



Computer Center

Interactive Biology with Videodisc

David W. Kramer

Guest Author

A walk in a rich woods. An afternoon in your laboratory when all the equipment works properly. A stimulating discussion with colleagues. Think about it! These are the situations in which you enjoy biology and the situations in which you learn something about biology you didn't know before. What is it about these situations that enhances learning? Can we duplicate the essential ingredients of these situations for our students?

Teaching and learning are much easier if the learner is curious. I feel that I can teach anything about biology to a student who is genuinely interested in the subject. Conversely, it's next to impossible to teach something to the "slug" who "wants his tank filled at my full service pump." If curiosity is a critical factor, how do we create it? Curiosity is probably as impossible to create as energy. What we can do is design a learning environment capable of stimulating the student's curiosity. Examine your own curiosity. Admit that you are not equally curious about every subject every minute of every day even in biology! When you take that walk in the woods you may be attracted first to a beautiful wildflower, then to a strange fungus growing on a dead log, then to a seed germinating in the leaf mold. When that white-tailed deer meanders into your view you suddenly become curious about its feeding habits, sexual behavior, predator-

prey relationships, etc. The next time you walk into the same woods the sequence of events will probably be quite different but just as exciting and educational. You can easily understand how this same scenario is played out in your other stimulating encounters with biology. What we all realize, intuitively or from research on the subject, is that one's personal learning is rarely locked into a simple linear sequence. Instead it is a complexly branched series of events, a pattern that is rarely repeated.

If teachers in the elementary schools have learned this secret and have designed their students' educational experiences accordingly, how many of the rest of us have? Before I criticize others, let me say that college classrooms perhaps will be the last bastions of rigid, linear teaching. Until recently there have been few practical alternatives. Most of us teach the way we were taught rather than the way we learn. So, the first barrier is in our own minds. Then, especially in science, there is a strongly held belief, at least partially supported by fact, that some things have to be learned before others. It seems unlikely that one would benefit from lectures on cellular respiration without first knowing something about glucose, enzymes, ATP, mitochondria, etc. But most of us also utilize both inductive and deductive presentations in our courses. We need to consciously consider ways we might expand this to allow individual students to choose, based on their curiosity at the moment, which way he or she will move through a lesson. We have an obligation to become aware of the tools that give us this option.

New Tools

Computers, even relatively simple ones, make it possible for us to break the shackles of linear teaching. This

new technique is called "interactive" learning. What it literally means is that the student is able to interact with the "teacher" (the computer) to decide, possibly within certain limits, what will be learned in biology class today. The computer, of course, can't take full credit for this dramatic new teaching-learning technique. Effective, affordable software is an essential ingredient. Videodisc technology is also a useful tool that recently has become affordable and practical. The purpose of this article is to tell you how "interactive videodisc" can improve teaching and learning in your biology classroom.

Earlier articles in this series told you how to "get started" with videodisc technology. My advice then as now is: Try it! Find someone, hopefully a teacher rather than a vendor, who will let you "test drive" commercially available software or will let you use authoring software to create your own lesson so you can grasp the powerful potential of the technology.

Available Software for Interactive Biology

A number of "modules" exist for interactive computer lessons in biology. These, out of necessity, are designed for specific computers so some work in MS-DOS (IBM and compatibles) environments, others are written for Apple computers, or Macintosh, etc. Vendors who originally may have marketed movies, videotapes and other audio-visual media have subsequently expanded into videodiscs and computer software. One of these is Educational Images Ltd. (P.O. Box

Richard Duhrkopf, editor of the Computer Center, is an assistant professor in the **department of biology at Baylor University, Waco, TX 76798**. He teaches introductory biology for majors and non-majors and advanced genetics and also serves as director of Biological Computing. He has a B.S. in zoology and an M.S. and Ph.D. in genetics, all from Ohio State University. He has been active in the development of a wide variety of educational software.

