

Bioscene



Journal of College Biology Teaching
Volume 20 Number 1 • March 1994

Bioscene

Journal of College Biology Teaching

Volume 20(1)

March 1994

Table of Contents

Articles:

- Interactive Simulations in Biology Education:
New Techniques** 3
Mark Bergland
- Auxin Movement During Root Gravitropism** 7
Soon Y. Kim and Timothy J. Mulkey
- Lactose Operon: An Active Learning Approach** 11
Amy Mulnix

News & Views:

- Do Good People Make Better Teachers?** 15
Craig W. Steele
- Candidates for 1994 Elections** 18
- Letter from AMCBT President** 19
- American Society for Microbiology:
Announcement** 19
- Henderson Community College: Profile** 20
- AMCBT 1994 Meeting: Tentative Agenda** 21
- CELS Meeting Announcement** 23
- Poster Submission Guidelines** 25
- AMCBT Membership Application Form** 27

Cover Illustration: Courtesy of Buzz Hoagland, McPherson College, McPherson, Kansas. From a laboratory notebook from G. Winston Cassler when he was enrolled in the McPherson High School Botany Course ca. 1900.

Bioscene: Journal of College Biology Teaching

Editor:

John R. Jungck
Department of Biology
Beloit College
700 College St.
Beloit, Wisconsin 53511
jungck@beloit.edu
FAX: (608) 363-2052 or 363-2718

Managing Editor:

Teresa Holevas
holevast@beloit.edu

Advertisements appearing in Bioscene do not reflect the opinion of the Editorial Board. Please submit all manuscripts directly to the Editor. We prefer receiving two printed copies and one in computer readable form. We work with the following word processors on the following computers: Microsoft Word, MacWrite and WordPerfect on the Macintosh, and Word Perfect on IBM PC compatibles. Final copy is prepared in Quark XPress on a Mac Centris 650. If you can submit your manuscript only on another system, please check with us beforehand. We can receive manuscripts electronically by connecting through Applelink where our address is BioQUEST. If you are connecting to us from BITNET via INTERNET, then our address is HOLEVAST@BELOIT.EDU. Please address file to AMCBT. All manuscripts will be sent out to two members of the editorial board for review. In the case of a split decision the manuscript will go to a third reviewer. The next deadline in 1994 is May 15.

Bioscene Editorial Board:

Chairperson:

Ethel Stanley
Biology Department
Millikin University
Decatur, IL 62522

George Garoian
Biology Department
Southern Illinois University
Carbondale, IL 62901

Secretary:

Timothy J. Mulkey
Biology Department
Indiana State University
Terre Haute, IN 47809

William Brett
Biology Department
Indiana State University
Terre Haute, IN 47809

Phyllis Kingsbury
Biology Department
Drake University
Des Moines, IA 50311

Ray Reed
Biology Department
Jefferson Community College
Louisville, KY 40210

Bruce Edinger
Biology Department
Valparaiso University
Valparaiso, IN 46383

Richard Kowles
Biology Department
Saint Mary's College
Winona, MN 55987

Robert L. Wallace
Biology Department
Ripon College
Ripon, WI 54871

Dave Finley
Biology Department
Lincoln University
Jefferson City, MO 65101

Malcolm P. Levin
Biology Department
Sangamon State University
Springfield, IL 62708

C. Robert Wikel
Biology Department
Doane College
Crete, NE 68333

Suggestions for Manuscripts:

Announcements
Letters to the Editor
Book Reviews
Laboratories that Work
Sources of Funding

Sociology of Biology
Courses that Work
Professional School
Biology Policy Issues
Minority Education

Women in Biology
Computer Advice
Review of Software/Hardware
Philosophy of Biology
History of Biology

***Bioscene* is the official publication of the Association of Midwestern College Biology Teachers**

Interactive Simulations in Biology Education: New Techniques

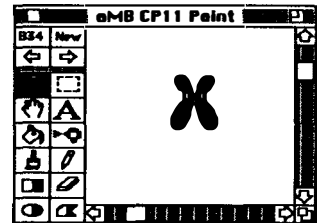
Mark Bergland

Department of Biology
University of Wisconsin-River Falls
River Falls, Wisconsin 54022

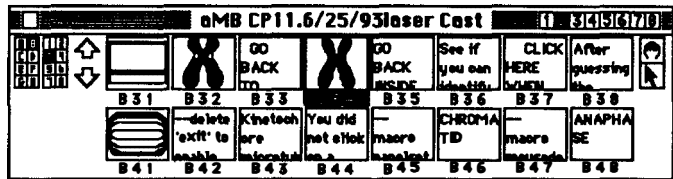
Recent advances in computer technology have made it easier for educators with little formal programming experience to develop interactive biological simulations which challenge the analytical thinking skills of students, taking them beyond the rote memorization inherent in "drill-and-practice" tutorials. Authoring software is now so powerful that complex experimental procedures can be simulated on the computer with relatively less effort than previously required. Despite these advances, many educators remain skeptical that they are capable of developing useful simulations in a reasonable period of time. I will address these concerns by describing techniques which have been used to develop educational simulations for undergraduate students at the University

of Wisconsin-River Falls. Hopefully this discussion will give others an incentive to explore new authoring systems which are revolutionizing educational software development. My programs are developed on the Macintosh using MacroMedia Director (MD)[1], one of the most powerful and flexible authoring packages currently available. To illustrate steps in software development, I will use sample screens from a Plant Cell Division program which I developed with support from the Undergraduate Teaching Improvement Council of the UW System. I will also discuss simulations which are currently being developed with support from the National Science Foundation (Division of Undergraduate Education, Grant No. DUE 9254089).

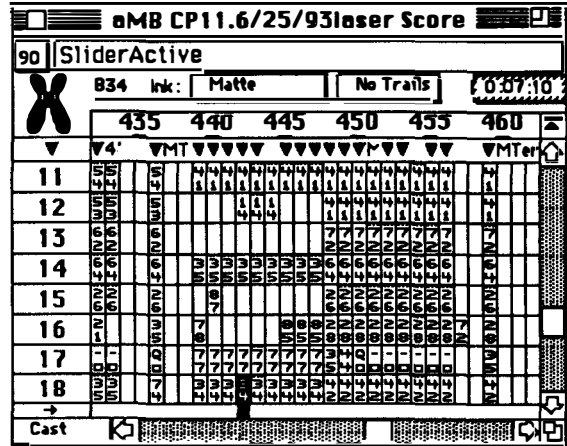
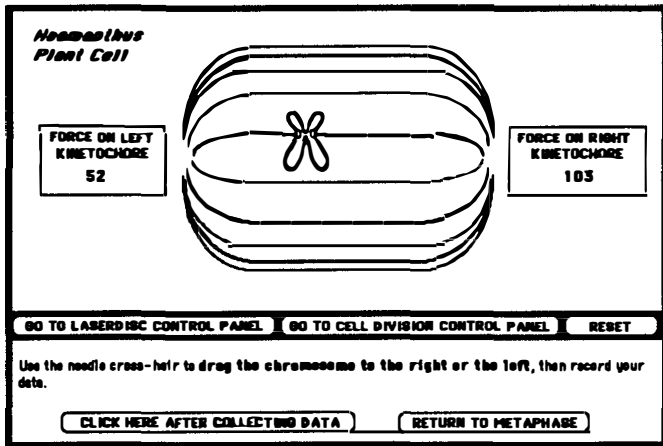
STEP #1: Design graphics. This is a portion of the Paint window of MD, showing a metaphase chromosome created in this window. An outline of one-half of the chromosome was drawn with the pencil tool, then the outline was filled in with the paint-bucket tool. This half was duplicated, and the duplicate was flipped horizontally to create the x-shaped chromosome shown here. I make extensive use of mirror imaging features like this to make symmetrical graphics. Note that these images are in 8-bit color rather than the monochrome necessary for this report.



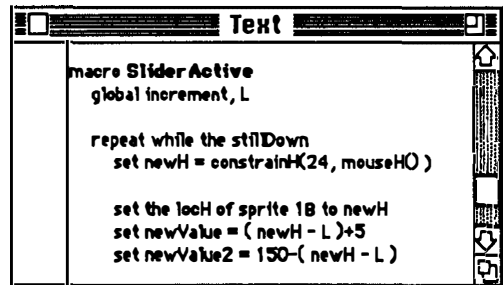
STEP #2: Add graphics to cast. Since the chromosome illustration was created in MD, it is already part of the cast (cast member B34 - see upper left of paint window). Images created using other software such as Ultrapaint or Canvas are imported into MD to be assigned a cast member position. Opening the Cast window reveals thumbnail images of all cast members, including cast member B34 above. Only 16 of the 512 possible cast member positions are shown here.



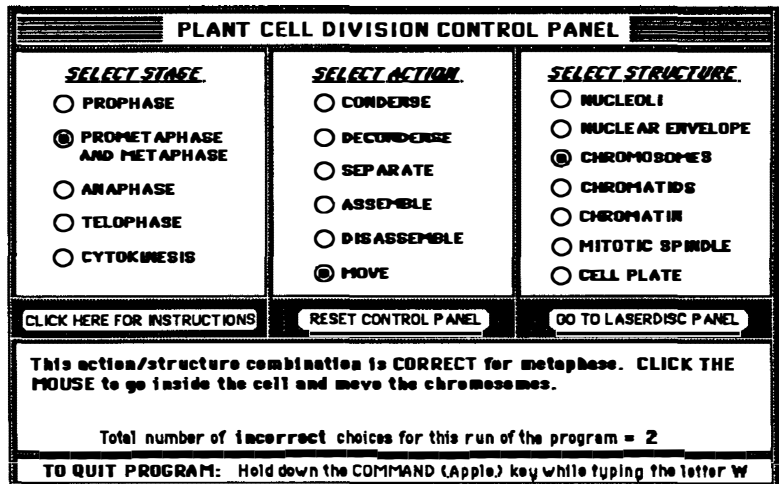
STEP #3: Place cast members on stage. Cast members are selected in the Cast window and are then dragged into position on the Stage, the location where action occurs. Before doing so, cast members are assigned to channels in the Score window. For example, cast members B34 (the chromosome) and B41 (the mitotic spindle) occupy channels 18 and 11, respectively, of frame 442 in the Score. Navigational buttons and other cast members occupy other channels of the Score. Since the mitotic spindle occupies a lower channel number, it appears behind the chromosome and serves as a background for it. When the movie is played and the playback head (the small black box) reaches frame 442, cast members present in the channels of that frame are displayed on the Stage as shown at the top of page 4.



