the timing even worse. My background in taxonomy is indeed modest, with formal course work many years ago; teaching the course is not as easy as rolling off a Mark Hopkins log. The limited herbarium facilities of the college constitute an additional handicap.

Confronted with these negative aspects, then why teach such a course, and especially, why teach it in January? In my classical organization of the fields of plant science, I tend to recognize Taxonomy, Morphology and Physiology as primary subdivisions. Our regular curriculum seemed to have time and place for the other two but Taxonomy didn't fare so well, a neglect I regretted. The Interim was therefore an opportunity. Almost annually, undergraduates with strong backgrounds in animal biology but with an abyssmal lack of botany would discover that they were unqualified for summer appointments in conservation and natural resource fields because their

academic records included no plant taxonomy. Students were woefully unable to identify plants for their "Independent Projects" in the department, and, moreover, they considered me an incompetent consultant because of my inability to identify a poorly pressed leaf or leaflet which they presented to me, concluding that they didn't want to take a course from a prof who didn't know anything. I felt offering a Taxonomy course was a personal challenge to me, an opportunity to extend my own knowledge and, at the same time, make some modest contributions to our herbarium. The January Interim seemed ideal because few courses with formal lab components were offered then, meaning that space was generously available. Mounted specimens could be spread out on tables for long periods of time. In fact, three labs were involved, one for regular lab work, one for herbarium displays and the third for practical exams. Moreover, in the Interim, the time of the students and the instructor could be used more flexible than during the semester as this would be the only course in which they would be involved at the time. Lectures, labs or demonstrations could be intermixed without concern for scheduling.

Organization of the Course

The more formal introductory portion of the course was organized around four problems; photocopied sheets and lab materials were used. The widely divergent backgrounds of the students made it imperative that the material be basic lest frustration be encountered at the outset. Below are summaries of the contents of the four problems:

1. How are floral features useful in identification and classification? Frozen lily buds, greenhouse grown tulips, paper white narcissus, sunflowers, wheat, oats, sweet peas, garden peas, beans, squash, etc. were used.
2. How are leaves used in taxonomy? Various greenhouse materials and pressed specimens were used, such as elm, maple, rose, Tradescantia, barley, oats.
3. The use of stems, including modified stems: elm, maple, catalpa, walnut, lilac, onion, quack grass, etc.
4. How are less obvious features sometimes involved? This topic included roots, fruits (many from the produce department of the grocery store), hairs, glands, etc.

The objective of the introductory material was to make the instructor as unnecessary as possible for the subsequent lab identifications on which the students worked at their own pace. In this part of the course, each student identified 40 plants, using herbarium materials, preserved specimens, and 2x2 slides. Needless to say, this entailed a great deal of summer collecting and photographing on my part. Report slips were provided, on which the student recorded the numbers he/she pursued in the key and also the reference used for the confirmation of the identification. Confirmation from herbarium material could keep track of the progress of each student.

Several other activities were scheduled during the month, including a day-long excursion to the Herbarium, Greenhouse and Museum of Natural History of the University of Minnesota, the Minnesota Landscape Arboretum, and Como Park Conservatory in St. Paul. Each student also worked on an individual project, such as a teaching model, a museum-type display, or a report and also had the experience of mounting a specimen which was then entered into our herbarium.

IDEAS FROM THE NORTH COUNTRY

Harold W. Hansen, St. Olaf College, Northfield, Minnesota

- One of the most interesting projects which my students in Plant Physiology undertook was excising cotyledons at various stages of growth to determine the influence of the cotyledon on growth. They used soybeans, but any plant with large cotyledon which emerge from the soil could be used such as squash, cucumber, sunflower or garden bean. The basic plan was to remove the cotyledons on the day of emergence from one group of plants, on D+1 for another, etc., ultimately making a comparison with a control group. The effects were very clear, and a fine pictorial record could be made, lining the uprooted plants up on a sheet of paper, using the cotyledonary node as a reference point. Some interesting variations also suggest themselves, such as removing one cotyledon, the distal halves of one or both cotyledons, covering cotyledons with foil to block photosynthetic activity or painting the cotyledon with an inhibitor of photosynthesis. (The idea for this work came from Lane and Hesketh. 1977. Cotyledon Photosynthesis During Seedling Growth of Cotton, Gossypium hirsutum L. Amer. J. Bot. 64(6):786-790. 1977.)

- Rubber cement may be used in the making of a stomate model, gluing an extra thickness of balloon rubber to the surface of a balloon which simulates a guard cell. one balloon is carefully split lengthwise and fastened to a piece of cardboard; an intact balloon is similarly fastened down with clips (paper clips, spring clips, even clothes pins). This is essential because the rubber tends to become unmanageable when coated with the cement. Coat the exposed surfaces of both with ordinary rubber cement and allow to dry. Now match the two coated surfaces together. To complete the model, make another so you have a pair of "guard cells." Inflate and note that the thicker surface is toward the stomate and that the increase in pressure opens the "stomate." The model may be prepared and used as a demonstration, examples may be given randomly to students to inflate and compare or students may prepare the model "from scratch."

TEAM-TEACHING GENERAL BIOLOGY

Dr. Laddie Bicak and Dr. Linda Spessard, Kearney State College, Kearney, Nebraska

INTRODUCTION

General Biology 103 in Kearney State College is described as a study of basic biological principles. This is a rather concise statement but one that accurately implies the purpose of the course, that is, to have students learn these basic principles as they relate to human and environmental conservation.

Biology 103 is a general studies course and is used by non-science students to meet part of their science requirements in a degree program. Students majoring in biology may take the course for personal reasons, and it may be counted in the major's biology program as an elective.

In the past several years, the course has been offered in other than a team-teaching/lecture laboratory format. Earlier, it was offered in several small lecture sessions with accompanying laboratory sections. This plan required many instructors and ultimately resulted in a budgetary problem as well as reducing the number of upper division courses offered. For several years the course was taught as an audio-tutorial (A-T) course. This format was very successful and provided a choice for students between the traditional approach and the A-T. In recent years students have tended to register in growing numbers for the team-teaching/lecture laboratory classes. What precisely caused this shift is not known. Perhaps the students of today are looking for more structure in a course rather than the independence offered by the A-T classes. At present we offer no A-T classes. All Biology 103 classes are

team-taught.

The lecture sections meet for three one-hour sessions a week. Usually two lecture sections are scheduled and each section will have from 150-200 students. These sections are then scheduled into laboratory sections of not more than 24 students, which meet for one two-hour laboratory per week. Our Bruner Hall of Science has a lecture hall which will seat 200 students. The laboratory sessions are taught in two laboratory rooms, each accommodating a maximum of 24 students. Thus, as many as 16 laboratory sections may be needed.

Planning for a team-taught general biology course should begin several weeks before the course is scheduled to start because the logistics of teaching one or more large sections can be overwhelming if careful preparation has not been made. Some of the areas which must be considered are: objectives for the course; units to be included in lectures and laboratories; division of lecture units between lecture instructors; student requirements for the course; lecture presentation methods; laboratory manual preparation; evaluation of students; and, laboratory instructor responsibility.

LECTURE

Division of Lectures

Lectures are arranged into units and are evenly divided between the two instructors' personal preference. For example, one instructor has a background in animal biology while the other is more botanically oriented. The units are arranged so that the instructors alternate unit presentation. Each unit is planned to be 3-5 days in length.

The biological principles taught are related to the following units: the cell; cell transport; mitosis and protein synthesis; energy relationships; classification; protista and animal kingdom; reproduction and homeostasis; heredity; monera, fungi, and plant kingdom; ecology; diseases of man; and physiology and nutrition. We have collaborated in the writing of these units and have made a conscientious effort to emphasize how these principles relate to the life of the individual student.

Presentation of Lectures

The basic outline for each unit is provided to the student on transparencies, with an overhead projector. The outline is then elaborated upon and enhanced by the instructor's lecture. Application to the human organism is emphasized as often as possible although other examples are given. Films and/or slides are used to reinforce concepts when appropriate. Time for student questions is allowed since student interest and participation must be encouraged.

Readings and Objectives

Assigned readings from the textbook are given with each unit. Also, study objectives (review questions) are given with each unit so the student knows what he or she is required to learn. Over 90% of an examination comes from material covered in the study questions. The readings and objectives are printed and bound into the laboratory manual for the student's convenience.

Instructor Obligations to Lecture Information

All instructors, including the laboratory instructors, are asked to attend lectures so that they know which concepts are presented. The lecture instructors attended each other's lectures the first time the team-taught course was presented. The reason for all instructors having a knowledge of the lectures is to avoid student confusion about the various areas of information and to provide a uniform basis for discussion in laboratory sessions.

LABORATORY

Laboratory Manual

The laboratory manual used was co-authored by the team-teachers who are in charge of the course. The laboratory manual is written to supplement and illustrate information presented to the students during the lectures. It was felt that an in-house laboratory manual was preferable to a commercial manual because the order of the labs could be arranged to follow the lectures and that there would not be many unused activities. Included in the laboratory manual are: laboratory safety reminders; assigned readings for each unit; review objectives for each unit; and, the individual laboratory activities. Another advantage for the manual is that it is printed locally, thus any corrections, deletions, or additions are fairly easy to accomplish.