David W. Kramer is an assistant professor of plant biology at the Ohio State University at Mansfield, 1680 University Drive, Mansfield, OH 44906.

3456 West Side, Elmira, NY 14905; 607/732-1090). There are others. A rather specialized one is EDUCORP Computer Services (531 Stevens Ave., Suite B, Solana Beach, CA 92075; 800/843-9497) which distributes public domain and "shareware" computer programs for Macintosh computers.

Until recently, available programs were interesting and probably effective lessons on isolated topics. That is, one author wrote a program on photosynthesis, another on insects, another on roots, etc. Few biologists had taken time to develop an entire course of computer lessons. Those of us who wanted to introduce this technology had to first find the programs that were compatible with our equipment and then select from a strange assortment of unrelated topics, most by different authors and in different formats. Many teachers accordingly used computers only to add interest to the more dull or difficult concepts, not to support an entire introductory biology course.

The Living Textbook, published by Optical Data Corporation (P.O. Box 97, Florham Park, NJ 07932; 800 524-2481), was one of the first comprehensive packages in biology (it includes other natural sciences, too). These computer lessons also were among the first to incorporate the use of videodisc. The lessons are designed for fourth grade through college and run on Apple IIe computers.

Colorado State University, under the leadership of biology professor Charles Ralph, recently formed a new company, OmegaWare, to market a package of 52 computer lessons in biology . . . an entire introductory course. These lessons run on IBM or Macintosh computers and some of them interface with videodisc players to utilize images from Videodiscovery's *BioSci* videodisc. OmegaWare (P.O. Box 8024, Ft. Collins, CO 80526; 303/491-7858) will send you a description of the lessons, a price list for individual diskettes or network license (with quantity discounts based on enrollment) and demonstration discs. This series has the advantage of covering all topics of a typical introductory biology course in a uniform format. Field tests at CSU, where two courseware lessons per week substitute for the traditional two-hour laboratory, showed that "computer users did significantly better on course exams" (Ralph, personal communication). Each lesson ends with a short quiz which gives the student his/her score and even recommends which parts of the lesson need further study.

What Do Interactive Lessons Actually Do?

Early computer lessons differed little from textbooks or lectures. Organization was primarily linear and screens were heavily textual. Users did little more than "turn pages" as they went through the lesson. Students merely read from a screen rather than from a printed page! If an early exposure to this left you cold and determined to ignore computer-based instruction, you need to take another look. Newer interactive computer instruction is very different from the past. Recent advances in software have made it possible for most biology teachers and their students to design interactive software. We'll come back to this point in a moment.

Today's interactive computer lessons allow the student to choose from a menu the parts of a lesson that will be studied and in which order. They can eat their dessert before their vegetables! More importantly, the student is constantly asked to respond to an instruction, answer a question (in a variety of formats including true-false, multiple choice, fill in the blanks, etc.), or perform an experiment. Perform an experiment?! Yes! The best of these programs have several simulations of experiments, dissections, etc. For example, OmegaWare's lesson on plant hormones allows the student to perform Frits Went's classic 1926 experiment on the production of auxin in coleoptile tips and its subsequent transport down the coleoptile where it produces the bending effect of phototropism. The student is "given" a knife, coleoptile, agar block and even a greenhouse where the experiment can be stored "while time flies" (a bit of humor that won't be revealed here). By clicking and dragging with the computer's mouse, the student uses the knife to cut off the coleoptile's tip, sets the tip on the agar block, puts the set-up in the greenhouse while waiting for active transport of the auxin, cuts up the agar block (now containing auxin), places the agar block on the decapitated coleoptile and watches the coleoptile bend! While critics will charge that this falls far short of performing the actual experiment, enthusiasts argue that it's more supportive of learning than simply reading about the experiment, looking at a series of diagrams, or seeing a movie of the experiment. Besides, this makes learning fun! A lesson is more like a video game!