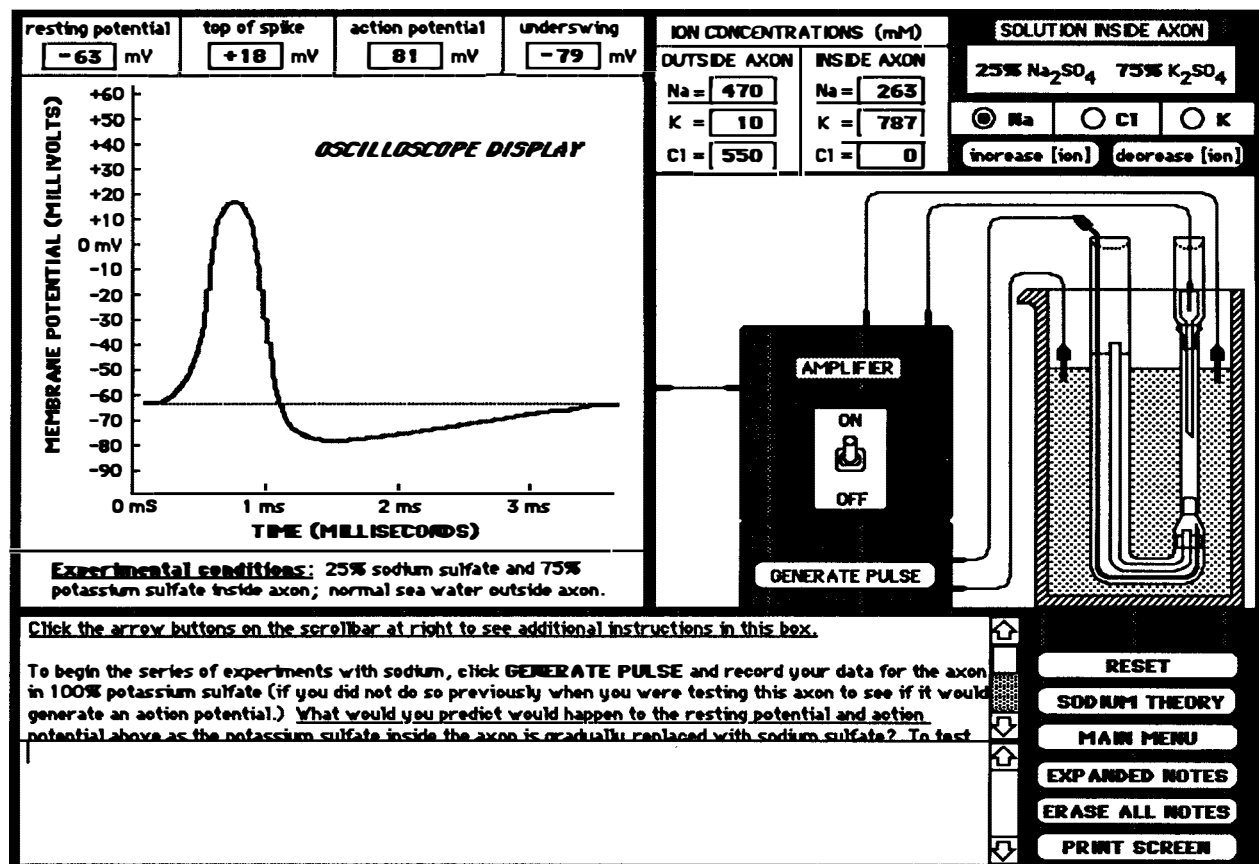
STEP #4: Add scripts to cast members. In this example students simulate a micromanipulation experiment by dragging the chromosome to the left and right with a “microneedle”. As they do so, numbers change on the screen corresponding to the microtubule forces on the right and left kinetochores. The program accomplishes this by calling a “macro” (collection of Lingo commands) which generates the force numbers based on the chromosome’s relative position on the stage. Note that cast member B34 is highlighted in the Score, and that the words “Slider Active” appear in the script window at the top of the Score. This means that whenever the student drags the chromosome (B34), the macro Slider Active is called and executes the series of Lingo statements shown in the Text window. This program was written using MD v2.0; more recent versions of MD use “handlers” in the Movie window instead of macros in the Text window, but the principle is the same. The ability to call complex macros or handlers by clicking or dragging screen icons is what gives MD its ability to create sophisticated interactive simulations.



STEP #5: Construct control panels and other navigational aids. For the Cell Division program, students select combinations of buttons on a main control panel. The program gives hints if they select inappropriate combinations, and they can double-click any of the stage buttons on the left to go directly to the beginning of that stage. Students can use this panel either as a navigational aid or to test themselves, since the program keeps track of incorrect combinations. The program uses a fairly complex series of logical IF and other Lingo statements to operate this main panel. Potential developers should be aware that the construction of this type of panel is a challenging, time-consuming task, even when one uses a higher-level language such as Lingo. Control panels that do not require button combinations (such as the Laserdisc control panel not shown here) are relatively easy to construct since MD has built-in handlers for controlling laserdisc and CD-ROM players. The laserdisc panel in the Cell Division program is accessible from any screen and enables students to see actual video footage of the various stages of cell division.



STEP #6: Design note-taking and screen-printing features. These features allow students to record data and write laboratory reports from within the program. The scrollable note-taking area at the bottom of the screen below is in reality an "editable text field" cast member; a full-screen view of this cast member is accessed by clicking the "expanded notes" button. The "print screen" button produces a printed copy of the current screen for use in laboratory reports. It is relatively simple to add these features to each frame of an MD movie.



The above illustration is from my program which simulates classic experiments in electro physiology by A.L. Hodgkin and his colleagues. Students first assemble the experimental apparatus by dragging objects into position. For example, they mount the giant axon of a squid onto a glass cannula and insert (drag) a microelectrode into the cannula. A J-tube is dragged into position underneath the bottom cannula, and the apparatus is connected to a pulse generator and amplifier so that action potentials can be recorded on the oscilloscope. A device at the top of the screen enables students to change ion concentrations inside the axon, for each of three different ions. In actuality, the screen above is a collection of cast members, some of which have been assigned Lingo scripts. For example, the on/off switch on

the amplifier is a cast member whose script will cause the program to jump to a different frame when the cast member is clicked. This new frame has all of the elements shown above, except for the graphic that depicts the action potential spike. When the amplifier is turned back on, the program jumps to another frame where a horizontal line (representing the resting potential of the cell) appears on the oscilloscope display. Clicking the "generate pulse" button jumps the movie back to the frame containing the action potential spike graphic, which scrolls smoothly across the display screen due to a special "transition" effect placed in the transition channel of that frame.

In another simulation a patch pipette is brought into position, isolating several ion channels. A slider control is used to set the command

voltage, then a "generate pulse" button generates an oscilloscope tracing of ion current flow along with a simultaneous animation of ions flowing across randomly opening channels.

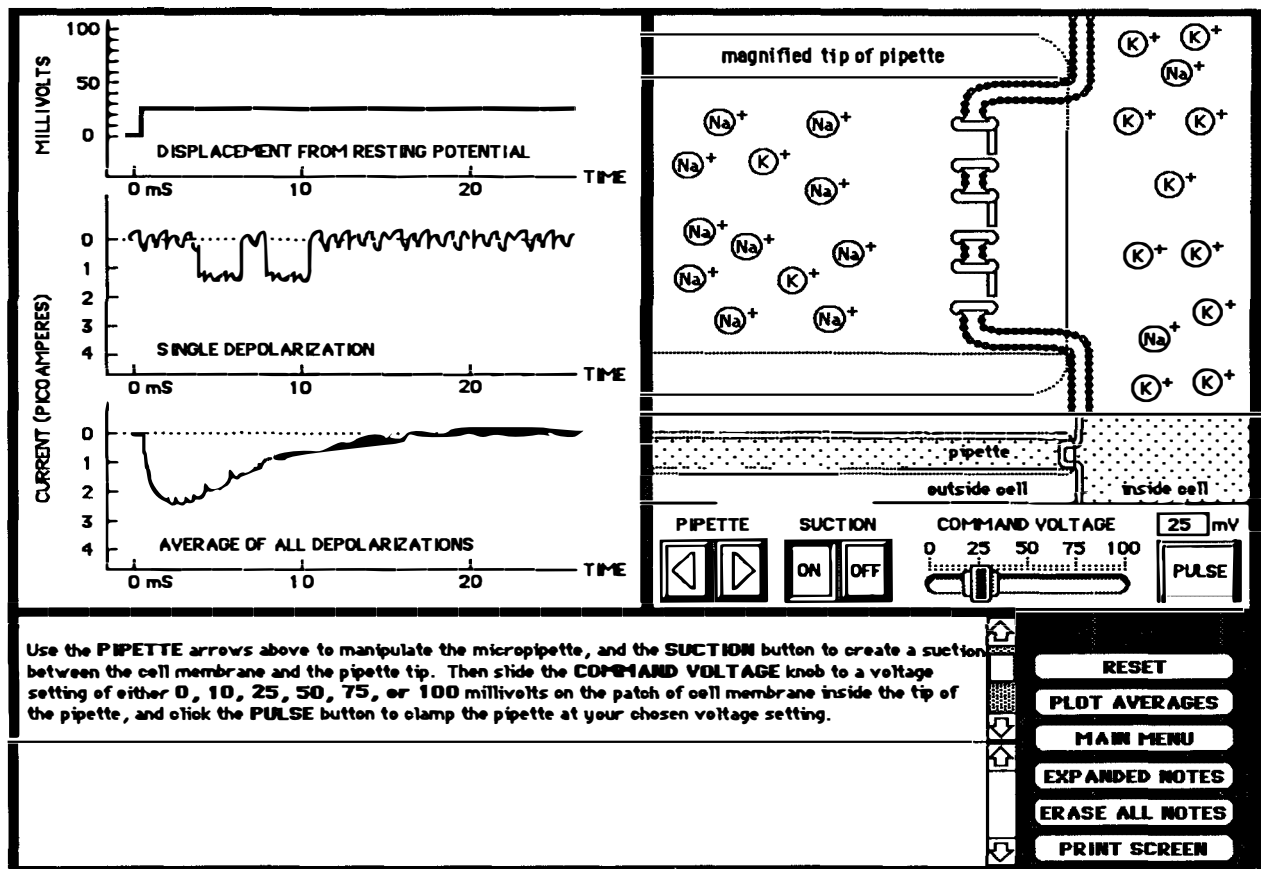
Lingo commands which control the voltage slider are similar to those which control the moveable metaphase chromosome described previously. Numbers generated by the slider are used in logical IF statements to jump to frames containing oscilloscope tracings associated with particular command voltages.