Laboratory Instructors

The laboratory instructors are chosen with the student's needs in mind. Since most students enrolling in general biology are freshmen, laboratory instructors are chosen who will assist the student in learning without intimidating the student. When graduate assistants are used, they are given careful instructions so that they are fully aware of the way they are to conduct their laboratories. Staff meetings take place each week, before the first laboratory day, in order to coordinate activities and to discuss potential rough spots with suggestions on how to meet them. The laboratory instructors are responsible for evaluating the student's performance in the laboratory and for giving the results of the evaluation to the lecture instructors who then assign the final grade.

Laboratory Procedure

At the beginning of a laboratory session, usually a film or a 2 x 2 slide presentation is used to introduce the nature of the lab. For example, a film dealing with Mendel's Laws may be used, or a slide set of representatives of the animal phyla may be shown. Some of the films emphasize lab techniques which the student will be using. For example, the film, Earthworm Anatomy and Dissection, instructs the student in performing the dissection and in identifying the systems of the worm.

Following this, laboratory procedures are explained to the student and the students then work individually or in small groups to carry out the tasks. The instructor is a guide in this learning process.

Models, charts, living and preserved specimens, permanent microscope slides, film loops, and filmstrips are used to enhance and emphasize concepts being studied. The laboratories are designed to give the student a number of experiences in the processes of science. An example of a lab which dwells on the scientific method is "Animal Behavior". A copy of this lab and excerpts from others may be found at the conclusion of this paper. Some labs demonstrate a particular principle. For example, an aerobic "train" is set up to show CO₂ production in germinating seeds. Direct involvement

of the student is paramount; hence, labs like those dealing with chlorophyll and paper chromatography, and, the onion root-tip squash and mitosis, are good illustrations of inquiry laboratory situations.

EVALUATION

Several types of test items have been tried in the formation of tests for general biology, but because of the large numbers of students the multiple choice test is used. Items are designed for recall, analogies, inquiry, and for identification with the use of diagrams. Five one-hour tests are administered during the course. Each test has 50 points. In addition to the lecture tests, a 10 point quiz is given at the conclusion of each laboratory session. A 20 point value is placed upon the quality of the laboratory manual, which is handed in for grading, and attendance. Generally, a maximum of about 410-420 points is available in a semester's course. Grading is based on 90% and above A, 80-89% B, 70-79% C, 60-69% D, below 60% F. The hour tests are administered and proctored by the team teachers and laboratory instructors. Three or four forms of the test are used for each hour test.

SPECIAL CONSIDERATIONS

Even in classes of 150, students may be accommodated for handicaps. A student with poor vision or poor hearing is provided a seat close to the projection screen in lecture. A student legally blind is allowed to take examinations in a private office in order to allow the student to use a special magnifying glass. A dyslexic student, and others, are allowed to tape record lectures. In some instances, tests have been recorded on cassette tapes for special students. Tutors are available to any student who desires additional help. There is no charge for tutoring. With a little effort, most special student needs can be accommodated. A close relationship is held with the Student Affairs Office in order to alert that office to the needs of students who are having a difficult time.

SUMMARY

Team-teaching general biology can be a successful adventure. Perhaps a key to this kind of course is a cooperative and conscientious effort on the part of persons involved in the presentation of the lecture and laboratory sessions. Then too, the time and material resources for the course must be acknowledged and provided by the department.

ANIMAL BEHAVIOR (A Scientific Investigation)

Introduction

Living organisms, plant and animal, respond to many situations and to many specific stimuli. Consider for a moment, the multitude of stimuli to which we react each day...temperature, light-dark, foods, stress, atmospheric conditions, medications, etc. In this laboratory session we will investigate in the field, the behavior of animal organisms.

Objectives

1. To observe in the field, an animal in its natural environment.
2. To record data in an orderly way, about the behavior of an animal. (Data may be quantitative, qualitative or both.)
3. To interpret behavioral data.
4. To write a report, in scientific format, to explain the observational investigation.

Procedure

1. Select a field study for the observation of the behavior of an animal. Consider such animals as:
 - A. Birds: robin, sparrow, bluejay, sandhill crane, ducks, etc.
 - B. Mammals: squirrel, 13-lined ground squirrel, prairie dog, etc.
 - C. Insects: fly, bee, butterfly, moths, beetle, ant, etc.
 - D. Other animals: spiders, sow bug, etc.
 - E. NOTE: Cats, dogs, domestic animals (pigs, cattle, etc.) and man cannot be observed for this study.
2. Observe your animal in its natural habitat for as many observations as you deem necessary. For example: two one-hour periods on two successive days; or, one day for two hours; etc.
3. Keep a record of your data. Record number (quantitative) data and descriptive (subjective) data. Use tables or charts.
4. Development of a scientific report. The report must have these sections.
 - A. Title: give your observational investigation a title.
 - B. Procedure: describe what you did. Tell exactly how you carried out the investigation.
 - C. Data: present your recorded data (use tables, charts, brief anecdotal statements, etc.).
 - D. Results and Conclusions: What findings can you state about the behavior of your animal, based on your observed data?

Reporting your work

1. Your written report will be handed in during the next laboratory period.
2. The report will be graded on the basis of ten.
3. Be neat! Use your best composition and grammar!

EXERCISE 2:

A. Onion Root Tip Squash

PRECAUTION: SOME OF THE CHEMICALS USED IN THIS EXERCISE CAN CAUSE IRRITATION IF THEY COME IN CONTACT WITH THE SKIN OR WITH THE SURFACE OF THE EYE. IF YOU WEAR CONTACT LENSES, IT IS RECOMMENDED THAT YOU WEAR REGULAR EYE GLASSES DURING THIS LABORATORY. FUMES FROM THE PROPIONIC ACID CAN GET BEHIND THE CONTACT LENSES AND IRRITATE OR EVEN DAMAGE THE SURFACE OF THE EYE.

Onion seeds have been placed in culture dishes for five days in order to initiate the process of root growth. These seeds will be used to prepare the onion root tip squashes. The procedure is as follows:

1. Place onion seed and root in drop dish.
2. Kill and fix with 20% propionic acid for 30 minutes.
3. Place in 15% HCl (hydrochloric acid) for 5 minutes in order to hydrolyze (dissolve) the middle lamellae (cement) between the cell walls.
4. Rinse in distilled water for 5 minutes.
5. Place 2 - 3 drops of aceto-orcein stain on a clean glass slide.
6. Place 1/4 inch tip of onion root on the slide.
7. Let set for 3 - 5 minutes.
8. The slide may be heated (move slide through flame until it feels warm to the back of your hand). Heating will intensify the stain.
9. Macerate (tear apart) the root tip with a steel needle.
10. Place cover slip on slide.
11. Tap cover slip with wooden end of steel needle.
12. Fold paper towel over cover slip.
13. Use thumb to apply pressure to cover slip. Remember to press straight down. Allowing the cover slip to slide over the surface of the root tip will distort the cells.
14. Examine slide under high power.
15. Record all observed stages of mitosis.

List the stages of mitosis that you were able to observe.

- B. From available charts, models and filmstrip, illustrate the phases of mitosis above the name of each phase.

1. Prophase

2. Metaphase

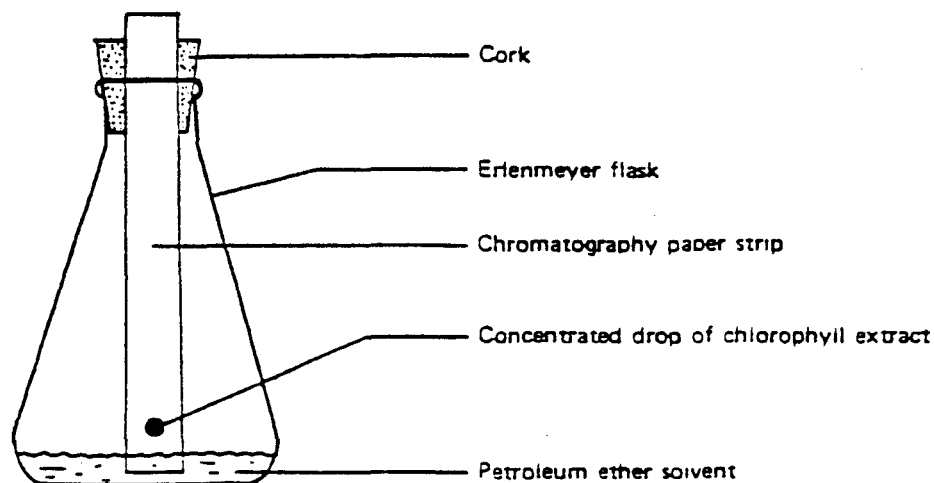
EXERCISE 2:

Chromatography

Paper chromatography can be used to separate the individual pigments which are found in green plants. Several pigments (substances which absorb light) are present in plants, but the green color of chlorophyll masks the other pigments. The pigments present in the chlorophyll extract to be used in this laboratory are: Chlorophyll a (bluish or blue green), Chlorophyll b (olive-green or yellow-green), carotene (orange) and xanthophyll (yellow).

Methods of preparation:

1. Obtain a strip of chromatography paper.
2. By using a small capillary tube, place a small drop (about the size of the head of a straight pin) about an inch from the end of the paper strip.
3. Allow the spot to dry.
4. Put the chlorophyll end of the strip into a flask containing petroleum ether (solvent) so that it resembles the following illustration. The paper should touch the liquid, but the drop of chlorophyll should be above the solvent.