OmegaWare's lesson on Biomes is

one that drives a videodisc player so that students who are learning about tundra or rainforest, to name two, see these habitats on the video monitor and can choose to see some of the specific plants and animals in each biome merely by clicking buttons on the computer screen. Videodiscovery's *BioSci Stack* includes an even more impressive Biomes lesson in which students can move from one biome to another by clicking icons on a world map. Or, by clicking on temperature, rainfall or altitude/elevation, icons can move from one biome to another with greater or lesser rainfall, or one with a lower temperature range, or a higher elevation, etc. A map icon of the State of Washington (the disc was produced in Seattle) offers buttons that will "take the student" to the many interesting biomes there.

Making Your Own Interactive Lessons

I have always been impressed with the individualism displayed by biology teachers (probably by the best teachers in all subject areas) and their desire to exercise a high degree of freedom in the design of instruction. So, it isn't surprising that we would want to create our own interactive lessons. Until recently this was nearly impossible. Even those few of you who can program intricate branching routines with feedback loops, or produce high quality graphics with the various draw or paint programs, or program animation sequences, don't have the enormous amount of time and patience required to produce more than one or two such lessons. At the university level the problem is compounded because few institutions are willing to reward such an "aberrant" use of research time.

Now, however, a wide variety of "authoring software" enables those who can't even write the simplest computer program to design highly interactive, attractive lessons in a fraction of the time. Some authoring software costs several thousand dollars but others with nearly equivalent features are priced in the \$150 range and Amiga computers are "bundled" with *AmigaVision* in an effort to encourage authoring by educators.

Authoring software is available for most computers. *Authorware* (Authorware, Inc. (8500 Normandale Lake Blvd., Ninth Floor, Minneapolis, MN 55437; 612/921-8555) lessons are developed on a Macintosh but can be packaged to run in Mac or MS-DOS environments. *Mentor/MacVideo*

Here are several R groups for amino acids. Move the correct R group into position so that you "build" the second amino acid from the left of the video screen. (Move the R group by putting the cursor on top of it, depressing the mouse button, and "dragging" the R group while keeping the button depressed. Release the button when the R group is in position.)

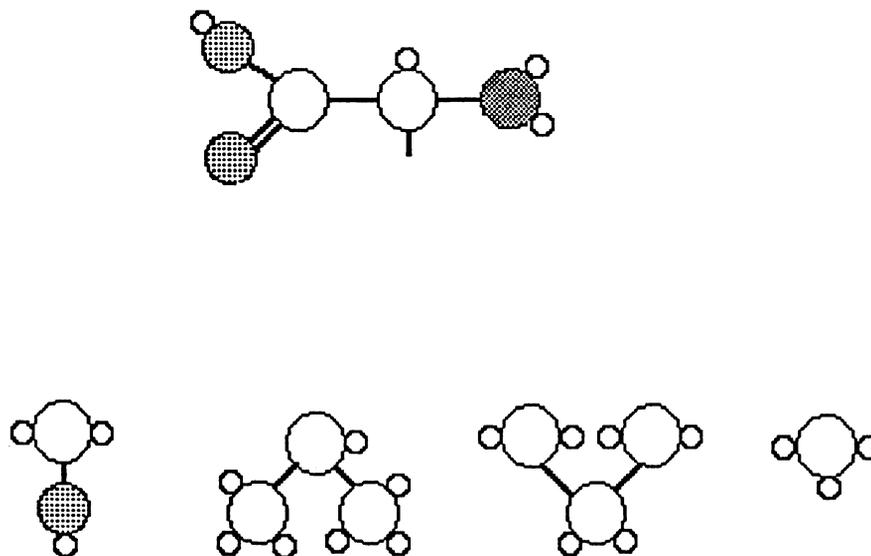


Figure 1. One screen from the author's initial attempt to write an interactive lesson on Protein Structure using Authorware authoring software. The student interacts with the computer lesson while viewing a videodisc image of several different amino acid models.