From a logical standpoint, there is nothing particularly difficult about constructing these types of simulations since they do not involve complex sets of Lingo statements as does the Cell Division control panel discussed previously. Rather, the process is analogous to constructing a crossword puzzle which has 24 rows (channels) in which to place cast members and a variable number of columns (frames), depending on the length of the movie. Once cast members are constructed and the logical framework of the simulation is thought out, it is relatively easy to assemble a working program. However, constructing cast members and assembling them in a logical order can be a time-intensive process, despite all of the

powerful tools available in MD to help one do this. The advantage of making this time commitment is that you can simulate virtually any experimental procedure, including those difficult or impractical to implement in an undergraduate biology laboratory. For example, programs to be developed this year will simulate the creation of transgenic animals and their use in medical research experiments. These programs will incorporate photographs and video sequences of actual laboratory procedures to increase realism. Video will be captured and incorporated into QuickTime windows accessed by clicking buttons on the stage.

The response of students to the Cell Division program has been very positive, and it is now regularly used in my introductory biology course. I will soon be testing the electrophysiology software with undergraduate students, and it will be interesting to see if they can recreate some of the thought processes of Hodgkin and his colleagues as they conducted experiments which ultimately resulted in the Nobel Prize.

[1] Macromedia Director version 3.13. 1993. Macromedia, Inc., 600 Townsend St., San Francisco, CA 94103



Auxin Movement During Root Gravitropism

Soon Y. Kim and Timothy J. Mulkey

Life Sciences Department
Indiana State University
Terre Haute, IN 47809

There have been many attempts to elucidate the effect of auxin on root growth and gravitropic response since Thimann (1937) observed the dose-response relationships of auxin on root and stem elongation.

Indole 3-acetic acid (IAA) is the active form of auxin in most plant species. Auxin is an essential factor in the control of root and stem growth and development. Auxin can either stimulate or inhibit cell elongation in roots, depending on concentration. Thimann (1937) suggested that the auxin effects on root elongation are similar to the effects observed on stem or coleoptile tissue. Since he was unable to observe significant promotion of root elongation by auxin, he suggested that root cells are more sensitive to auxin than stem or coleoptile cells.

While auxin has several physiological functions in plant organs, many researchers have focused on the role of auxin in gravitropism in plants. Gravitropism is a plant growth movement induced by either a gravitational stimulus or by mass acceleration (e.g., by centrifugation). Roots exhibit positive gravitropic movement particularly in primary roots. During past years, the Cholodny-Went hypothesis (Digby and Firn, 1980; Went and Thimann, 1937) has been widely accepted to explain the mechanism of gravitropism in plants, although there is an alternative hypothesis that has been proposed. According to these researchers (Digby and Firn, 1980; Went and Thimann, 1937), the gravitropic response of roots is controlled by the lateral movement of a growth inhibitor across a root when the root is placed in a horizontal position in a gravitational field (Figure 1). Auxin is redistributed by lateral transport toward the lower side of the horizontally oriented root.

The accumulation of auxin in the lower portion of the root results in a supraoptimal auxin concentration. Since auxin is inhibitory to root growth, supraoptimal concentrations of auxin

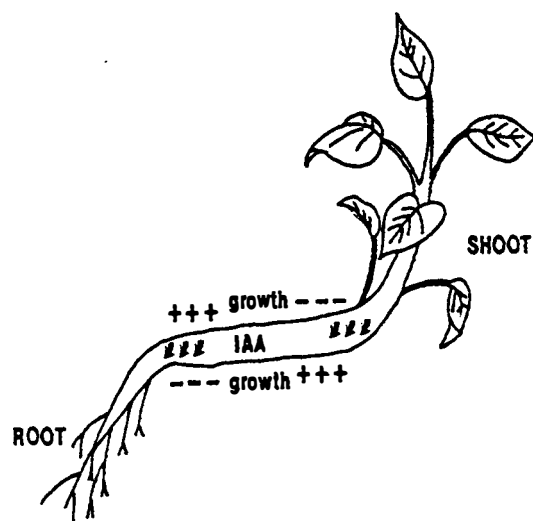


Figure 1. Diagrammatic representation of gravitropism in plants. Changes in the rate of elongation along the upper and lower surfaces of the shoot or root are indicated by +++ (promotion) or --- (inhibition). The direction of the movement of IAA in each organ is represented by the arrows.

inhibit growth of the elongation zone on the lower side of the root. The upper portion of the root contains optimal levels of auxin that stimulate growth of this upper portion. This differential rate of elongation between upper and lower halves of the root results in curvature.

Many researchers have reported a variety of experiments consistent with the concept that the site of graviperception for the root is the root cap (Björkman and Leopold, 1987; Moore and Evans, 1986; Poovaiah *et al.*, 1987; Wendt *et al.*, 1987). However, gravitropic response does not occur in the root cap, but in the elongation zone which is 2-6 mm behind the root cap. Based on a variety of experiments, authors have suggested that the

growth inhibitor may be either auxin (Jackson and Barlow, 1981; Mulkey and Evans, 1981, 1982; Mulkey *et al.*, 1983; Steen and Hild, 1980) or abscisic acid (AbA; Pilet and Chanson, 1981; Pilet and Rivier, 1981). Some authors discount AbA as a growth inhibitor in gravistimulated roots (Lee *et al.*, 1990, Mulkey *et al.*, 1983). Thus, it is widely

accepted that auxin plays the central role in the maintenance of the asymmetric elongation rates observed during gravicurvature of roots.

In this laboratory exercise, auxin movement in the elongation zone of root is observed during gravitropism using a simple donor-receiver agar block system.

Laboratory Exercise

GOALS OF THE EXPERIMENT

1. Examine the effect of gravity on IAA movement in the elongation zone of root.
2. Examine the time-dependent IAA distribution in the elongation zone of gravistimulated roots.
3. Examine the IAA movement related to the IAA transport inhibitors such as TIBA (2,3,5-triiodo benzoic acid) and NPA (naphtylphthalamic acid).

TIME REQUIREMENT

- 0.25 hours (approximately) 3 days prior to experiment to soak grain
- 1.00 hours prior to experiment to prepare agar blocks
- 1.00 hour (approximately) 1.5-2.0 days prior to experiment to plant grain
- 1.50 hours prior to experiment for pretreatment as needed
- 2.00 hours experiment running time
- 2.00 hours (approximately) after the experiment to setup and measure radioactivity)

MATERIALS AND EQUIPMENT

- Agar
- Disposable gloves
- Disposable plastic petri dishes, 100x15 and 150x15 mm
- Filter paper (Whatman No.1)
- Forceps
- Grain, corn
- Hot plates
- Oxygen Tank
- Paper Towel
- Plastic trays and tub
- Radioactive IAA (30,000 cpm per block and concentration of IAA is approximately 10^{-9} to 10^{-10} M)
- Razor blade
- Scintillation counter
- Screws, two machine screws (1.5" x 8/24 or 8/32)
- Small block of wood
- Thread
- Tissue culture flask (200 ml) with syringe needle (20G 1 1/2)
- Window putty (Mortite)

METHODS

Seedling Preparation. Corn grains are soaked overnight in running tap water to prevent anaerobiosis. Grains germinate between wet paper towels on plastic trays in a vertical position. To obtain straight primary roots you should place the corn grains in rows on a tray covered with 2-3 layers of paper towel. Cover the grains with 3 or 4 layers of paper towels; place another tray over final layer of towels to hold the paper towels and grain in place. Position the trays vertically in a shallow tub containing 1-2 inches of water. Primary roots of approximately 1.5-2.0 cm should be used for the experiment. This should require 2-3 days of growth, depending upon the cultivar and temperature.

Application of Radioactive IAA. For donor (containing radioactive IAA) and receiver (plain) agar plates, prepare 100 ml of 1% of non-nutrient agar solution. The solution is boiled to dissolve the agar and poured in 100 x 15 mm plastic petri dishes (10 ml of solution per plate). One of the plates contains radioactive IAA (30,000 cpm; 10^{-9} to 10^{-10} M IAA) with a drop of food dye to distinguish radioactive and plain agar plates. The poured plates are placed on a level surface and allowed to solidify.