Paper Chromatography Apparatus

5. Allow the solvent to travel up the paper strip by capillary action until the solvent line almost touches the cork.
6. Remove paper strip from the flask and allow to dry.
7. Label the pigments which should now be separated. (The orange carotene should be near the top, the yellow xanthophylls are just above the greenish pigments, bluish chlorophyll a is below the xanthophyll and olive-green chlorophyll b is below chlorophyll a).
8. Using the transparent tape provided in the laboratory, tape your strip in the space provided below.

TEACHING HISTORY OF BIOLOGY AND MEDICINE
John H. Becker, Knox College, Galesburg, IL 61401

Introduction

At the last AMCBT meeting, it was suggested that biologists may have an "image" problem: when the lay public thinks of a scientist, invariably a chemist or physicist is conjured up. One way to assist our students (and ourselves) in understanding biologists is to look at the historical and philosophical underpinnings of modern biology. For this reason, I decided to transform one of my avocations, history of biology, into a formal course at Knox College. Our college, as do many others, offers a course in the history and philosophy of science, but the book and lectures use examples from chemistry and physics - the lone exception is evolution. Ignoring all suggestions of physics envy, I decided that the development of the scientific method for biology fits different paradigms than those of physical sciences, and further, that biology's development was just as exciting as the other sciences.

Pilot

I searched the catalogs of other colleges in our consortium, and found no listed course in the history of our discipline. Therefore, I designed my own course. I knew that I would include a writing component because of Knox's strong emphasis on writing skills, so a topical paper was the first part of the framework. I used my senior seminar class in 1983 as a pilot for the new course. I gave a few cursory lectures, used Asimov's¹ paperback as a text, and asked each student to write a 15-page paper on a topic in the history of biology, then deliver a 1 hour talk based on the paper. While the papers were excellent, the seminar format was a mistake - no one got a decent overview of the history.

Curriculum Committee

Submission of my designs for the course to the college curriculum committee was easy. The hard part was the distribution assignment. When I sought history distribution, questions arose about my training in history (minimal) and whether this would become a "punt" course for science majors trying to avoid real history courses. When I sought science distribution, my colleagues asked if this would become a "punt" course for non-science majors trying to avoid real laboratory science courses. What I ended up with was: one-half credit class, 200-level, 2 lectures per week, with science distribution. The latter required a promise that scientific theory be covered, not just people, places, and events. This turned out to be easy since evolution by natural selection vs. acquired characteristics, preformation vs. epigenesis, and other historical controversies require some knowledge of biology itself.

Books

As my sole textbook, I used Lois Magner's A History of the Life Sciences². Other possibilities were Gardner's History of Biology³ or Green's History for Medical Students⁴. The Magner book is the most recent, and the students found it readable; it does have some idiosyncrasies, however. Other sources include my modest personal collection of books, those of other biology professors, and a bibliography of the Knox library collection which I drew up last summer. I found some rare books in Knox's collection - a 1748 Linnaeus, and a 1705 Robert Hooke. Of course, most students had to use interlibrary loans for their papers.

Format

I used a lecture format; the grades were based on 2 essay-style exams, 1 ten-page topic paper, and a book report. The latter required the students to read 20-100 pages in a primary source, such as Aristotle, Theophrastus, Vesalius, etc., and write a 2 page synopsis/critique. This is especially important-even in English translation the flavor of these ancient works breaks through, and the students get a very different taste than they get from the chronicles of the textbook.

Results

This fall, nine students enrolled; their majors were: Biology (2), Chemistry (1), History (2), English (2), and 2 underclassmen. The course seemed to proceed well, and some students reported greater appreciation and enthusiasm for biology at the end of the course. I did use some slides and transparencies during the lectures, and I intend to expand this next time because settings are very important for history courses. One problem is the lack of significant contributions by women before the twentieth century. Even the textbook author, a woman, had few examples. I intend to continue the course, although some adjustments such as alternate year offerings may be warranted.

Assessment and Conclusions

I personally feel that the course was successful - I learned much more teaching this class than when I took it as a graduate student. Furthermore, the course attracted some biology majors, but also raised the biological consciousness of some non-majors. (Not everyone received that easy A, either.) Finally, my colleagues are interested in the course - our microbiologist gave a guest lecture on his discipline when I had to be out of town.

If you are interested in developing such a course at your institution, I think that it can readily be done. Please write to me if you would like to see my syllabus, bibliography, titles of student papers, or other information.

References

- ¹Asimov, Issac, A Short History of Biology, 1964, Garden City, NY, The Natural History Press (189pp).
- ²Magner, Lois N., A History of the Life Sciences, 1979, New York, Marcel Sekker, Inc. (489 pp).
- ³Gardner, Eldon J., History of Biology, 3rd edn., 1972, Minneapolis: Burgess Publishing (464 pp).
- ⁴Green, John R., Medical History for Students, 1968, Springfield, IL, Charles C. Thomas (197 pp).

POSTER SESSIONS AT THE 29TH ANNUAL AMCBT MEETINGS

Jerry Foote, U.W. Eau Claire

A first for AMCBT happened at the 29th annual meeting at Augustana in Rock Island

on September 27-28, 1985. This new occurrence was the POSTER SESSION. Suggested by Harold Wilkinson at our planning meeting in December 1984 and carefully organized by Harold, as was the entire program, the first poster session was a success with eight very interesting posters.

Because not all members could get to the meeting, I will briefly describe each of the posters and list addresses for anyone wishing further information about any of these topics.

Millikin University was well represented with posters by Neil Baird, Tom McQuiston & Patti Dingman, and Harold Wilkinson. All can be contacted at the Biology Department, Millikin University, Decatur, IL 62522.

Neil's Poster was entitled A Simple Microcomputer Analysis of Simulated Research Data. It described an exercise in which the students learn a bit of BASIC so they can understand a statistics program. They then use this statistics program to test significance between an experimental and a control group in a simulated research project. If you wish to have your students gain a better understanding of statistics and its use in biology experimentation, contact Neil Baird for further information.

Drug Efficacy to Coccidian Parasites of Ring-Necked Pheasants was the title of the poster by Tom and Patti. Sulfaquinoxalin, amprolium and furazolidone were tested for their coccidiocidal or coccidiostatic action against four species isolated from pheasants. All three drugs caused a reduction of oocyst discharge in the pheasants compared to the controls indicating some coccidiocidal activity by each of the drugs. All you parasitologists, contact tom McQuiston for further information.

Freeze Drying of Biological Tissue Using a Closed Chamber Containing Phosphorus Pentoxide was the poster of Harold Wilkinson. This poster described a method for freeze drying small samples in any freezer without the continuous use of a conventional pump or a condensor unit. Using test tubes in a wire basket and phosphorus pentoxide to absorb the tissue water, one gram of tissue will lose 75% of its water in 4 hours at -20 degrees C. If you need a simple method to freeze dry one or many small samples, write to Harold.

Bill Andresen of Harper College showed us How to Learn Your Students' Names Quickly and Easily. His technique consists of taking instant type photos of small groups of students in the laboratory and writing their names on the pictures. Carrying the pictures with you and studying them during those odd moments of few minutes duration will do the job and you will know the names of your students quickly and with no strain. Bill can be contacted at Harper College, Palatine, IL 60067.

If you are looking for an interesting, easy to raise insect for any of a variety of experiments, Ingemar Larson has the answer. Rearing of the Blaberus Cockroach and its use as an Experimental Animal was the title of his poster. Ingemar emphasized that this cockroach "does not stink" and is really a good experimental animal. Raising these insects in an old aquarium built up with thin layers of plywood and feeding them dry puppy chow, makes this a very inexpensive animal to have around. Putting petroleum jelly around the top of the aquarium will keep the cockroaches from wandering away, Ingemar says. What made this poster unique was having the actual colony of cockroaches present for all to see. We could observe that indeed there was no bad odor emanating from the colony and the raising of these insects was very simple and easy. For further information, write to Ingemar Lason, Biology Department, Augustana College, Rock Island, IL 61202.

Harold Hansen had another 3D poster entitled Stomate Model. He demonstrated a unique way to cut up and glue balloons to simulate a working stomate. Having the actual balloons hanging on the poster, showing the step by step procedure for constructing these guard cells which operate the stomate, made for a clear, concise, demonstration type poster. Now if he can figure out a way to insert chloroplasts into those balloons..... Contact Harold at Biology Department, St. Olaf College, Northfield, MN 55057 for full details!

Pat Guilfoile, a teacher at Greenwood High School, and former graduate student at U.W. Eau Claire, presented another unique poster, Magnetotactic Bacteria: A videotape produced at U.W. Eau Claire. After collecting, culturing, and playing around with magnetotactic bacteria for some time as a graduate student, Pat got together with the UWEC Media Development Center and produced a 13 minute videotape. His poster was a showing of the videotape in which he explains how to collect, culture, and look at these fascinating bacteria. In the tape, one can see the bacteria swimming rapidly toward and away from a magnet depending on which pole, Pat presents to them. Another interesting phenomenon is seen as "strings" of dead bacteria show a rotational movement in response to the magnetic field. If you would like to purchase a copy of this videotape, write to Pat Guilfoile, Greenwood High School, Greenwood, WI 54437. For more information, Pat also has an article in the May 1985 issue of The American Biology Teacher.