(Edudisc) is another Mac possibility. *Linkway* (IBM) and *SHOWCASE* (Cal-syn) are for IBM and compatibles. *HyperStudio* (RWP) will let you program interactive lessons on the Apple IIGS platform. *Tutor-Tech* (Techware) expands the technology to Apple IIe and IIc as well as IIGS users. Those products listed above without addresses and phone numbers are available from Ztek Co. (P.O. Box 1055, Louisville, KY 40201; 800 247-1603) and other distributors as well as directly from the publishers.

With this wide array of authoring software the educational programmer now is more like a traffic engineer who plots a "map" which allows the "driver" (student) to decide which of a variety of "roads" (instructional pathways) to take and then inserts a number of "roadside attractions" (original graphics, clip art, scanned images), "rest areas" (ability to stop out of the program and continue later), "scenic overlooks" (videodisc images, digitized snapshots) and other diversions that keep you "truckin'" through the learning experience. No two "drivers" need follow the same "route" to reach a given "destination"

and they often are enticed to take a "side trip" to a "tourist trap" that may be purely frivolous but makes science fun and scientists "Real, man!"

My own initial attempt at writing an interactive videodisc lesson with *Authorware* was much better (personal evaluation!) than I ever expected. With self-instruction (it comes with a tutor package) and very little practice I incorporated sound, animation, simulation, videodisc images and several other "goodies" from the big bag of tricks. For example, my lesson on protein structure includes a screen (Figure 1) which asks the students to attach the proper side chain to an amino acid "backbone" to produce alanine. Putting the wrong group in place produces an error message with an explanation of why the choice was wrong followed by that group returning to its original position at the bottom of the screen so the student can try again. Conversely, the correct choice elicits audio and visual "rewards." Figure 2 shows how this screen is programmed: Icons for various displays and events are moved into place and connected by paths you want to allow.

It isn't possible to paint a word picture that does justice to the most "active" of the interactive software. You simply must see a demonstration; better yet have the kind of hands-on experience that will be so fascinating and educational for your students.

Students Can Program Interactive Lessons, Too

Don't overlook the possibility of giving your students a chance to use the authoring software. Relying on your knowledge of the subject matter and their own bold creativity with the computer, these "hackers" will amaze you. Charles Ralph wisely drew on this rich resource in developing the OmegaWare series at CSU. The development project which he called "BICEP" (Biological Instruction Computer Enhanced Project) utilized undergraduate students who first earned credit for a series of three computer applications courses (in word processing, graphics and authoring). Ralph then hired the best of the students as summer interns for a specific authoring project. He advises that "the prime