Preparation of Agar Blocks. Prepare a marking block as illustrated in Figure 2. The block is constructed of two machine screws which are glued to a small block of wood. The machine screws act as guides and spacers for thread, which is wrapped around the block/screws. Using this wood block, press the surface of agar block horizontally, then vertically to make small squares. Using the razor blade, carefully cut the agar along the scars of the thread to obtain uniform squares of agar.

Pretreatment of Root. Roots are pretreated with the desired chemical or hormone solution for proper time periods, depending on experiments (usually for 1 hour). Roots are attached vertically to the wall of a tissue culture flask using window putty.

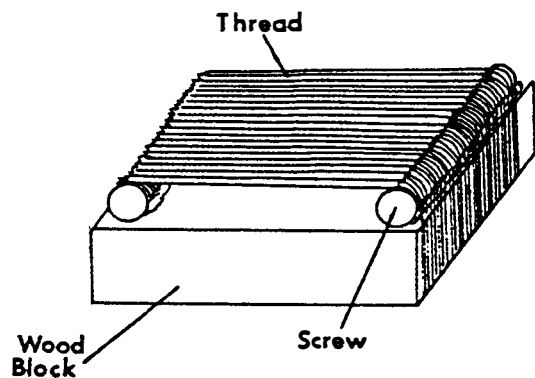


Figure 2. Design of wood block for making the scar on the surface of agar plates to prepare the agar block.

The flask is filled with a solution of the test compound. The solution is oxygenated using a syringe which is inserted and glued through the wall of the flask. After the pretreatment, roots are transferred to the humidified disposable petri dishes.

EXPERIMENTAL PROCEDURE

1. Prepare the humidified disposable petri dishes, as many as need, by adding wetted filter paper circles to the top half of each dish.
2. Make a holder for seedlings with window putty in the center of bottom of petri dish (150x15 mm). The putty strip is vertical across the bottom of petri dishes (Figure 3).
3. Prepare a stand for petri dishes to keep them in the vertical position. A small empty box with a slit in the top is ideal.
4. Select 10 corn seedlings with primary roots 1.5 cm in length for each petri dish. Roots are pretreated (if needed) with testing chemical solution while in a vertical position.
5. Attach the seedlings to the putty in the humidified chamber so that the roots are oriented in a horizontal position; 5 seedlings should be attached to each side (Figure 3).
6. Apply donor agar block containing radioactive IAA on the top surface of the elongation zone (2-4 mm from the tip) of the roots on

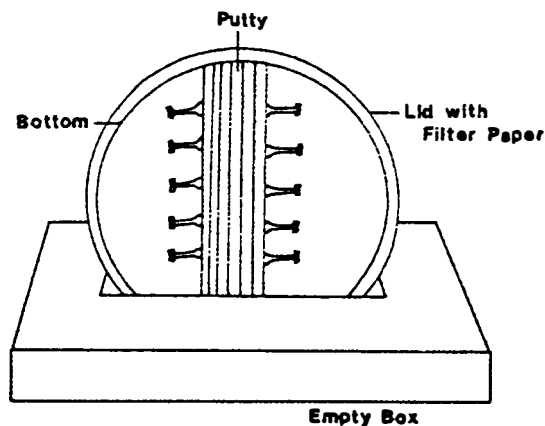


Figure 3. Diagram of putty holder in the bottom of petri dish (humidified chamber) and a stand for petri dishes to keep them in vertical position using an empty box.

7. Apply the receiver block on the opposite surface of the roots directly opposite of the donor block (Figure 3).
8. Incubate the roots for proper time period (45 or 90 min), then collect the donor and receiver agar blocks from both surfaces of root.
9. Measure the radioactivity of the donor and receiver agar block by scintillation counting.
10. Calculate the ratio of radioactivity in the agar blocks (amount which moved into the bottom receiver/amount which moved into the top receiver) to determine the IAA movement.

OBSERVATIONS AND QUESTIONS

What is the significance of the ratio of radioactivity in receiver agar block if ratio is greater than 1 or less than 1?

Which direction did IAA move? Could the amount of IAA which moved be considered significant? Does this method measure the total amount of IAA which moved? Why or why not?

What degree of curvature was obtained by the roots during the time selected for auxin transport? Does the degree of curvature and the ratio of auxin in the receiver blocks correlate?

SUGGESTIONS FOR ADDITIONAL EXPERIMENTS

1. Observe the IAA movement in different time periods. observe the IAA movement in the elongation zone of root during gravitropism.
2. Determine the effect of an auxin transport inhibitor (NPA or TIBA) on IAA movement.
3. Pretreat the roots with ethylene biosynthesis inhibitors such as cobalt ion (0.1 mM) and/or 1 μ M AVG (aminoethoxyvinylglycine), then
4. Pretreat the roots with ethylene-producing agents such as Ethephon (1 mM) or 1 μ M ACC (1-aminocyclopropane-1-carboxylic acid) which is a precursor of ethylene, then observe the IAA movement in the elongation zone of root during gravitropism.

Literature Cited

- Björkman, T., and A. C. Leopold. 1987. An electric current associated with gravity sensing in maize roots. *Plant Physiol.* 84:841-846.
- Digby, R. D., and J. Firm. 1980. The establishment of tropic curvatures in plants. *Ann. Rev. Plant Physiol.* 31:131-148.
- Jackson, M. B., and P. W. Barlow. 1981. Root geotropism and the role of growth regulations from the cap: re-examination. *Plant Cell Environ.* 4:107-123.
- Lee, J. S., K. H. Hansenstein, T. J. Mulkey, R. L. Yang, and M. L. Evans. 1990. Effects of abscisic acid and xanthoxin on elongation and gravitropism in primary roots of *Zea mays*. *Plant Sci.* 68:17-26.
- Moore, R., and M. L. Evans. 1986. How roots perceive and respond to gravity. *Am. J. Bot.* 73:574-587.
- Mulkey, T. J., and M. L. Evans. 1981. Geotropism in corn roots: Evidence for its mediation by differential acid efflux. *Science.* 212:70-71.
- Mulkey, T. J., and M. L. Evans. 1982. Suppression of asymmetric acid efflux and gravitropism in maize roots treated with auxin transport inhibitors or sodium orthovanadate. *J. Plant Growth Regul.* 1:259-265.
- Mulkey, T. J., M. L. Evans, and K. M. Kuzmanoff. 1983. The kinetics of abscisic acid action on root growth and gravitropism. *Planta.* 157:150-157.
- Pilet, P. E., and A. Chanson. 1981. Effect of abscisic acid on maize root growth: a critical examination. *Plant Sci. Lett.* 21:99-106.
- Pilet, P. E. and L. Rivier. 1981. Abscisic acid and distribution in horizontal maize root segments. *Planta.* 153:453-458.
- Poovaiah, B. W., J. J. McFadden, and A. S. N. Reddy. 1987. The role of calcium ions in gravity signal perception and transduction. *Physiol. Plant.* 71:401-407.
- Steen, M., and V. Hild. 1980. Geotropic curvature of decapitated *Avena* coleoptiles after application of tips of maize roots, tips of *Avena* coleoptiles, indole acetic acid, or abscisic acid. *Planta.* , 150:37-40.
- Thimann, K. V. 1937. On the nature of inhibition caused by auxin. *Am. J. Bot.* 24:407-412.
- Wendt, M., L. L. Kuo-Haung, and A. Sievers. 1987. Gravitropic bending of cress roots without contact between amyloplasts and complexes of endoplasmic reticulum. *Planta.* 172:321-239.
- Went, F. W. and K. V. Thimann. 1937. *Phytohormones*. Macmillan, New York.

Lactose Operon: An Active Learning Approach

Amy Mulnix

Department of Biology
Earlham College
Richmond, Indiana 47373

INTRODUCTION

Interest in alternatives to the traditional lecture format has been on the rise. Active- and group-learning approaches attempt to draw students into purposeful interaction with the material, the faculty member and with each other. At their best, these approaches can bring the student past memorization to understanding, synthesis and application of the material. Other advantages of these techniques include giving the student a larger responsibility for his/her own learning process and practice in interpersonal skills.

I have attempted to introduce a variety of presentation formats into our sophomore Cell Biology course. Many of these take a hands-on, interactive approach. One such exercise introduces the central concepts of prokaryotic gene regulation: polycistronic genes, repression, activa-

tion, DNA-protein interactions, allosteric regulation of DNA-protein interactions. The objective of the exercise is to have students deduce the model for the regulation of the lac operon from summary statements of observations about the system. Students work in small groups (3 or 4) to answer a series of questions, modify a diagram, and complete a table in response to the statements. The exercise that the student groups are given follows.