Jerry Foote's Thin Layer Chromatography of Chlorophyll Pigments concluded the posters. An easy method to separate chlorophyll pigments using thin layer chromatography with a mixture of petroleum ether and acetone as the solvent was described. The beauty of this method lies in the fact that the entire process can be completed while the paper chromatographs of chlorophyll are running up the paper. Also, the same solvent chemicals are used in both processes. Thus, your students can experience two types of chromatographic separation using no more laboratory time than is currently used. This was another 3D poster since Jerry had the materials present so that everyone could experience the process and make his/her own separation! For further information see the April 1984 issue of The American Biology Teacher or contact Jerry at Biology Department, University of Wisconsin-Eau Claire, Eau Claire, WI 54701.

Get ready for next year's meeting at Sangamon State by preparing a poster on one of your favorite topics. They take a bit of work, but are really fun to do and give you some time to talk with others while also demonstrating your ideas to them!

REFERENCES:

- Foote, J. (1984) Thin Layer Chromatography (TLC) of Chlorophyll Pigments. The American Biology Teacher 46(4)226.
- Guilfoile, P. (1985) Magnetotactic Bacteria in the Classroom. The American Biology Teacher 47(5)301.

THE SCIENCE HONORS SEMINAR COURSE AT MILLIKIN UNIVERSITY

Neil M. Baird, Department of Biology, Millikin University, Decatur, IL

The science honors seminar course at Millikin University is part of the James Millikin scholars program which was established in 1974. Students are selected for

this program from a pool of applicants who are in the upper 10% of their high school class and have an ACT composite of at least 26. Additional criteria include the ability to communicate well and to think independently as shown on the application essay and in the interview.

I taught the course for the first time last spring. I knew it would not be an easy task - teaching an interdisciplinary course about science to a group of honor students from all different majors - some in science fields, but most from outside science. Perhaps we faculty in biology are a little more interdisciplinary in our knowledge than colleagues in chemistry, physics, or math because of the required coursework in these related fields we take as part of our training. But very little time in a biologist's training is devoted to such matters as an appreciation of the history of science or the philosophy of science.

Although most readers of this article have not and will not teach such a course themselves, it is possible that some of the ideas in this article might be applicable in general biology and/or biology general education courses for non-majors. It seems to me that in these courses we often rush into covering the specific details of our discipline without providing at least some background in the history, philosophy, and methodology of science. Of course, few textbooks are organized in this way and it is difficult in many courses to have enough time to cover the main topics as it is. Nevertheless, it is probably true that a fair number of our students cannot "see the forest for the trees" because the teacher spends too little time with the characteristics of science.

In the first week of the course I have the students write an essay on their background experiences with science. I ask them to address the following topics: What do you remember about the science you were taught at the elementary level? What science courses did you take in high school and what did you like and dislike about them? What attitudes have you noticed that college students exhibit toward science in general, scientists, and science teachers?

The class then looks at the state of science education in this country today. Studies have shown that students exhibit a growing disinterest in science as they progress through the grades. By the end of the third grade only half of the students want more science. By eighth grade only one-fifth of the students have a positive attitude toward science. Only one-third of the nation's school districts require more than one year of high school biology and one year of high school math for graduation. The average high school student is less prepared in science and math when entering college compared to his counterpart twenty years ago. In two year community colleges 42% of math courses are remedial courses.

This sorry state of affairs in science education seems to be caused by an interaction of many factors: misconceptions about science, science anxiety, anti-intellectualism (or maybe just plain laziness) on the part of certain students, too much television, underprepared and/or unappreciated high school science teachers, and lack of adequate support from parents, the public, and state and national governments.

On the other hand, there are some encouraging signs which indicate that adults are showing an increased interest in science. For example, popular publications about science such as Science Digest, Science 85, Discover, and Omni are making science understandable to more and more laymen. Many excellent television programs (especially on PBS) have been produced in the past fifteen years. More and more people are reading books written by popularizers of science such as Carl Sagen, Lewis Thomas, Jacob

Bronowski, and Issac Asimov.

After looking at the background situation described above, the class turned its attention to scientific methodology. A brief study of logic was made with an emphasis on the concepts of induction and deduction. Three exercises were used to illustrate the scientific method. One was a modified version of John Carlock's game of hypothesis. Another was the interactive microcomputer program Tribbles (available through Conduit) which leads the student through a simulated problemsolving situation with the aid of a student tutorial booklet. The last exercise was one that I have devised in which the students run some statistical analysis on sets of simulated data I provide on the biology department Apple computers.

Two of the assigned texts for the course were The Game of Science by McCain and Segal and Philosophy and Science: The Wide Range of Interaction by Mosedale. Both contain excellent sections on science methodology, characteristics of science, important historical turning points in science, and values in science. Both have sections that describe the decrease in governmental support for science in the U.S. in contrast to increases seen in the U.S.S.R., Japan, and certain western European countries. Basic sciences have lost ground to both applied ("relevant") science research and military research in this country.

For a more thorough coverage of the history of science, the book Ascent of Man by Bronowski was read and discussed. Four of the chapters (episodes) from the series were seen in film format. Especially interesting to me were the discussions on biological evolution vs. cultural evolution, Galileo's confrontation with religious authorities, and the episode dealing with knowledge, certainty, uncertainty, probability, and the principle of tolerance.

The fourth assigned book was The Double Helix by James Watson. Students enjoyed this "behind the scenes" account leading to the discovery of DNA structure. I found the Norton Critical Edition of this book especially valuable as a teacher's aid to discussion for it contains a number of critical reviews of the book that appeared in the two years after the book's original publication.

Several colleagues served as guest speakers during the course. Two members of social science departments (psychology and economics) described how their disciplines should be considered sciences and how they differed from the natural sciences. A professor from the philosophy department who teaches the bioethics course on campus presented a number of interesting case studies where decisions involving science and ethics had to be made. A reference librarian spoke on library search strategies for digging out information on the library research paper. Finally, a colleague from the religion department contributed during the week-long focus on the evolution and creationism issue.

The issue of evolution and creationism is useful to study in a course like this because of the lively discussion generated by the following questions it raises: What is the nature of science? What is the nature of religion? What is freedom of scientific inquiry? What is religious freedom? What does the public understand about science? How does the first amendment to the Constitution apply to this situation? Why do scientists as well as many clergy want to see balanced treatment laws such as the one in Arkansas defeated?

I gave an introductory lecture reviewing Darwin's original contributions, the added perspectives of population genetics, speciation, molecular studies of DNA and

protein in related species, and newer interpretations such as continental drift and punctuated equilibrium. I then reviewed the Scopes trial of 1925 and spent a considerable amount of time reviewing the Arkansas "balanced treatment" trial of 1981. I had the class read Judge Overton's decision in full as it appeared in the March 1982 issue of the American Biology Teacher. His essay is well written, and I feel it should be considered required reading for anyone looking at this issue today.

My colleague from the religion department provided some important background on the bible scholarship done of the first two chapters of Genesis. The two chapters differ in their authorship, date written, and sequence of creation events. Studies show that several details in the Genesis I account have been borrowed from the older Babylonian creation story.

The library assignments were made during the course. One was a periodical assignment in which students were to compare and contrast four periodicals (Science, Science 85, Scientific American, and Science Digest) with respect to types of articles, departments, intended audiences, degree of technicality, and interest for them. The other library assignment was the individual research project presented in written and oral form toward the end of the semester.

This coming spring I will be teaching the course for the second time. I plan to add a couple of lab experiences to the course and to bring in more current issues and news items regarding science this time. In teaching the course, I have learned a great deal about the history, philosophy, methodology, personalities, and values of science that I had only partially understood and appreciated before. If anyone has additional suggestions for teaching such an interdisciplinary course, I would appreciate hearing the ideas.

CONFRONTING THE CREATION SCIENCE/EVOLUTION ISSUE IN EDUCATION

Malcolm P. Levin, Sangamon State University, Springfield, IL

INTRODUCTION

Understanding nature and exploring the universe have been cherished values since the beginnings of civilization. Often scientists were first "men of God." In that search for God, they studied the workings of nature and the universe. Today, scientists still seek an understanding of the universe and many still hold strong religious beliefs. Albert Einstein is often noted for his religiosity. When asked "Do you believe in God?" He responded, "Yes." I believe in

Spinoza's God, who reveals himself in the harmony of all being. What I see in nature is a magnificent structure that we can comprehend only very imperfectly and that must fill a thinking person with a feeling of 'humility'. This is a genuinely religious feeling that has nothing to do with mysticism.... My religiosity consists in a humble admiration of the infinitely superior spirit that reveals itself in the little that we, with our weak and transitory understanding can comprehend of reality (Ferris, 1982, p. 38).

In this elegant statement of Einstein's feelings about God and universe we find a

In this paper I will address three aspects of this important controversy. First, I intend to develop the hypothesis and present evidence to show that "creation science" is simply a mechanism devised by Christian fundamentalists to establish control over the thinking of individuals and to inculcate a world view in which all problems reduce to black and white, good and evil. Second, I will examine the impact of the "creation science" movement in my own community. Finally, I will offer suggestions on how we can reverse the scientific ignorance of the general public.