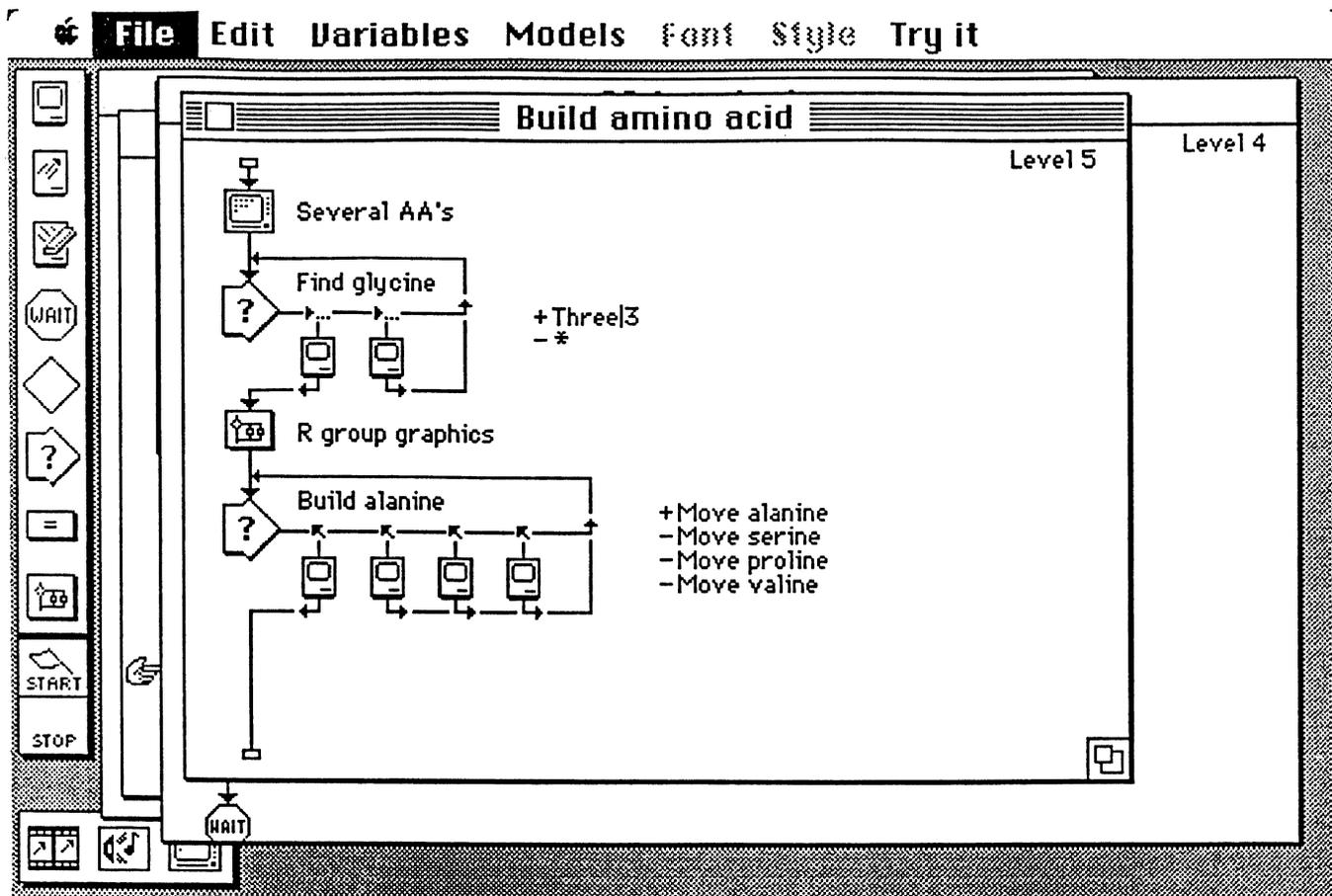


Figure 2. The programmer's view of the screen portrayed in Figure 1. *Authorware's* icons of various functions (display, move, erase, wait, make decision, etc.) are dragged onto the "map" from the menu on the left. Connections are established which allow the student to "drive" interactively through the course.

factor to be selected for is creativity. Subject knowledge is essential, but secondary to creativity" (Ralph 1990). I agree completely. One can always ask subject matter specialists to edit lessons for content accuracy but few professors have the time or incentive to author the lessons.

Whether you buy a package of interactive lessons, write your own or utilize student assistants, you will want to explore this effective technique that is a real "turn on" for students who

watch TV with remote controller in hand, jumping from channel to channel, feeling very much in control of their world. Let them experience interactive biology!

Acknowledgment

This concludes a series of four articles on uses of videodisc in biology instruction. My own development of videodisc applications was made possible by an Instructional Enhancement Grant from the Ohio State Uni-

versity's Center for Teaching Excellence and smaller but no less important equipment grants from the OSU Mansfield campus. Their support has kindled my growing interest in computerized instruction with videodisc and, more importantly, has enhanced learning in my students. I'm grateful.

Reference

Ralph, C. 1990. Biology courseware for college freshmen. *Computers in Life Science Education*, 7(5), 33-36.