EXERCISE

Directions: Each of the following statements is an observation of the lactose utilization system in *Escherichia coli*. Read each statement carefully and identify the appropriate feature on the diagram provided (see Figure 1). Discuss the answers to the questions posed, making your own notes as necessary. If a term or concept (especially one in

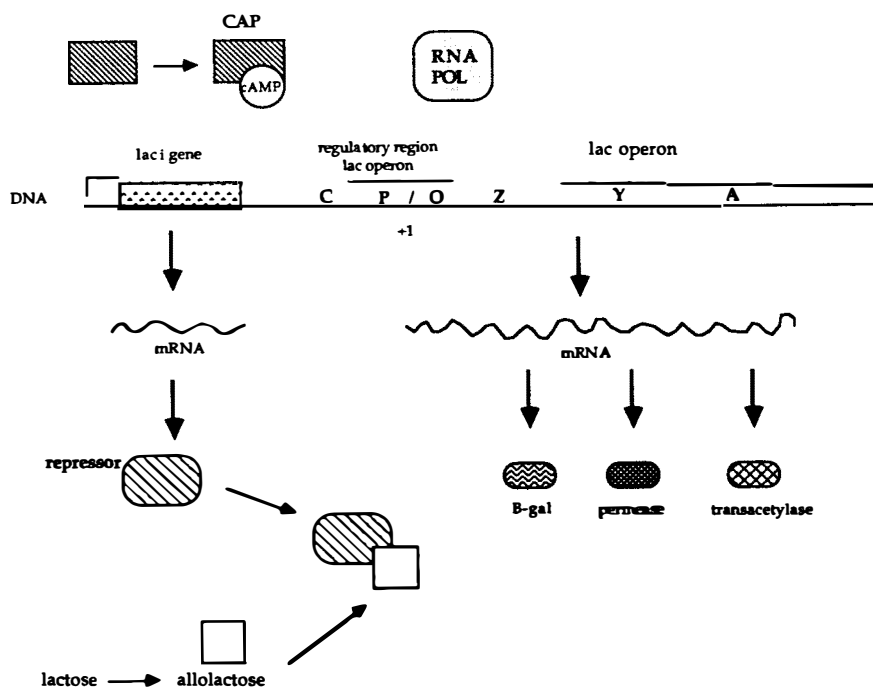


Figure 1. Regulation of the lac operon. A diagram similar to this is drawn on newsprint paper (18" x 24"). Color markers are used to distinguish between DNA, RNA and protein. Student groups are provided with markers or crayons and are encouraged to alter the diagram with arrows, numbers, and phrases to indicate the regulatory mechanisms.

bold, underlined type) is unclear to you, ask a team member for clarification, consult your text or (as a last resort) discuss your question with the instructor. There are two components to the exercise: repression and activation. Remember, you are trying to develop a model for the regulation of transcription from the lac operon.

PART I. REPRESSION

Glucose is the preferred energy source for most prokaryotic cells. The enzymes required for uptake and metabolism of glucose are always present. When *E. coli* cells must use alternative sugars as energy sources, specific enzymes are synthesized that utilize that sugar. When lactose is being used as an alternative energy source, a set of genes contained in the lac operon are newly transcribed and translated. The **lac operon** contains three coding units for enzymes that allow for the utilization of lactose. The **z-gene** codes for the enzyme beta-galactosidase which hydrolyzes the bond between the galactose and glucose units of lactose. The **y-gene** codes for the transmembrane transport protein, galactoside permease, that transports lactose across the plasma membrane. The **a-gene** codes for a transacetylase enzyme that adds an acetyl group to lactose. These three genes are transcribed as a single **polycistronic** message; i. e., they are under the control of a single set of regulatory elements.

1. Locate the three structural genes on the diagram provided. In what order are these coding units transcribed? Are the structural genes transcribed in the absence of lactose?

The site of transcription initiation is indicated as +1. The lac operon contains a set of 3 sites that control synthesis of the mRNA. At this point, we will focus on two of these (the following exercise on activation focuses on the third region). The **promoter (p)** site is the DNA sequence (-25 to +28) to which **RNA polymerase** binds and begins transcription of the polycistronic message. The **operator (o)** site is a DNA sequence (-4 to +24) that is recognized and bound by a protein called the **repressor**. IMPORTANT!! The operator and promoter sites physically overlap each other.

2. Do you think it is possible for both the repressor protein and the RNA polymerase to be bound to the control region simultaneously? Explain your response.

3. The lac operon is not transcribed in the absence of lactose. Is repressor bound to the operator site under these conditions?

The **repressor** protein is encoded by a gene that is physically adjacent in the *E. coli* genome to the lac operon. This gene is called the **i gene**. The **i gene** has its **own** promoter and terminator; it is **not** a part of the lac operon.

The repressor protein is an **allosteric** protein. In addition to having a binding site for the operator DNA, the repressor protein has a second binding site for allolactose. Allolactose is an **isomer** of lactose that is produced after lactose enters the cell. The binding of allolactose to repressor alters the ability of repressor to bind to DNA.

4. Consider your answer to question 3; hypothesize how the binding of allolactose to the lac repressor might alter the binding of repressor to operator (remember, the bacteria will usually activate the lac operon when lactose becomes available). Is repressor bound to "o" in the presence of lactose? In its absence? Is polymerase able to bind to "p" in the presence of lactose? In its absence?

Modify your diagram to reflect the control of the lac operon by repressor protein. For example, you may wish to indicate the positions of the regulatory sites, where RNA polymerase and repressor bind, and how binding of allolactose alters the activity of repressor. Use arrows, X's, lines, whatever you like to modify the diagram.

PART II. ACTIVATION

Repression of the lac operon by the repressor protein is an excellent example of a **negative** control mechanism (the expression of a gene is turned off by the binding of the repressor protein). The lac operon is also under **positive** regulation (the expression of a gene is turned on by the binding of a protein). The following are a series of statements and questions describing the positive control of the lac operon. The procedure for completion of this portion of the exercise is the same as for the first exercise.

As stated earlier, glucose is the preferred energy source in bacterial cells. Even if glucose and lac-

tose are both present in the growth medium, the glucose will be used first and the lactose utilization genes will not be transcribed until the glucose has been depleted.

The levels of glucose within a bacteria are correlated with and communicated by the levels of **cAMP**. cAMP (cyclic AMP) is a derivative of ATP which is studied in greater detail in other lectures. **WHEN GLUCOSE LEVELS ARE HIGH, cAMP LEVELS ARE LOW. WHEN GLUCOSE LEVELS ARE LOW, cAMP LEVELS ARE HIGH.**

The third control site in the lac operon is a binding site for the **catabolite activator protein (CAP)**. The binding site for CAP (c) in the lac operon is immediately adjacent to the promoter (-72 to -52).

1. Do you think it is possible for the CAP and RNA polymerase to be bound to the control region of the lac operon simultaneously? Do you think it possible for the CAP and lac repressor to be bound simultaneously?

cAMP binds to CAP, which is (you guessed it) an allosteric protein. The CAP-cAMP complex has a higher affinity for its binding site than CAP alone. In addition, the presence of CAP-cAMP complex at the regulatory region greatly increases the affinity of RNA polymerase for the promoter site.

2. Under what nutritional circumstances (high or low glucose) is CAP bound to cAMP?

Would you hypothesize that the binding of the CAP-cAMP complex to the lac operon control region increases or decreases transcription from the operon?

3. In the absence of lactose and the presence of glucose in the bacterial growth media, what proteins are bound to the lac control region? Is the operon being transcribed?
4. In the presence of lactose and the presence of glucose in the bacterial growth media, what proteins are bound to the lac regulatory region? Is the operon being transcribed?
5. In the presence of lactose and the absence of glucose in the bacterial growth media, what proteins are bound to the lac control region?

PART III. EFFECT OF MUTATION

Make modifications to the diagram (see Figure 1) to illustrate the regulation of lac by cAMP and CAP.

6. Complete the table provided, indicating how much (lots, little, none) of the lac z gene product would be made given the following mutations:
 - a) mutation in the operator that reduces the affinity of the operator for the repressor protein (operator-constitutive mutants = o^c)?

Table 1. Nutritional status, mutation and expression of the lac operon. For each of the following conditions, indicate how much (none, little, lots) of the lacZ gene product, beta-galactosidase, is being synthesized.

GENETIC STATUS	NUTRITIONAL STATUS		
	+lactose/-glucose	+lactose/+glucose	-lactose/+glucose
normal			
o^c			
p^-			
i^s			
i^-			
y^-			
c^-			
c^c			

- b) mutation in the promoter that reduces the affinity of the promoter for RNA polymerase (p^-)?
- c) mutation in the repressor gene such that the protein has lost the ability to bind allolactose (superrepressor mutant = i^s)?
- d) mutation in the repressor gene such that the protein has lost the ability to bind the operator (i^-)
- e) mutation in the beta-galactosidase gene that introduces a stop codon in the first third of the protein (y^-).
- f) mutation in CAP protein such that the affinity for cAMP is significantly decreased (c^-).
- g) mutation in the DNA binding site for CAP-cAMP that allows CAP to bind regardless of whether cAMP is bound to CAP or not (c^c).

ADDITIONAL QUESTIONS:

8. Why is it adaptive for a bacterium to not express the genes that encode the lactose utilization proteins when lactose is not available or when glucose is present?
9. Why is it adaptive for the structural genes for using lactose to be under the control of a single promoter (i.e. synthesize a polycistronic message rather than three monocistronic messages)?

COMMENTS

I have used this exercise twice. Both times students approached me after class to say how much they enjoyed the exercise. When asked about the exercise on the course evaluation, the overwhelming majority of students (53 of 58) found it helpful in learning the details of the system and indicated that the exercise should be used the following year. A few students commented that they did not like 'these-kind-of activities' and that they would rather have had a lecture over the material.

Student comments on the evaluations from the first year prompted me to modify the exercise slightly for the second year. A collected vocabulary assignment (the underlined, bold words) is now given the day before the exercise is scheduled in an attempt to get the students to at least skim the appropriate pages in their text¹. The day following the exercise, a short, in-class quiz on the material is given. The quiz asks which proteins will be bound to the control region under different nutritional states. I then provide the answers to the quiz and respond to questions.

During the fifty minute class period in which the exercise is done, students are divided into groups of three or four. Group assignments were made to include in each group a student who has performed well on exams. During the class period, I circulate among the groups and eavesdrop on their conversations and examine their diagrams. Guidance is offered only if the group is significantly off-track. In the past, I have tried to check all of the tables and diagrams before the groups leave the room. This has not been possible for logistic reasons; in the future, an example of a diagram and the completed table will be posted during the last few minutes of class. All groups have been able to complete the repression portion of the exercise in the 50 minute class period and several groups are able to complete the activation portion. For those groups who do not finish the exercise, I ask the individuals to work through the remainder of the handout on their own that evening.