SECTION I

In his book, Exploring New Ethics for Survival, the biologist Garrett Hardin (1973) described a future event in the politics of the United States. In this scenario the political extremists from both the left and the right reach the conclusion that environmentalism is the common enemy and they join ranks to eliminate evil. There are parallels in the creation/evolution debate. I believe that the battle over the legitimacy of "creation science" is just the first step of a coalition of political and religious extremists whose common ground is an ill-defined religious fundamentalism. Their ultimate goal is to establish their world view as a guiding philosophy for, at the very least, the United States. In this instance, the common enemy is evolution because the theory of natural selection proposed by Darwin tangibly marked the beginning of materialism and relativism for the life sciences, especially for man. Consequently, evolution challenged and continues to challenge fundamentalist patterns of behavior. A key element in the opposition to evolution is that theory confronts, at least in the minds of fundamentalists, the special relationship between God and man. To put it in a biblical context, it impugns the notion of dominion over the earth and our creation in God's image. To fundamentalists, the theory of evolution negates a "fixed and knowable" world -- one in which the word of God inevitably leads to heaven, if not heaven on earth.

Evidence for this strong condemnation of fundamentalists and the creation science position comes from a variety of sources. In particular, many of the writings of the creation scientists espouse positions which delineate their values and their world view (Kitcher, 1982, pp. 186-202). Henry Morris, the Director of the Institute for Creation research and the editor of the book Scientific Creationism, makes his position clear in his numerous books and pamphlets. In The Remarkable Birth of the Planet Earth (Morris, 1972), the reader is told that "evolution is contrary to God's nature of love and mercy" (p. 73), that "evolution is incompatible with Christian ethics" (p. 74), and that "evolution produces anti-Christian results" (p. 75). In support of this last statement Morris declares that

Evolution is the root of atheism, of communism, nazism, behaviorism, racism, economic imperialism, militarism, libertinism, anarchism, and all manner of anti-Christian systems of belief and practice (p. 75).

His solution is "a solid faith in a personal, sovereign Creator," for "a good tree cannot bring forth evil fruit," and "neither can a corrupt tree bring forth good fruit" (Matthew 7:18). In the edition of Scientific Creationism (Morris, ed., 1974) written for the general public, as opposed to the edition written for public schools, the Institution for Creation Research states, "Evolutionist teaching is not only harmful sociologically, but it is false scientifically and historically." Thus, while Morris and others are arguing equal time for what they call science, they also make it clear that what is wrong with the science of evolution is more than just false science. Evolution, in their view, is sociologically, politically, and economically

evil as well as being godless.

As evidenced above, the fundamentalist position is one that sees the world only in black and white, or good and evil. Again, I believe that Morris (1972) makes this clear in the preface of his book, The Remarkable Birth of the Planet Earth, in which he states, "Belief in evolution is a necessary component of atheism, pantheism, and all other systems that reject the sovereign authority of an omnipotent personal God." And according to Morris, an evolutionary view of the world justifies "a long succession of evil systems," "animalistic attitudes and behavior by individuals," and "leads usually and logically to the rejection of the trustworthiness of the Bible, and, therefore, failure to appropriate its premises leading to salvation and eternal life." Thus, the acceptance of evolution makes man a purveyor of evil, and the acceptance of Bible and God makes man good. That there is no room for fence riders is apparent when Morris (1972, pp. 75-76) comments on "the semantic curiosity called progressive creation" and on theistic evolution. In this passage he tells us that these Christians are dishonoring God especially those who promote progressive creation. Further, a review of several of the creation science books (Gish, 1972; Gish, 1978; Kofahl and Segraves, 1975; Levitt, 1976) reveals that the authors hold the same absolutist position as Morris. Their books, however, are designed to bring together the "positive" aspects of creation science rather than develop a frontal attack on evolution. Kofahl and Segraves (1975) are especially careful to develop a positive thesis. Levitt (1976), on the other hand, lapses and falls back on the same arguments as Morris, telling the reader that evolution and communism are equivalent. Thus, the creationists' ideology is clear: there is one universal truth.

Thus far I have concentrated on the writings of the fundamentalists who have worked to develop the creation science model. I believe it is important, however, to connect the Institute for Creation Research (ICR) and their publications to the broader new right movement. The connections are there. Both the writings and public pronouncements of two leading television evangelists, the Reverend Jerry Falwell (1981) and Dr. Marion "Pat" Robertson (1984, pp. 28-33) link evolution and secular humanism. The Reverend Tim La Haye (1980) also makes this connection in his writings. These fundamentalist spokesmen sometimes work together to promote their world view. Jerry Falwell has been active in the effort to raise funds to assist in the scientific creationism movement (Kitcher, 1982, p. 165, Shear, 1983) and has promoted it by distributing copies of Morris' book, The Remarkable Birth of the Planet Earth. Moreover, in a written response to my request for an interview with Falwell, or a representative of the Moral Majority, regarding Falwell's policy position on creation science, I was told to contact Dr. Duane Gish at ICR.

Falwell (1981) makes several statements in his book Listen America? which are relevant to the argument that all issues can be analyzed from only two points of view, that of the anti-evolutionist and that of the evolutionist, or good and evil. At the end of his book he discusses the "Seven Principles that Made America Great." Principle six is particularly relevant. I quote the entire passage below:

The principle of god-centered education
(Deuteronomy 6:4-9; Ephesians 4:4)

In recent years, the name of Almighty God has literally been removed from our public schools. Voluntary prayer has been banned. Creationism is no longer taught as a viable alternative to evolution which is now taught as a fact. As God was taken out of our schools, we saw moral permissiveness, academic deterioration,

and the drug epidemic creep in.

In many cases, sex education classes in the public schools are nothing more than academic pornography. Secular humanism, rather than God-centered education, has resulted in decadence and deterioration (p. 241).

Here, Falwell makes a crucial link which defines the enemy clearly. Secular humanists and the God-less evolutionists are the common enemy. According to Falwell, the young people, age 25-40 years, "have been educated in a public school system that is permeated with secular humanism. They have been taught that the bible is just another book of literature. They have been taught that there are no absolutes in our world today" (p. 15). He pursues the dangers of secular humanism arguing that young Americans have grown up under a government influence that teaches socialism and welfarism and that the television has taught situation ethics and immorality. These influences, according to Falwell, lead to a loss of respect for life and to disrespect for the family as God established it. In short, when the leaders of fundamentalist right place the secular humanists and the evolutionists together, the definition of what is wrong with America becomes clearly defined for the fundamentalist audience.

Tim La Haye, one of the founders of the Moral Majority and an outspoken fundamentalist, has devoted an entire book, The Battle for the Mind, to warning Christians that the humanists are ready to destroy what America stands for. He is an important link in my thesis that the goals of those promoting creation science are more broadly conceived. Citing the humanists' Manifesto II, La Haye (1980, pp. 125-140) also asserts a one-voice position of evolutionists and humanists. La Haye's logic and peculiar world view lead him to divide the world into two religions: those with a biblical base - Judaism and Christianity and those with a pagan base - Confucianism, Buddhism, Muhammadanism, Babylonian Mysticism, and Humanism. La Haye, along with Henry Morris, was a founder of Christian Heritage College in 1970. Morris served as its vice-president and professor of apologetics from 1978-80 (Conway and Siegelman, 1982, p. 361; Numbers, 1982, p. 543). While I make this connection, I also want to point out that Morris and other members of ICR have made an effort to play down this relationship, to keep their activities separate, and to remain apart from the political and legislative activities. Morris and the Institute see their role as scientists whose task it is to disseminate the facts of creation science (Conway and Siegelman, 1982, pp. 119-128). The references to humanism, however, and its inseparability from an evolutionary perspective are found in most of the creationist books and articles that I have examined. Examples include Evolution, The Fossils Say No! (Gish, 1978, p. 25), What's All This Monkey Business? (Kester, 1981), Introducing Scientific Creationism into the Public Schools (Morris, 1975), Creation: A Scientist's Choice (Zola, 1976), and The Creation Explanation (Kofahl and Segraves, 1975). Based on the foregoing discussion, the relationship between the anti-evolution and anti-humanist perspective should be clear. Fundamentalists see the sciences, as they relate to evolution, and the philosophy of humanism as one and the same. Thus, biologists that use evolution as a unifying principle, are viewed in the only way possible by fundamentalists; we are all secular humanists.

At the beginning of this paper I stated that it is my intent to show that the thrust of equal time for creation science is only the first piece of a broader move to reshape American values along the values of the fundamentalist right. Although the notion of thinking about the ethics of decision making from a humanist perspective is an anathema to fundamentalists as should be apparent from the discussion up to this point, I believe it is worthwhile to present portions of a code of behavior developed for our youth by the Moral Majority of North Carolina. The guidelines for behavior

that are listed below are designed to discourage thinking, to limit the interchange of ideas between teachers and students, to restrict students' personal growth and development, and to generally isolate students from the world around them. The list of 25 don'ts eliminates discussions of the future, future social arrangements or governments, values, and boy-girl and parent-child relationships. Also, students are not to enroll in social studies classes, not to discuss values, not to write an autobiography, not keep journals of their opinions, activities, and feelings, and not to engage in classroom discussions which begin: "what if ...?", "Do you suppose...?", "Do you think?", "and "what might happen if ...?" Editorial, Voice of Youth Advocates, (1981). Thus, the position of the fundamentalist right is very clear. They want all Americans to do as they are told and to behave alike.