SUMMARY

This active learning exercise has students work in small groups to develop a model for the regulation of the lactose operon. Both repression and activation are covered. Groups are given a series of observational statements and a diagram to guide their development of the model. The final component of the exercise is the completion of a table that requires the students to synthesize all of the material and place it into a physiological context. The exercise has been exceptionally well received by students.

¹Although the stated expectation is that students are reading the material prior to coming to class, I have found that only about 10% of the class fulfilled this expectation unless some type of assignment was given.

News and Views

Do Good People Make Better Teachers?

Craig W. Steele

Department of Biology and Health Services
Edinboro University, Edinboro PA 16444

The virtues required of good teachers are virtues which are virtues in everyday life, and those virtues essential for teaching effectiveness are courage, loyalty, maturity, self-discipline, and competence. To me, the point is clear: A good teacher is a morally good person. From this perspective, given equally sufficient education and training, an educational institution composed of teachers in which these qualities are more highly developed should produce better-educated students than an otherwise equal educational institution in which they are less. Now, to evaluate the truth of these claims.

As a practitioner of the scientific method, I would want to conduct a controlled experiment to determine the answer. However, a controlled experiment cannot be established in this instance. It is impossible to create an institution of moral ("good") teachers and an opposing institution of immoral teachers, and then record who's students are consistently "better-educated" or "more successful" in their careers (assuming we could even agree on operational definitions of these variables). Not only can we not conduct experiments to determine the answer, we cannot even evaluate empirical data. Although we could examine the academic records of former students and the records of their successes or failures in post-graduate careers, the goodness of their former teachers cannot be measured. And so many other factors influence success or failure in academics and in careers that no definite conclusions would likely be possible based solely on examination of past records. Rational analysis, however, provides an alter-

native approach. By understanding how being a good person relates to the role of a teacher, we may better understand and more accurately evaluate my claims.

Start with trust. I think most of us could agree that a workable, operational definition of trust is individuals acting in accordance with the expectations of others. To be effective, any educational process, large or small, must possess the characteristic of obedience. Students must do what their teachers direct

if education is to be controlled to any extent and if learning is to occur.

Students obey in one of two ways: willingly or unwillingly. If unwillingly, obedience is obtained through intimidation and fear. Willing obedience, however, is a product of trust. Based on experiential knowledge, I know that students who trust their

teachers and accept their directions complete those directions with greater effectiveness and greater learning than students who do not trust their teachers.

Why do students come to trust their teachers? The answer, in part, involves morality. Students trust their teachers when they expect those teachers to make morally right decisions. One question arises immediately, however, concerning this claim.

Those who contend that people act out of self-interest might also contend that moral rightness is a separate issue. They might claim that students trust teachers when they believe teachers will make decisions that serve the interests of their students. In the classroom, this claim implies that students would trust teachers who were competent in

The educational welfare of one's students and the pursuit of the larger institutional purposes may, however, sometimes conflict.

their profession and concerned with the education of their students. The educational welfare of one's students and the pursuit of the larger institutional purposes may, however, sometimes conflict.

In order to increase the chance of (financial) success for the educational institution, teachers may be expected, for example, to teach according to outdated course outlines or syllabi which would be too costly or too administratively difficult to update. They might be directed to teach using outdated or, literally, antique equipment which would be too costly to replace with modern equipment. They might be directed to teach classes of hundreds of students in cavernous lecture halls or to accept doubled or tripled class sizes in order for the institution to minimize faculty salaries and maximize tuition monies. They might be directed that research, not teaching, should be their primary concern, and that decisions on tenure and promotion depend on their ability to attract extramural research funding, with its concomitant "overhead" monies. Conventional educational practice demands that teachers direct their students to proceed as if these unacceptable situations did not exist, even though the education of the students might be jeopardized. Exclusively self-interested students, therefore, would distrust a teacher who makes morally right decisions, if the students recognize that such decisions might put their education at risk.

Students would trust a teacher who puts their welfare above other concerns, although they might realize that the institution would not consider such a teacher to have the "right" moral perspective or to be "politically correct." Some students might also realize that an educational institution with many such teachers would not be an effective organization.

There is more to trust, however, than simply serving the interests of students. Even if it were true that people always act out of self-interest (a view with which I do not agree), there must be more to consider. A teacher receives directives and must decide to comply or not. If strict self-interest prevailed, only a teacher who made decisions that would benefit the interests of the individual student would be trusted.

We will ignore the problems of teachers acting in their own best interest in applying the self-interest theory to those involved in education and focus on the student's perspective. Usually, a teacher's decisions would benefit some of the students, but not others. No teacher acting on the basis of students' interests could consistently satisfy the self-interests of each.

Students, whether they express the idea clearly or not, recognize a teacher who favors one individual as a teacher they cannot trust. A teacher acting to further the self-interests of only one, or a few, students would not be acting fairly in the sense of recognizing each student as an individual worthy of equal consideration.

I believe students recognize fairness as a fundamental moral quality, and that they expect teachers to possess it. They will trust a teacher only if they expect the teacher to act fairly. They will, in general, trust a teacher who exhibits certain moral qualities, which makes it reasonable to claim that they will trust a teacher if they believe he or she is a good person.

I should also mention another basis for trust. Teachers who have convincingly demonstrated their teaching ability and professional competence often enjoy their students' respect. Do they also enjoy their trust? Ability has, undoubtedly, generated trust on occasion.

On the other hand, teachers who successfully accomplish institutional objectives by expending minimal resources certainly satisfy their administrators. Predictably, such teachers may make unfair decisions, especially if they extend little value to their students as persons. They can be expected to act according to agendas best suited for achieving their own goals. The educational welfare of their students will be a consideration, but it will have significance only in the pursuit of personal and institutional success. For those directly teaching students as opposed to administrators or administrative faculty, the difference becomes critical in developing trust. At the classroom level, with time, students will recognize the difference between teachers who try to treat them fairly and those who see students primarily as means to their own ends. Students will real-

ize that teachers who consider only personal and institutional accomplishments use their students merely as tools for advancement. Thus, we return to the importance of fairness and the greater issue of being a good person. If fairness is important in developing trust, several considerations arise. To act fairly, our behavior must be consistent with respect to standards that the group recognizes as principles that should be acceptable to group members. Students use group principles in justifying and evaluating each other's actions; principles which, in fact, constitute the qualities by which students identify a good person.

What is the nature of the principles (or standards) that students regard as applicable? If students consider such principles because of their concern with fairness, then they must apply reason

in evaluating the fairness of their teachers' actions. The principles must be considered from a perspective that provides equal consideration to each individual student. Over time, consistent actions by a teacher that meet this standard of fairness is the initial step in developing trust. Fairness is an essential element of what it means to be a good person in an educational environment.

To examine this idea further, other principles of conduct that should be collectively recognized in an educational institution must be considered. Our rational analysis, therefore, leads us to the issue of professional ethics.

What principles should an educational institution recognize? What generalizations can be made concerning a professional teaching ethic (PTE) that establishes standards of conduct for members of the educational institution? What principles make sense as those teachers would accept? If the ethic is understood by members of an educational institution and is accepted by them as the codification of acceptable principles for justifying teachers' actions, the PTE will also serve as an effective behavioral constraint. The ethic would play a critical role in any decisions by

teachers that directly affect the educational welfare of students.

How can we determine the appropriate elements of a compelling PTE? First, the members of the profession must recognize its provisions as the appropriate standard for morally evaluating their actions. Second, the PTE must make sense to members of the profession. It must be acceptable because it makes sense; otherwise, group members will neither know how to apply the PTE consistently, nor will they consider it compelling.

The PTE must also actually affect behavior. Teachers must desire to act in accordance with it because they recognize it as the way to justify actions to others. The PTE should consist of principles or values that teachers could not reasonably reject.

Without the background of a moral education, however, teachers may not be motivated to act in accordance with moral guidance. A moral education is the process of learning what is acceptable behavior and recognizing that others expect such behavior. However, most people who grow up in a social environment, learn what is acceptable and what is not. Although they may not always adhere to such guidance, they do develop the motivation to be seen as justified in their actions. Obviously, teachers are the products of various social environments. Most teachers, however, should be expected to understand the fundamental social value of what society expects regarding morally acceptable behavior.

Perhaps the first step in developing a PTE is to recognize the qualities that teachers must possess to be successful in teaching, i.e. to produce educated, literate citizens. In my opinion, these qualities are the virtues of courage, loyalty, maturity, self-discipline, and competence. These qualities constitute functional requirements of educational activity. Properly educated and trained teachers should understand their importance. To be compelling and effective, a PTE, must incorporate these qualities.

. . .the qualities that teachers must possess to be successful in teaching. . . are the virtues of courage, loyalty, maturity, self-discipline, and competence.

Functional requirements and fundamental social values of society apply to any educational institution; the more professional the institution, the more strongly they apply. Thus, these two factors should be the sources for the principles that comprise the PTE. These principles should define what it is to be a good person in an educational environment.

We can now return to my claim that an educational institution whose teachers possess the teaching virtues will be more effective than one whose teachers do not. If such virtues are incorporated into the PTE, and if teachers become committed to the PTE, they will be committed to developing qualities that enhance success in teaching. If teachers, and their administrators, are committed to the fundamental values of their society, again logically incorporated into the PTE, such commitment put into practice will generate trust. And trust allows a faculty (a "teaching force") to make maximum use of its capabilities.

A PTE that is a compelling moral system for a teaching force makes the moral com-

mittments of a teacher the highest order desire he or she possesses. That is what being "morally motivated" means — that we recognize what we really ought to do. If the virtues functionally required for successful teaching are those of the accepted PTE, the teaching force will indeed be more effective than one in which such virtues are less developed. A teaching force whose members possess the virtues of moral (and physical) courage, loyalty, maturity, self-discipline, and competence is superior to one equal in ability but lacking these virtues.

If properly structured, efficiently promulgated, and widely accepted, a PTE will help develop a potent teaching force. Leaders of educational institutions striving to improve their organizations should place development of a compelling, effective PTE and development of the teaching virtues high on their priority list. By doing so, they truly place the students first, because these virtues all bear on the establishment of trust among teachers and students, a pivotal condition that can be an important "learning multiplier" in the classroom.

Candidates for positions in the upcoming elections are:

For President:

Tim Mulkey, *Indiana State University*
Jeanene Yackey, *Fontbonne Science Academy*

For Steering Committee:

Bill Brett, *Indiana State University*
Thomas A. Davis, *Loras College*
Dick Wilson, *Rockhurst College*
Norman Woldow, *Maryville University*

Full Curriculum Vitae will appear in the next issue of *Bioscene*.

AMCBT

Association of Midwestern College Biology Teachers

Dear Colleague:

The Association of Midwestern College Biology Teachers has been, and continues to be, an organization of Biology teachers who believe teaching to be an important and scholarly endeavor. Membership provides faculty the opportunity to network, socialize, and exchange ideas as well as valuable teaching techniques. At the same time, AMCBT provides its membership with a forum to express their ideas to colleagues; the opportunity to present and attend interesting and informative hands-on workshops; the chance to hear and meet speakers of national repute; and allows them to publish their work in the peer reviewed *Bioscene*. Over the years, AMCBT has established a tradition of excellence and has proven to be a valuable resource for those of us who spend a significant portion of our professional lives in the classroom.

AMCBT has had a glorious past and promises to have an exciting future. In order to determine the future, however, it frequently is necessary to look to the past. Heretofore, the past of AMCBT has been boxed and shelved in the office of the Executive Secretary and is generally available only to members who are organized enough to save their back issues of *Bioscene*. This will change. Work is now underway to put the history of AMCBT, as recorded in *Bioscene*, on a server and all who have an "on ramp" to the "electronic information superhighway" will have access to the rich body of information contained in these journals.

Just as the traditions of AMCBT will play a role in determining its future, so will your ideas and assistance. The programs delivered by an organization must serve the needs and meet the goals of its membership. It is for this reason that during the next meeting you will be surveyed for your ideas relative to how AMCBT can better serve your needs and, at the same time, determine the direction(s) you believe the organization should take over the next few years. The Steering Committee will use this information to guide them as the activities of the organization are planned. Therefore, it is important for you to complete and return your survey form as soon as possible after you receive it.

Since the viability of AMCBT is directly proportional to the participation of its membership, I invite you now to begin making plans to bring a colleague and attend the 1994 general meeting of AMCBT. This meeting will be held on the campus of Henderson Community College, Henderson, Kentucky, September 22-24. I look forward to seeing you there.

Sincerely,



David Finley, President, AMCBT

UNDERGRADUATE MICROBIOLOGY CONFERENCE

Sponsored by the American Society for Microbiology

The Board of Education and Training of the American Society for Microbiology is sponsoring the Undergraduate Microbiology Conference at the University of Nevada, Las Vegas from May 21-23, 1994. The goal of the conference is to increase the use and incorporation of effective teaching strategies used in undergraduate microbiology education. Individuals teaching microbiology in community colleges, liberal arts colleges, comprehensive universities, and research universities are encouraged to participate in this conference. Participants in the conference will define the common ground all microbiologists share and explore how to integrate core concepts into cost-effective laboratory and classroom exercises.

For more information on the Undergraduate Microbiology Conference, please contact the Office of Education and Training, American Society of Microbiology, 1325 Massachusetts Avenue, NW, Washington, DC 20005; (202) 942-9299.

HENDERSON COMMUNITY COLLEGE

Henderson Community College, one of fourteen colleges in the University of Kentucky Community College System, was first established by the University of

System in 1964.

Henderson Community College has an enrollment of approximately 1500 students, 92 percent of these from the immediate tri-county area. Henderson Community

the Henderson Community College student body receives financial aid. Henderson Community College offers class in two sixteen week semesters, an eight week summer session and a variety of condensed short-term sessions throughout the academic year. Classes are offered at evening and at several off-campus locations throughout the tri-county.

Henderson Community College grants the Associate of Applied Science, the Associate in Arts, and the Associate of Science degrees. Henderson Community College has programs in business management, engineering technology, human services, medical laboratory technician, nursing and office administration. Henderson Community College is accredited by the Southern Association of Colleges and Schools, National League of Nursing and a division of the American Medical Association.

A major mission of Henderson Community College is the provision of life-long learning opportunities for area residents. Henderson Community College is a leader in the University of Kentucky Community College System in developing Continuing Education Units for area residents, businesses and industries. Henderson Community College operates a Career Development Center where eligible participants develop skills to assist them to enter or re-enter the workforce. The Adult Learning Center assists persons in improving their basic reading, writing, and mathematical skills.

Henderson Community College is located in Henderson, Kentucky with a population of 25,945. Henderson sits on the Ohio River south of Evansville, Indiana. Henderson has a strong agricultural base and is a center for _____s technology industry. Henderson's wooded hills once attracted the naturalist, John James Audubon who lived here for nine years and operated a mill at the river front. The newly renovated 55-year old Audubon Memorial Museum boasts the largest collection of original Audubon oils and one of the rare intact editions of "Birds of America" as well as numerous letters, journals and personal articles belonging to Audubon. The adjoining nature center introduces visitors to the flora and fauna found in the 692 acres of Audubon State Park and wildlife sanctuary. Henderson is accessible by I 64, US 41, and by our air travel into Evansville, Indiana. Ample overnight lodging is available including camping facilities at Audubon State Park.

Teaching as Scholarship

1994 AMCBT Annual Meeting Tentative Schedule HENDERSON COMMUNITY COLLEGE September 22-24, 1994

<u>Thursday, September 22</u>		LOCATION
6:00-8:00 PM	REGISTRATION RECEPTION	Henderson Fine Arts Center
8:00 PM	OPENING SESSION Welcome for AMCBT <i>Jim Rooney</i> , Program Chair <i>Cathy Hung</i> , <i>Mary Anne McMurray</i> , Local Arrangements Welcome by Henderson Community College <i>Dr. Patrick R. Lake</i> , President Opening Address: <i>David Schuffett</i> , Host of <i>Kentucky Afield</i> TV Program, Frankfort, KY	
	EXECUTIVE COMMITTEE MEETING (to immediately follow opening session)	
<u>Friday, September 23</u>		
7:00 AM	REGISTRATION	Henderson Fine Arts Center
7:00-8:00 AM	BUFFET BREAKFAST	Henderson Fine Arts Center
8:00-8:50 AM	CONCURRENT SESSION I 1. USING CADAVERS AS A TEACHING TOOL: LEGAL, MAINTENANCE AND DISPOSAL ISSUES <i>Bill Andresen</i> , Harper College, Palatine, IL 2. THE TEACHING PORTFOLIO AS EVIDENCE OF SCHOLARSHIP <i>Dorothy May</i> , Park College, Parkville, MO 3. FRESHMAN SCIENCE SEMINAR: A TOOL FOR RETENTION <i>Dick Wilson</i> , Rockhurst College, Kansas City, MO 4. To be announced.	Academic Technical Bldg.
9:00-9:50 AM	CONCURRENT SESSION II 1. WE SHOULD LIVE WITH THE RIVER <i>Alfred F. Pogge</i> , Quincy University, Quincy, IL 2. STUDENT-DESIGNED LABORATORIES <i>Marc Roy</i> , Beloit College, Beloit, WI 3. STUDENTS AS SCHOLARS <i>David Hicks</i> , Manchester College, N. Manchester, IN 4. CAMP CLIPS/SCIENCE SCENES <i>Sr. Jeanene Yackey</i> , Fontbonne University, St. Louis, MO	Academic Technical Bldg.

9:50-10:45 AM	COFFEE, EXHIBITORS INFOSHARE: POSTERS, SOFTWARE, VIDEOS	Academic Technical Bldg.
9:50-10:45 AM	KENTUCKY COMMUNITY COLLEGE BIOLOGY FACULTY MEETING (tentative)	Academic Technical Bldg.
10:45-11:45 AM	GENERAL SESSION Announcements Panel Discussion: HOW IS TEACHING SCHOLARSHIP? <i>John Jungck, Beloit College, Beloit, WI; William Brett, Indiana State University, Terre Haute, IN; Leona Truchan, Alverno College, Milwaukee, WI</i>	
12:00-1:30 PM	OPEN LUNCH, EXHIBITS, INFOSHARE	
1:30-5:00 PM	FIELD TRIPS 1. Audubon Park, Museum and Nature Center, Nature Hikes 2. Angel Mounds - State Historical Site, Evansville, IN	
1:30-4:00 PM	WORKSHOP SESSIONS 1. ROLE PLAYING AND CLASSROOM THEATER IN TEACHING BIOLOGY <i>Pat Bowne and David Ferris, Alverno College, Milwaukee, WI</i> 2. BIOLOGY IN CYBERSPACE <i>Tim Mulkey, Indiana State University, Terre Haute, IN</i>	Academic Technical Bldg.
5:00-6:00	BIOSCENE EDITORIAL BOARD MEETING	Academic Technical Bldg.
6:00-7:00 PM	SOCIAL HOUR (Cash bar)	Day's Inn Motel
7:00 PM	BANQUET (price included in registration)	Day's Inn Motel
8:00	BANQUET SPEAKER <i>Dr. Angelo Caparella, Assistant Professor of Biology Illinois State University, Normal, IL (Title to be announced)</i>	

SATURDAY, SEPTEMBER 24

7:00-8:15 AM	CONTINENTAL BREAKFAST interest groups by discipline	Henderson Fine Arts Center
8:30-11:00 AM	BALLOTING	Academic Technical Bldg.
8:30-9:15 AM	CONCURRENT SESSION III 1. METHODS OF ENGAGING CREATIONIST-ORIENTED STUDENTS IN EVOLUTION-BASED SCIENTIFIC DISCUSSIONS (tentative title) <i>Terry Derting, Murray State University, Murray, KY</i> 2. MEASUREMENT OF SARCOMERE LENGTH USING LASER BEAM DEFRACTION PATTERNS <i>Harold Wilkinson, Millikin University, Decatur, IL</i>	Academic Technical Bldg.