One final point is relevant to this analysis of the goals and objectives of the creation scientists and the fundamentalist right. They have adopted a position of "the ends justify the means." A review of their attack on biological evolution and what science is and does reveals both a distortion of modern biology and the natural sciences and a distortion of the writings of the scientists who have tried to broaden our understanding of the natural world. Morris, Gish, Kofahl, Seagraves and other creationists have consistently taken passages out of context to show their readers that even the evolutionist doesn't believe in evolution. Kitcher (1982) and Ruse (1982) have been more than fair in their analysis of the creationists in suggesting that perhaps they don't realize how they have twisted science. I would not be so generous. As absolutists, Morris and his colleagues know that they have truth on their side. They are for Bible and God; we represent Satan. The creation scientists and the fundamentalist right will not swerve from the path in their effort to turn America around. From my perspective they are but one short step from totalitarianism. They rail about the atheism and amorality of communism but I believe they would substitute a theistic republic which would have only the aura of democracy. Everyone will have one world view or will be afraid to express any other perspective.

SECTION II

I will now turn to the second part of this paper, a discussion of the impact of creation science and its advocates in the public schools of my own community. I present this section because it illustrates what can happen in your community. The events that transpired and the knowledge that I gained tell us much about the nature of this conflict and also suggest what our role as biologists and scientists should be. Finally I believe this discussion leads logically to my recommendations and suggestions in the last part of this paper.

In November, 1980, the Ball-Chatham School District received a grant from the regional educational service center, a unit of the State of Illinois' public educational system. The grant provided for the development of a district-wide Citizen's curriculum Advisory Council (CAC) "to examine all areas of the Ball-Chatham school curriculum and make recommendations for change if, in their view, change was warranted." In February, 1981, a twenty person council representing a cross section of the community was established. The Council elected officers and organized twelve subcommittees to review the various curricular areas as well as the adequacy of such entities as the libraries and the guidance and counseling services. In addition, a subcommittee was established to develop a survey instrument to determine public opinion on aspects of the curriculum and school services. The Council then requested volunteers from among its membership to chair the subcommittees and asked for recom-

mentations from the council for community people to staff them. As a result of this process, the local fundamentalist minister who chaired the Council became the self-selected chair of the science curriculum subcommittee. The science subcommittee was subsequently established with two of its 7 members, including the chairman, coming from the membership fundamentalist churches. (There are at least 2 in the district.) There were no scientists, no individuals with a science background, and no science teachers on the subcommittee other than myself.

In the weeks that followed the establishment of the subcommittee, its activities were carefully orchestrated by the chairperson in order to exclude me from the meetings, to challenge any teaching using an evolutionary perspective in the curriculum, and to promote equal time for creation science in any classroom setting where evolution was taught or implied. (The efforts to exclude me were not apparent to the subcommittee.) At the same time, the minister used his pulpit to deliver a series of sermons which informed his congregation that false science, heresy, was being taught in the local public schools. Further, in support of his position, he voluntarily provided me with a tape of two of these sermons. He also devoted two evenings, one during a regular committee meeting time, to show me the pedagogic value of the two model approach to the teaching of evolution.¹ His discussions with me included the presentation of a slide and tape show prepared by ICR and a critique of the humanists' Manifesto II. The slide and tape production, "Creationism and Evolution: A Comparison of Two Scientific Models," was also shown to the subcommittee during an earlier session. In short, he had done his homework from a fundamentalist's perspective; he had argued the connection between evolutionists and humanists.

By now, the reader may be wondering what happened to the review of the science curriculum by the subcommittee, what information was sought in the survey instrument, and what recommendations were placed before the Curriculum Advisory Council. A synopsis of these events follows.

My limited observations of the subcommittee's work suggested that the group intended to solicit little information from the schools on the status of the science curriculum. Further, the subcommittee seemed perfectly willing to let the chairman proceed to challenge evolution and to promote "creation science." Various members of the committee held at least one meeting with appropriate faculty and administrators from each of the schools in the district. The reports were perfunctory. In at least one instance the subcommittee member had misplaced his notes and gave his best recollection of the information gathered. Because I had been unable to meet with the subcommittee when the various members assumed their responsibilities, I was asked to review the science texts. It is my opinion that the only acceptable meeting time was chosen by the chairperson to exclude me from the process. Consequently, I rescheduled the remaining sessions of the only class I taught in the Spring of 1981. This allowed me to attend the last 2 of the approximately 6 meetings of the subcommittee. A draft report was prepared by the chairperson and presented at the last meeting. It consisted of eight short paragraphs and was only 1-1/4 pages in length.² Four paragraphs summarized the science curriculum, the remaining four dealt with the creation/evolution controversy. The latter half of the draft report noted the conflict with religious beliefs as a result of teaching evolution, recognized the newness of "scientific creationism," and recommended that a creation scientist from ICR's Midwest Center provide workshops for the teachers. This section also recommended "that books supporting scientific creationism be placed in the school libraries and be made available to teachers at all levels." Moreover, these recommendations were prepared without any formal or informal approval by the committee and prior to the availability of the results of the survey.

With regard to the survey instrument, the subcommittee submitted five statements which were to have graded responses from strongly agree to insufficient information.³ The first two statements dealt with the teaching of evolution, the scientific evidences against evolution, and the scientific evidences for creation.⁴ My objections to the ambiguity of these two statements were presented to the chairperson, but unfortunately, I was not present at this subcommittee meeting. The five statements were subsequently submitted to the CAC. After considerable debate by the task force concerning the ambiguity of the creation/evolution statements, they became part of the survey instrument because of the forcefulness of the minister (White, 1983). The statements ultimately occupied the first and second positions of the science section. With this summary of events, I now will turn to my response to the efforts of the minister.

My naivete caused me to see the problem as one of education.⁵ Initially, my efforts were aimed at dissuading the minister from pressing the issue because it was clear the "creation science" was bad science. Then it became apparent that I would have to argue that "creation science" had no place in the science curriculum, that it was not only bad science but also that it was religion. Further, I would have to delineate the issues for the subcommittee, and it would be necessary to bring the issues to a vote.

Given my first inclinations, the solution to the problem was to discuss the merits of the creation science model with the minister. We examined the Second Law and the great flood. At each point I explained that one corrupts the scientific method when one selects bits and pieces of evidence to fit a hypothesis and discards the main body of facts. I argued that neither the creationists' interpretation of the Second Law nor their evidence for the great flood was consistent with the larger body of scientific knowledge. We ultimately examined each of the pieces of definition of creation science that became law in Arkansas in 1981. From our discussions it was apparent that I had not been persuasive and that he would pursue making creation science a major part of the recommendations of the report.

As a result of the foregoing, I contacted a member of the Advisory Council, the wife of a protestant minister. I explained that I felt the creation science model was simply a narrow view of our Judaeo-Christian heritage and clearly religious in nature. I asked if she was aware of any books by theologians that reconciled the conflicts between science and religion. My search led me to a book entitled The Christian View of Science and Scripture by Bernard Ramm (1954). Ramm, an evangelical Christian, has written a number of books dealing with apologetics and biblical interpretation. He holds both degrees in theology and advanced degrees in the philosophy of science. I believed that his views would be an appropriate way to approach a committee discussion of creation science. My purpose was to show that even within the fundamentalist churches there was no one voice on the meaning of Bible and that some religious scholars saw no conflict between science and religion. Consequently, the teaching of evolutionary theory was not heresy.

Why I determined to argue creation science and evolution in this manner has a great deal to do with my feelings about religious freedom and my own personal values about how one should treat his fellowman. I believe that one must respect, and must not infringe upon, the religious beliefs of others. While I could not accept the position of the chairperson, I believed, and still believe, that it was unethical to systematically attack an individual's faith to win a scientific position. In retrospect, I concede that I may have been in error to hold that degree of respect for those who know only one cosmological view and hold with only one truth. Nevertheless,

I resisted the temptation to attack Biblical inerrancy, the basis of this minister's faith.⁶ Consequently, I searched for this common ground between Christian beliefs and science. I wanted to show the minister and the committee that the teaching of the theory of evolution and Christian beliefs need not conflict. To my surprise, the result of my presentation of Ramm's thesis, that there is no conflict between science and Christianity, was answered by the minister quickly and tersely. I paraphrase the response - "I have read Ramm and he is wrong; I reject him." Thus, I was faced with seeking a solution of other methods.

The next step was one which many writers in philosophy, religion, and science have taken to eliminate contradictions in these areas of knowledge. I prepared a brief report examining the nature of knowledge in religion and in science showing that the former was based on faith and that the latter derived theory and law through experience and experimentation. Therefore, there are fundamental differences in how we know what we know in these two realms. I argued that science and religion are two mutually exclusive ways of understanding the world. Thus, one is left with the conclusion that creation science has no place in the classroom because it is not science. It does not meet the basic criteria of the scientific method.