3. SCIENCE AS A WAY OF KNOWING: THE OUTCOME
Eugene Braun, University of Wisconsin, Waukesha

4. To be announced

9:15-9:45 AM COFFEE, BALLOTING, POSTERS Academic Technical Bldg.

9:15-10:45 AM CONCURRENT SESSION IV Academic Technical Bldg.

1. TODAY A BIOLOGY COURSE MUST BE MORE THAN A BIOLOGY CLASS
William Brett, Indiana State University, Terre Haute, IN

2. INCORPORATING LABORATORY RESEARCH SKILLS INTO A MOLECULAR
BIOLOGY COURSE

Karen Klyczek, University of Wisconsin-River Falls

3. TOMBSTONES: AN EXERCISE IN SCIENCE

Buzz Hoagland and *Jonathan Frye*, McPherson College, McPherson, KS

4. To be announced

11:00-12:30 PM BRUNCH (price included in registration) Henderson Fine Arts Center
BUSINESS MEETING

Presidential Address: *David Finley*, Lincoln University, Jefferson City, MO

Election Results: *Rudy Prins*, Western Kentucky University, Bowling Green, KY

Bioscene: *John R. Jungck*, Beloit College, Beloit, WI and *Ethel Stanley*, Millikin
University, Decatur, IL

Executive Secretary Report: *Ed Kos*, Rockhurst College, Kansas City, MO

12:35-1:15 PM EXECUTIVE COMMITTEE

Academic Technical Bldg.

COALITION FOR EDUCATION IN THE LIFE SCIENCES (CELS)

In 1991, individuals from 30 life science organizations, representing over 250,000 professional life scientists and science educators, called for a coordinated effort of national organizations working together to improve life science education. They established the life science education network called the Coalition for Education in the Life Sciences, or CELS. The mission of CELS is to bring the expertise and resources of the life science professional societies to bear upon critical issues relating to life science education in America and to enhance every citizen's knowledge of the complexity and interdependency of living systems, from ecosystems to molecules.

The CELS five year plan calls for a series of national strategies conferences to increase the visibility and accessibility of innovative strategies and methods used to teach undergraduate students the life sciences. The outcome of the strategies conferences will be a collection of innovative life science models; a network of national leaders in life science education serving as workshop faculty and speakers for professional, scientific meetings; and establishment of a national clearinghouse for life science education. The CELS III conference, held in February, 1993, featured strategies for teaching the life sciences to undergraduates. CELS III exposed participants to a diverse number of teaching and learning strategies ranging from investigative laboratories, challenging problems that develop critical thinking skills in lecture discussions and laboratories, and case studies as an instructional tool to computer graphics and technology for instruction. Exemplary programs, discussions on institutional change and updates on the implementation of the life science education network were included in the program. The next CELS conference, CELS IV, tentatively scheduled for May, 1995, will feature assessment strategies.

For more information please contact: Dr. Paul Williams, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706, 608-262-6496.

SECOND CALL FOR PRESENTATIONS
Association of Midwestern College Biology Teachers (AMCBT)
CONFERENCE
September 22-24, 1994
Henderson Community College
Henderson, Kentucky

Do you have:

Labs that work?

Interesting Teaching Methods?

Tips on Teaching Nonmajors?

Useful Software?

Exciting Demonstrations?

The AMCBT 1994 Meeting will focus on

"Teaching as Scholarship"

Papers, Posters, Software, Media and Workshops are invited.

Final deadline -April 15, 1994

Name: _____ Institution: _____

Address: _____

Work Phone: _____ FAX Number: _____

Check one Oral presentation (50 min. including discussion)

Poster session

Workshop (2-3 hours)

Other (specify)

Title of Presentation:

Abstract:

Special equipment or facilities required: _____

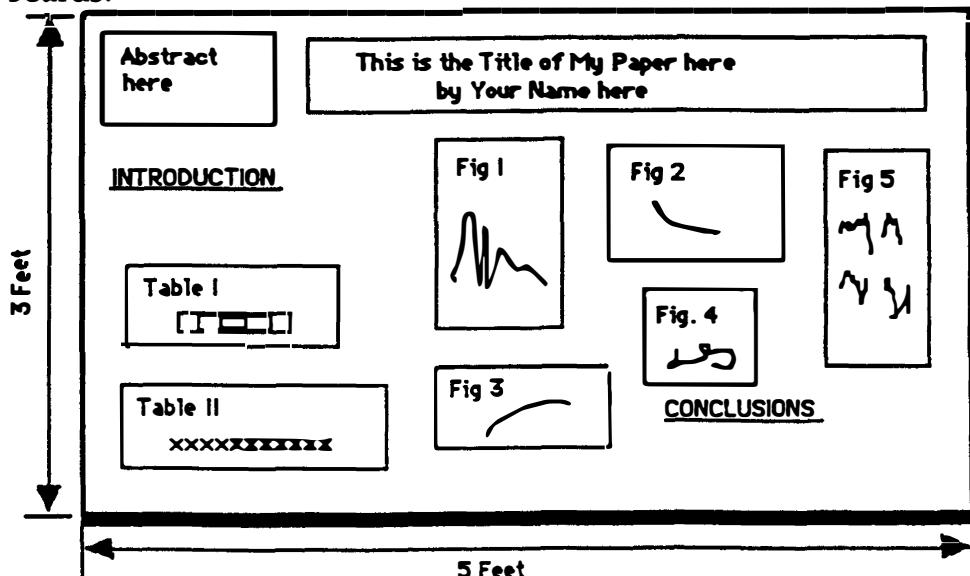
Return to James Rooney, Department of Natural Sciences and Mathematics, Lincoln University, Jefferson City, Missouri 65102. Phone: (314) 681-5120; FAX: (314) 681-5566.

AMCBT

Instructions for Poster Presentations

Persons wishing to present information at the meeting using a poster may do so by submitting an abstract no later than September 1, 1994. Presentation materials must be created to conform to the following guidelines:

1. The poster board surface is 3' high and 5' wide. A label placed in a space at the top of the poster board, should indicate the title and author(s). The lettering for this section should *not be less than 1"* high. A copy of the abstract, typed in large type, should be posted in the upper left-hand corner of the poster board.
2. All illustrations should be made prior to the poster presentations. Keep in mind that illustrations must be read from distances of about 3' or more. Charts, drawings, and illustrations need not be "arty." Simple use of color however, can effectively add emphasis. Hand-lettered material should be shade blocked and at least 3/8" high. Remember to keep all illustrative materials simple.
3. All type-written material should be prepared using at least a 14 point font, or be 3/16" in height.
4. Bring your own push-pins or thumbtacks. You will need at least 50.
5. Poster boards will be made of fiberboard. Please *do not* write or draw directly on the poster boards.



Abstracts should be sent to:

Cathy Hunt
Department of Biology
Henderson Community College
Henderson, Kentucky 42420

1994 AMCBT CONVENTION

SEPTEMBER 22-24
Henderson Community College
Henderson, Kentucky 42020
Abstract Submittal Form
(Return by September 1, 1994)

Please type or print legibly in black ink all necessary information in the spaces provided.

Presenter's Name _____

Faculty Sponsor if applicable _____

College or University _____

Street Address _____

City, State, Zip Code _____

Title of Paper _____

In the space below, please type an abstract for the poster presentation.

Application For Membership
**ASSOCIATION OF MIDWESTERN
COLLEGE BIOLOGY TEACHERS**

NAME: _____ DATE: _____

TITLE: _____

DEPARTMENT: _____

INSTITUTION: _____

STREET ADDRESS: _____

CITY: _____ STATE: _____

ZIP CODE: _____

ADDRESS PREFERRED FOR MAILING: _____

CITY: _____ STATE: _____

ZIP CODE: _____

WORK PHONE: _____ FAX NUMBER: _____

HOME PHONE: _____ E-MAIL ADDRESS: _____

MAJOR INTERESTS:

- 1. Biology
- 2. Botany
- 3. Zoology
- 4. Microbiology
- 5. Pre-professional
- 6. Teacher Education
- 7. Other _____

SUB DISCIPLINES: (Mark as many as apply)

- A. Ecology
- B. Evolution
- C. Physiology
- D. Anatomy
- E. History
- F. Philosophy
- G. Systematics
- H. Molecular
- I. Development
- J. Cellular
- K. Genetics
- L. Ethology
- M. Neuroscience
- N. Other _____

RESOURCE AREAS:

RESEARCH AREAS:

How did you find out about AMCBT? _____

Have you been a member before? _____ If so, when? _____

PLEASE MAIL
MEMBERSHIP APPLICATION
FORMS TO:

**Edward S. Kos
Executive Secretary, AMCBT
AMCBT Central Office
Department of Biology
Rockhurst College
1100 Rockhurst Road
Kansas City, MO 64110-2561**

CURRENT DUES ARE \$25.00