The presentation of this report to the subcommittee was punctuated with charges that I had not addressed the "facts" of creation science. In addition, the subcommittee was told that the teaching of theory of evolution taught children that their parents and their ministers were liars. Before the "debate" drew to a close, the minister resorted to name calling and declared that I was a secular humanist. In a final effort to gain support for his position, he told the subcommittee that he would give up his faith if he was wrong.

As a result of the position paper that I prepared for the subcommittee, the report submitted to the Citizens' Advisory Council was extensively revised. In its final form the subcommittee's report recommended that "the theory of the evolutionary development of man from lower forms of life ... be examined only on the high school level." I readily acceded to this statement because it was apparent that evolution per se was being taught only at the high school level and that the descent of man was only incidental to the biology curriculum. Unfortunately, the survey instrument suggested that this was not an unreasonable recommendation. Less than 4 percent of the respondents felt that the statements on creation and evolution were unanswerable because of insufficient information while approximately 75 percent appeared to support equal time for creation science. I believe we should be cautious in our interpretation of these data, however, because the statements were, as indicated earlier, ambiguous and because the meanings of various phrases are subject to interpretation.

The conflict did not end, however, when the report was filed with the advisory council. The chairperson of the subcommittee made a unilateral decision to attach 11 pages of supplementary materials on the teaching of creation science including extensive lists of creation science resources and where these materials could be obtained. Again, I found myself negotiating what I believed to be an acceptable appendix to the report. I reached a compromise which I felt expressed the will of the subcommittee.

Up to this point I have presented an extensive review of the events that took place in my own community. A brief analysis of what I learned is appropriate at this juncture.

First, what happened in my community could happen in yours. The steps taken by

the minister are outlined in Introducing Scientific Creationism into the Public Schools by Henry Morris (1975) which includes instructions to church members regarding the issue.

Second, I do not believe that the subcommittee on which I served is unique or unusual. Their knowledge of science and the scientific method, certainly of epistemology is limited. Therefore, one will have to carefully lead them through the arguments if you expect to keep the fuzzy thinking of creation scientists out of the classroom. Further, if the members of this subcommittee are typical, the scientist will have to "carry the ball" in the face of indifference. No one offered support during these discussions. It was the opinion of the subcommittee that the only reason for excluding creation science was that I had persuaded them that it was religion and that the U.S. Supreme Court was very clear as to what was permissible in the public schools. In general, the subcommittee was sympathetic to the minister's cause by virtue of the fact that ministers are community leaders.

Third, I do not believe you can expect to be treated with the sense of fairness that one expects from persons professing a Judeo-Christian heritage. Attempts to respond to the issues within the context of the minister's tradition failed. Approaching the issue from an epistemological perspective resulted in only name-calling and what was seen as a challenge to my adversary's faith.

Fourth, you should expect to have to explain the results of acquiescing to creation science to members of your community. Most do not perceive creation science as a threat to science or as the infringement of the separation of church and state which it clearly is. They certainly do not regard it as part of a broader set of values espoused by fundamentalists and the Moral Majority. In the final analysis, many are not sympathetic to the total absence of prayer from schools, and this is likely to underlie any such discussions.

Finally, while one may successfully defend secular science in your school district, the activities of fundamentalists and creation scientists have met with considerable success in the area of textbook publishing (Hastings, 1983). Because of state board of education action in Texas, you may find that biology and other science texts in your schools make no mention of evolution or give it only a brief or weak treatment. Thus, evolution may not be a part of the science curriculum unless special efforts are made to put in as a supplement. This problem is addressed in the last section of the paper.

SECTION III

In the introduction to this paper, I argued that the creation science/evolution controversy is a widespread problem for the scientific community. Further, the basis of the problem is not because the arguments of the fundamentalist right are either correct or persuasive but because we as educators have failed to communicate to the public what science is and what scientists do. In Sections I and II, I analyzed the efforts of the fundamentalists, identified the breadth of their goals, and critiqued their effort in my own community. I believe the evidence is sufficiently persuasive to conclude that the public will continue to be challenged by individuals, or groups, seeking equal time for creation science in public education in the future. In this final portion of the paper, I examine some potential solutions to the problem of scientific illiteracy. I approach the solutions at two levels. First, what can we do as teachers of the biological sciences in colleges and universities, and second what can be done to correct the problem at the secondary level?

If we have failed to communicate the nature of science to the public as I and other scientists and educators have argued and as the behavior of the citizens of the community, in which I live, suggests, then what is it about our curricula that results in scientific illiteracy? Biology curricula at most institutions of higher education require coursework in genetics, evolution, cell biology or physiology, and anatomy or embryology. These courses are generally taught by presenting a great deal of experimental data. Descriptive courses are not the rule. Additionally, biology departments offer a variety of organismal and integrative courses vertebrate biology and ecology, for example. These courses are both experimental and descriptive. Further, logic and critical thinking are implicit, if not explicit, universal components of course work within biology, as well as typical baccalaureate curricula. If this is an accurate description of biology curricula and of liberal arts curricula in general, then what is the cause of our failure? I believe that the problems result from acts of omission, that is, we do not clearly and specifically address the levels of organization of knowledge. We do not teach scientific methodology in a manner that shows the hierarchical nature of knowledge, or that shows how one moves from hypotheses to theories, and to laws. Similarly we do not actively convey the idea that one can conduct good science by working from both the specific to the general or from the general to the specific. In parts of higher education curricula my criticisms are now being adequately addressed, but I suspect this is the exception, not the rule.

The solutions are inherent in the criticisms; there are a variety of ways to solve the problem, however. At the college or university level I believe we need to place a course, or perhaps several courses, in the curricula which are required of all undergraduates not majoring in the natural sciences. One example comes to mind. More than 15 years ago, the University of California at Berkeley developed, and required of all non-biology majors, a course which subsequently was published as a textbook entitled Heredity Evolution and Society (Lerner, 1968). The book examines fundamental aspects of biology as they related to social issues. The only reservation that I have about this book is that it lacks a section devoted to the philosophy of science. The concepts are implicit in the book, but I would argue for a section which clearly spells out the nature of science and the scientific endeavor. Such a curricular requirement could do much for improving the scientific literacy of our college graduates.

Within biology departments, I believe we should address the problem by adopting a course in the philosophy and history of science. I would even argue for its inclusion in the other natural sciences. The course need not add to our biology requirements if

the college or university can meet the curricular needs in the philosophy or history departments. Alternatively, faculty could address the nature of science by supplementing existing courses. Both genetics and evolution lend themselves to the examination of scientific method and the nature of science. Perhaps we should also examine the historical setting at the time of Darwin in evolution courses. The controversy between creationists and the biological sciences has not changed. Arguments by contemporary religious leaders, theologians, and scientists who oppose evolutionary theory are identical to those arguments which beset Darwin in the 1860s and 1870s. Courses on evolution are a particularly appropriate setting for this topic.

Other areas of our biology curriculum also provide reasonable entrees to the nature of science and to evolutionary models as a unifying principle of biology. Organismal courses, such as entomology, herpetology, invertebrate zoology, mammalogy, ornithology and others, are appropriate places to build on the natural relationships and discontinuities of life from an evolutionary perspective. Incorporating a few lectures on the nature of taxonomy would do a great deal for strengthening the student's understanding of how science works and would clarify the efforts of taxonomists and phylogenists who use natural or evolutionary schemes of classification. Mayr's discussion of species concepts (1963) provides convincing evidence for such a pedagogic approach. Finally, one can address the nature of science and the question of evolutionary relationships in such courses as vertebrate anatomy and physiology, or cooperative vertebrate physiology. There are valid reasons for using the particular laboratory animals that we use and these can be traced to evolutionary relationships and methods in science. Thus, I believe that solutions within biology are simply a matter of determining where in a curriculum the nature of science is most appropriately addressed and that depends on the department and the philosophy of its faculty.

Solutions will be much more difficult for secondary education where the problems are different. First, as noted in the previous section, creation scientists have already made significant inroads in curbing the teaching of evolution as a part of the biology curriculum. The success is, in part, the result of a decision by the Texas State Board of Education which has brought about substantial modifications to biology textbooks at the secondary level (Moyer, 1983). The strength of the Texas decision lies in the fact that publishing houses must be able to sell their books in the Texas system or face financial difficulties. Thus, requirements by Texas as to how evolution must be handled have led to both a reduced and a modified treatment. Second, since most curricula in secondary schools are limited to teaching what is in the texts, it follows that evolution has been de-emphasized as the unifying principle of biology. The consequences are simply a result of the economic realities faced by publishers and of the manner in which the curriculum is handled in secondary education. Thus, what one should do to maintain or to reestablish a reasonable treatment of evolution will depend largely on the community in which one lives. In many localities the adequacy of science and mathematics curricula are likely to be examined and re-evaluated as the result of recent national studies showing a declining quality in our high school graduates. I believe that college science faculty should act as resource people in their school districts. In offering assistance, we should remember that while we have command of, or are experts in, a particular science, the teachers know more about how to present the material. While many teachers are only minimally qualified in the sciences, no useful purpose will be served by emphasizing this.

What about the textbooks? Should the changes in textbooks with regard to evolution be a key issue when providing assistance? I think not. While the treatment of evolutionary theory has been reduced in many textbooks, the books are still

satisfactory. In contrast to questioning the quality of the textbooks based on their treatment of evolutionary theory, it may be more useful to focus on how the scientific method is stated in the texts and taught in the classroom. Improving an understanding of the nature of science in the short term seems more likely to underline the importance and usefulness of evolutionary models in the sciences and in understanding the world around us. In general, I do not believe a direct confrontation and demands for broadening the treatment of evolution will help to solve the problem. On the other hand, I would certainly argue that we should provide assistance to teachers who wish to develop lesson plans that expand the material on evolution in biology courses.

I have left the most difficult aspect of this problem for my final recommendations. What should your role be in the event that creation scientists challenge the teaching of evolution in your community's schools? Given my limited experience, I believe the solution lies in preventing the problem from arising in the first place. I have already recommended that we offer assistance to local schools, that we serve as resource people. I believe that this action could prevent the problems that I encountered in my own district. In the event that a strong offense does not prevent the creation scientists from seeking equal time, you should be prepared to develop a position paper to clarify the issues. It is important to defuse the efforts of the creation scientists early. Otherwise, everyone's time and effort is diverted and the primary goals of getting on with the business of education takes a back seat. In my own community, the citizens never really evaluated the science curriculum because of such a diversion.

In conclusion, at least one professional teachers' organization has developed a source book (Wisconsin Education Association Council, 1982) and several scientific societies (WEAC, 1982) have passed resolutions and issued position statements which clearly identify the religious nature of creation science. All emphatically reject it as a model worthy of equal time. I recommend these materials as useful resources in dealing with the creation science/evolution controversy. Finally, the recommendations in this section are by no means the result of an exhaustive review of the literature. They are quite simply my initial thoughts on the problem and a few suggestions on how to proceed.

Endnotes:

1. The session held at the time of a regular committee meeting occurred because no other committee members attended. I assume the meeting was planned and that it was merely coincidence that the minister and I ended up debating each other.

2. Reports to the Citizens' Curriculum Advisory Council varied considerably in length. The mean length was 5.25 pages for the 12 subcommittees. The range was 0.5-40 pages. The median was 1.5 pages. If the same data were analyzed omitting the library service report (40 pages) the mean falls to 2.09 pages, range .5-5.5.

3. The subcommittees were asked to submit a minimum of 5 statements for the survey instrument. The Advisory Council indicated a preference for 10 in order that statements could be selected with regard to their general value in the curriculum study. One member of the Advisory Council has suggested that limiting the statements to 5 was a deliberate maneuver by the minister to insure that the creation/evolution issue went before the community.

4. The statements regarding creation science and evolution are as follows:

Ad Hoc Committee Creation, Evolution and Public Education. 1982. WEAC Sourcebook for the Teaching of Evolution in the Science Classroom. Wisconsin Education Association Concll, Administration/Governance Division, Madison, Wisconsin, 24 pp.

Ball, Howard G. and Terrance J. Nordman. 1981. Scientific Creationism in Our Public School Curricula. The Educational Resources Information Center, 13 pp.

Bergman, Jerry. 1979. Teaching About the Creation/Evolution Controversy. Phi Delta Kappa Educational Foundation, Bloomington, Indiana, 45 pp.

Conway, Pio and Jim Siegelman. 1982. Holy Terror. Doubleday and Company, Garden City, New York, 402 pp.

Editorial. 1981. Voice of Youth Advocates, 4(1): 4.

Eldredge, Niles. 1982. The Monkey Business, A Scientist Looks at Creationism. Washington Square Press, New York, New York, 199 pp.

Falwell, Jerry. 1981. Listen America! Bantam Books, New York, New York, 242 pp.

Ferris, Timothy. 1983. The Other Einstein. Science 83, 4(8): 34-41.

Gish, Duane T. 1978. Evolution, The Fossils Say No! (Public School Edition). Creation Life Publishers, San Diego, CA., 189 pp.

Godfrey, Laurie R. (Ed.). 1983. Scientists Confront Creationism. W.W. Norton and Company, New York, New York, 324 pp.

Hardin, Garrett. 1973. Exploring new Ethics for Survival. Penguin Books, Inc., Baltimore, Maryland, 273 pp.

Hastings, Ronnie. 1983. Letter to the Editor. Physics Today, 36(7): 100.

Kester, Phyllis. 1981. What's All This Monkey Business? New Leaf Press, Harrison, Arkansas, 104 pp.

Kitcher, Philip. 1982. Abusing Science. The MIT Press, Cambridge, MA, 213 pp.

Kofahl, Robert and Kelly L. Segraves. 1975. The Creation Explanation. Harold Shaw

Literature Cited:

6. This minister, as well as Morris and other fundamentalists, frequently refer to John 3:16 as a key reference to the concept of Biblical inerrancy.
5. Obviously the minister also saw the problem as one of education. However, he was approaching the issue from a position of absolute truth and knowledge while I was attempting to examine the problem using logic, not faith, and recognizing the tentativeness of science.
- a) "If the theory of evolution is taught or implied, then the scientific evidences opposing the theory must also be taught."
- b) "Scientific evidences for creation should be taught in conjunction with the evidences for evolution."

- Publishing, Wheaton, IL, 255 pp.
- LaHaye, Tim. 1980. The Battle for the Mind. Fleming H. Revell Company, Old Tappan, New Jersey, 247 pp.
- Lerner, I. Michael. 1968. Heredity Evolution and Society. W.H. Freeman and Company, San Francisco, California, 307 pp.
- Levitt, Zola. 1976. Creation: A Scientist's Choice. Victor Books, Wheaton, Illinois, 131 pp.
- Mayr, Ernst. 1963. Animal Species and Evolution. The Belknap Press of Harvard University Press, Cambridge, Massachusetts, 797 pp.
- Moore, John A. 1982. Evolution and Public Education. Bioscience, 32(7): 606-612.
- Morris, Henry M. 1972. The Remarkable Birth of the Planet Earth. Dimension Books, Bethany Fellowship, Inc., Minneapolis, Minnesota, 111 pp.
- _____. 1974. Scientific Creationism (General Edition). Creation-Life Publishers, San Diego, California, 277 pp.
- _____. 1975. Introducing Scientific Creationism Into the Public Schools. Creation-Life Publishers, San Diego, California, 16 pp.
- Moyer, Wayne A. 1983. Young Earth Creationism and Biology Textbooks. Bioscience, 33(2): 113-114.
- Newell, Norman D. 1982. Creation and Evolution. Columbia University Press, New York, New York, 199 pp.
- Numbers, Ronald L. 1982. Creationism in 20th Century America. Science, 218: 538-544.
- Overton, William R. 1982. Creationism in Schools: The Decision in McLean versus the Arkansas Board of Education. Science, 215(4535): 934-943.
- Ramm, Bernard. 1954. The Christian View of Science and Scripture. W.B. Erdmans Publishing Company, Grand Rapids, Michigan, 368 pp.
- Robertson, Pat. 1984. The Secret Kingdom. Bantam Books, New York, New York, 234 pp.
- Root-Bernstein, Robert and Donald McEachron. 1982. Teaching Theories: The Evolution-Creation Controversy. The American Biology Teacher, 44(7): 413-420, 405.
- Ruse, Michael. 1982. Darwinism Defended. Addison Wesley Publishing Company, Reading, Massachusetts, 356 pp.
- Shear, William. 1983. Personal Communication.
- Skoog, Gerald. 1981. Legal and Judicial Problems of Mandating Equal Time for Creationism. The Educational Resources Information Center, 18 pp.
- White, Madeline. 1982. Personal Communication.

NOMINATIONS

The Steering Committee requests nominations for the offices of
(a) president elect,
(b) two members at large,
(c) secretary.
You may nominate others or volunteer yourself.

Nominee for office _____

Nominee: Name _____

Address _____

_____ Zip _____

Nominator: Name _____

Address _____

_____ Zip _____

Send the completed nomination form to:

Ray Reed
P.O. Box 1036
Jefferson Community College
Louisville, Kentucky 40201

Put on Your Calender
September 26 - 27
Thirtieth Annual Meeting
Association of Midwest College Biology Teachers
at
Sangamon State University
Springfield, Illinois
Theme
Biologists and Public Policy
Call for Contributions

Since SSU has been mandated as the Public Affairs Institution of the state of Illinois, it seemed appropriate to look at the contributions of biologists to public policy - the biologist as consultant, advocate, educator and researcher. This is our first call for presentations. We are especially asking for papers that focus on biologists as citizens who because of their special expertise and skills have much to contribute to public debate and to public policy issues such as the nature of science education, and the effects of new knowledge and techniques in biology on medical and ethical issues. What role should biologists play? For whom should we consult and how should we go about maintaining the "objectivity" of scientists in controversial social issues that hinge on biological knowledge?

Don't consider this request a limitation. Sessions on teaching ideas, laboratory techniques, computers as teaching and learning tools and curricular discussions are planned as well. Poster presentations are also encouraged.

Plan to participate in the 1986 meetings. You can begin that preparation now by sending in the following application.

1986 AMCBT Program Application for Participants

Name:

Institution:

Address:

Type of Presentation (Paper, Poster, Other - specify)

Title of Presentation:

Abstracts should be submitted no later than May 15, 1986. It is our intent to publish them in advance of the meetings.

Additional suggestions regarding the program are welcome. Write or phone:

Malcolm P. Levin
Biology Program
Sangamon State University
Springfield, Illinois 62708 Ph. 217-786-6720